

OLIFANTS ESTUARY MANAGEMENT PLAN

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1 INTRODUCTION

1.1 Background

The Olifants Estuary is one of 279 functional estuaries in South Africa (Turpie 2004) and one of 4 permanently open estuaries on the west coast (Whitfield 2000). It is the 12th largest estuary in the country, with a total area of 702 ha. The estuary is one of the most important in the country in terms of its conservation value. Based on an index which takes size, estuary type, location and biodiversity (plants, invertebrates, fish, birds) into account, the estuary is ranked in the top five (Turpie *et al.* 2004a, Turpie & Clark 2007). It has been identified as an Important Bird Area (Barnes 1998) and a desired protected area in the conservation planning assessment conducted for C.A.P.E. (Turpie & Clark 2007) as well as in other studies (e.g. Turpie *et al.* 2002, Turpie 2004). The estuary is also noteworthy in that it is one of the least developed of the large permanently-open estuaries in South Africa, providing a valuable sanctuary for flora and fauna as well as for visitors. However, mounting pressures could reduce this value, as water abstraction and pollution degrade estuary condition, fish stocks are affected by small-scale fishing, and demand for development proceeds up the West Coast.

This document is a Management Plan for the Olifants estuary. It was developed under the auspices of the Cape Action Plan for the Environment (C.A.P.E.) Regional Estuarine Management Programme. The main aim of the overall programme was to develop a conservation plan for the estuaries of the Cape Floristic Region (CFR), and to prepare strategic management plans for each estuary.

1.2 Purpose and scope of the Olifants Estuary Management Plan (OEMP)

Drawing on the **Situation Assessment** prepared for the Olifants Estuary (Anchor Environmental Consultants 2008), inputs from key stakeholders (AEC 2008 – Olifants Estuary Management Plan Stakeholder Consultation Report), and other supporting documents prepared for the C.A.P.E. Estuaries Programme (e.g. Turpie & Clark 2007 – Cape Estuaries Classification, Prioritisation, Protection and

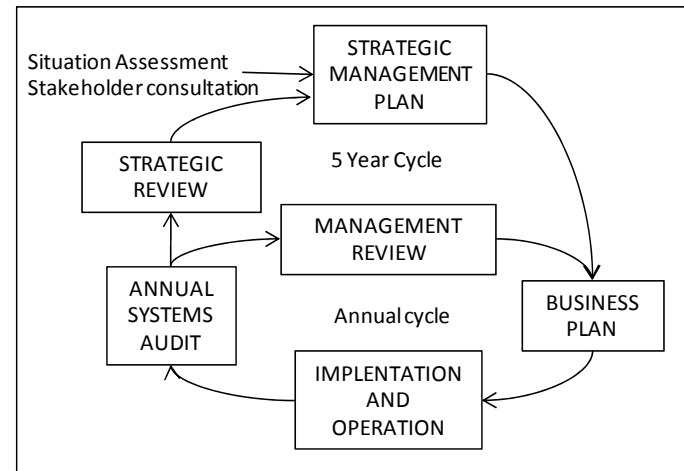
Rehabilitation report), the OEMP sets out the **Vision** and **Management Objectives** for the Olifants estuary. It also identifies **Strategies** needed to meet these objectives, and indicates the main **Actions** required in the next five years in order to achieve the overall vision. The OEMP focuses on strategic priorities only. While planning for some emergencies, e.g. floods, is part of the SMP, it remains possible that unforeseen disasters could disrupt the prioritisation set out here.

A set of Key Result Areas have been identified for the estuary for the next five years. A Key Result Area is a priority area of action for the estuary and addresses one or more of the strategies required to meet the objectives. Each strategy will be implemented through a set of actions and will result in a number of deliverables. A plan of implementation is provided for each Key Result Area.

The implementation of the strategies by the management agency for the estuary (still to be determined) and its strategic partners (Matzikama Municipality, Cape Nature, Marine & Coastal Management, West Coast District Municipality, Western Cape Provincial Government), will be monitored by an **Estuary Management Forum** comprising all key stakeholders on the estuary, using indicators within a set time-frame. The **Management Agency** for the Olifants Estuary and the appointed **Estuary Manager** will ultimately be responsible for overall management of the estuary, and will play a co-ordinating role for all other implementing agencies.

It is important to recognize that this document is designed to focus management attention at a strategic level and does not provide guidance on the day-to-day management actions required for management of the estuary. Annual Business Plans will have to be developed by the Estuary Management Agency and Estuary Manager in consultation with the Estuary Management Forum, and should be guided by this Management Plan in that major effort should be directed towards priority activities that support the strategic objectives of the Key Result Areas.

Progress towards achieving the objectives set out in this Strategic Management Plan should be reviewed on an annual basis by the Estuary Management Agency and Estuary Management Forum and focal efforts adjusted to ensure targets are met within specified time frames. This Strategic Management Plan will have to be revisited and updated within the next five years to reflect goals that have been achieved and to accommodate changing priorities. The flow diagram opposite shows how the Strategic Management Plan for the Olifants Estuary (this document) links with other documentation (e.g. the Situation Assessment Report) and Stakeholder consultation processes, and how it is embedded within annual and longer term management and review processes.



2 VISION FOR THE OLIFANTS ESTUARY

A vision is a high level statement which defines the strategic intent of a management intervention. The following draft vision was developed and agreed upon at a meeting of stakeholders on the Olifants estuary in January 2008:

"The Olifants estuary is a sanctuary for wildlife and visitors; it should bring economic benefits to the local community through sustainable use of natural resources and responsible ecotourism, and should benefit all South Africans through conservation of biodiversity and ecosystem functions."

3 MANAGEMENT OBJECTIVES

Key management objectives for the Olifants estuary were agreed upon at a stakeholder workshop held in Strandfontein in January 2008. These are all set out in the form of a circular diagram as all objectives are seen to reinforce all other objectives and none are seen as being of greater importance than any other.

3.1 *Maximise economic benefits*

The estuary must be managed to maximize the value of ecosystem goods and services delivered in the long term, ensuring an equitable balance between local, regional and national benefits

3.2 *Conserve biodiversity*

Adequate protection must be provided for estuarine biota to ensure persistence of populations, species, habitats and ecosystem processes, living resources must be protected from overexploitation and excessive disturbance.

3.3 *Improve local livelihoods*

New opportunities and benefits arising from enhanced management of the estuary must be harnessed, particularly for the benefit of those that are negatively affected by declining fish stocks and changes in their availability in the estuary.

3.4 *Maintain ecosystem health*

The estuary should be maintained in a condition which is largely natural. This will require that it is improved from its current status as a C-class estuary (moderately modified) to a B-class estuary (largely natural).

3.5 *Maintain sense of place*

Development and mining activities around the estuary should be planned to maximize aesthetic and tourism value without compromising the existing sense of place, cultural or archaeological heritage or conservation objectives.

3.6 *Increase public awareness*

Residents and visitors should be aware of the importance and economic value of the estuary, know the regulations, and understand the rationale for management measures.

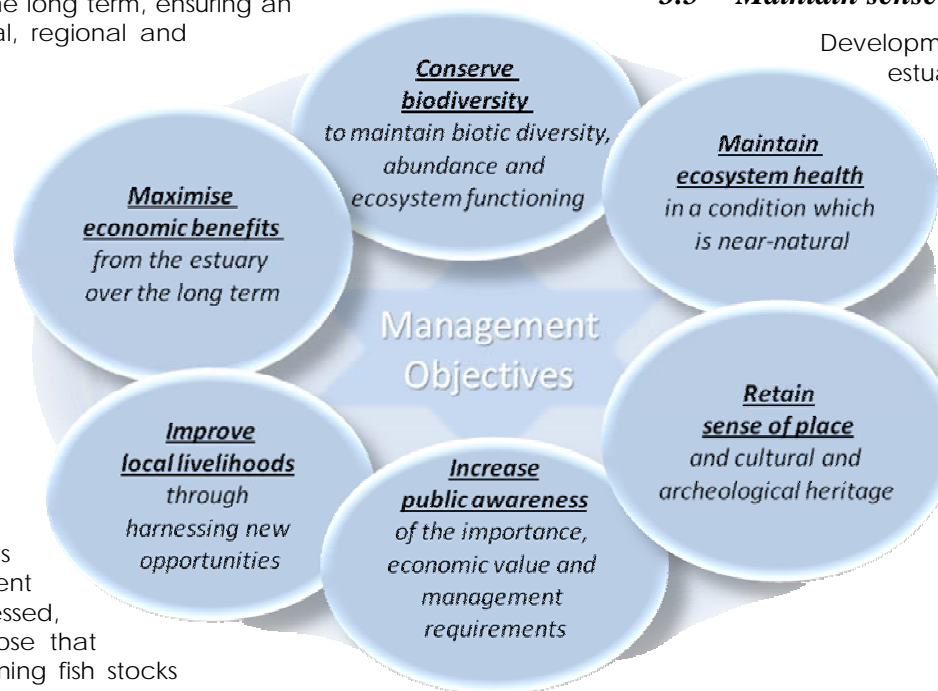


Figure 1 Management objectives for the Olifants estuary

4 STRATEGIES TO MEET KEY MANAGEMENT OBJECTIVES

Strategies required to meet the management objectives are summarized in Figure 2. Each management objective requires a number of strategies. Note that some of the management objectives form part of the strategy for other management objectives.

Maximising economic benefits and improving local livelihoods will require the conservation of biodiversity and maintaining the sense of place as well as development and marketing initiatives. Conservation of biodiversity requires the establishment of a **protected area** that provides a sanctuary for at least **50% of all biota** in the estuary. It also requires that use of the remaining stocks is **sustainable**. Adequate protection of the estuary resources from gillnet fishing may provide a preferable alternative to phasing out the gillnet fishery as has been suggested in 2005 rights allocation process for net fisheries (DEAT: MCM 2005), since this will also retain some of the livelihood benefits from the estuary, these will be sustained for longer, and the presence of the fishery can be a draw card for tourism. These measures in turn will require a **zonation plan**.

Economic and livelihood objectives require development and opportunities for **ecotourism** growth to provide **alternative livelihoods**, but this will have to be subject to **setback lines** and development guidelines that safeguard the sense of place of the estuary. To this end, the **west bank should remain undeveloped**. These features will need to be integrated into **regional and local development plans**. Ecotourism growth will require **marketing** and attractive **visitor facilities** that draw people to the area.

Conservation of biodiversity will also require restoration and maintenance of ecosystem health through the provision of **environmental flows**, as well as **rehabilitation** of habitats that have been damaged, e.g. by mining activities. Biodiversity conservation

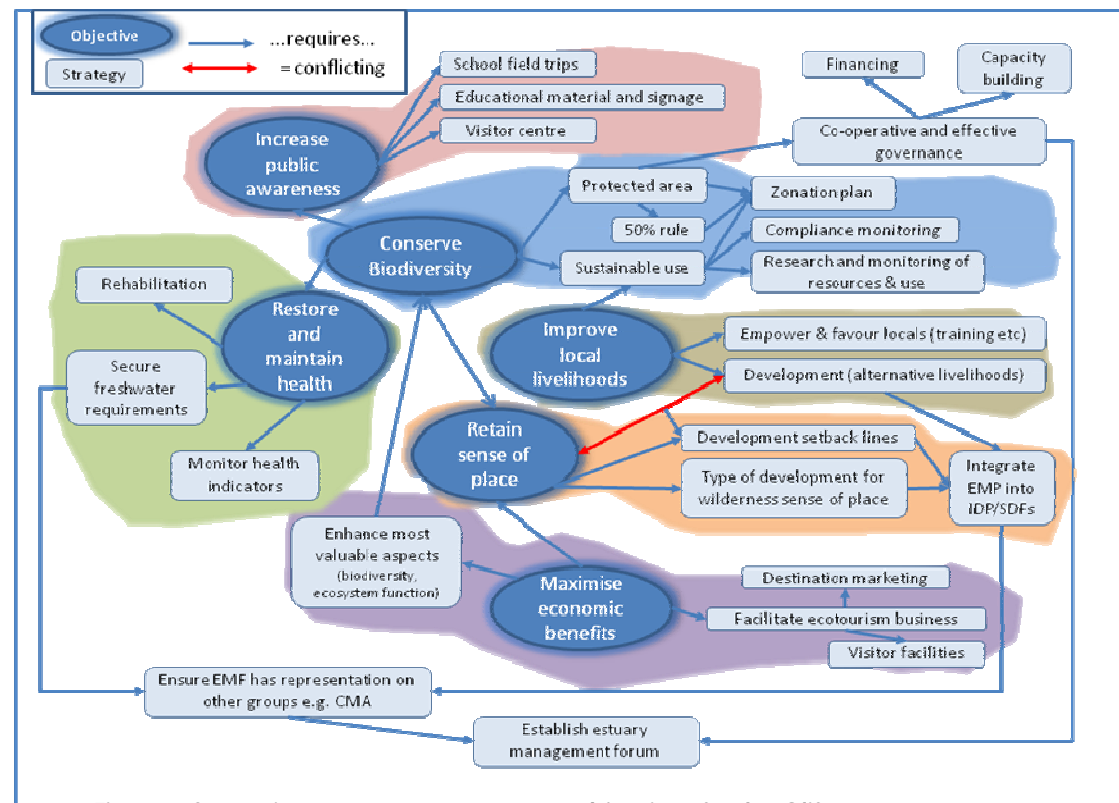


Figure 2 Strategies to meet management objectives for the Oifanis estuary

will also be facilitated if public awareness is improved, which in turn will require the provision of **educational material** and **signage**. The management and monitoring of the estuary area, the freshwater inflows and development in the surrounding area will require **cooperative governance** among the estuary management agency, catchment management agency, conservation agencies, and local and national government. This in turn will require an **estuary management forum** that has **representation amongst all relevant organisations**.

5 PROPOSED OLIFANTS ESTUARY (MARINE) PROTECTED AREA AND ZONATION

5.1 Introduction

The Olifants estuary is among the top five estuaries in the country in terms of conservation importance, and is under consideration for being assigned Ramsar status as a wetland of international importance. Establishment of a protected area on the Olifants estuary is fundamental to meeting biodiversity conservation targets (Turpie & Clark 2007) as well as meeting policy decisions enshrined in the White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (1998) and commitments made at the World Summit on Sustainable Development (WSSD), to increase the area under formal protection.

Currently, conservation in estuaries is achieved through a number of different legislative Acts. Conservation of living resources below the high water mark (including control over exploitation) can only be achieved through the Marine Living Resources Act, 1998. This act provides for establishment of Marine Protected Areas which can be zoned and hence provide varying levels of protection for living resources within their bounds. Conservation of fauna and flora above the high water mark can be achieved through various legislative Acts including the Protected Areas Act (2003), the Biodiversity Act (2004), the *Environment Conservation Act – Terrestrial and Marine Protected Areas* (1994) and the National Parks Act (1976). Maintenance of an adequate supply of freshwater to estuaries is provided for under the National Water Act (1998).

Many of the provisions contained in the *Environment Conservation and National Parks Acts* were rescinded with the proclamation of the Protected Areas Act, and it is recommended that any conservation measures applied to terrestrial portions of the Olifants estuary be achieved through proclamation of a protected area under the Protected Areas Act (2003). An additional benefit provided by this Act, is that it requires that marine and terrestrial protected areas with common boundaries be managed as an integrated protected area by a single authority.

Proposals for the establishment of a protected area at and surrounding the Olifants estuary, and its zonation, were mooted at a stakeholder meeting in Strandfontein in January 2008, and are described briefly below.

5.2 Boundaries and zonation of the marine protected area

It is proposed that a marine protected area be established on the lower Olifants Estuary extending from the mouth to 12 km upstream. The proposed MPA will be zoned in such a way as to satisfy the many conflicting requirements of the different user groups and stakeholders who wish to enjoy the benefits provided by the estuary. Zonation will allow for partitioning of activities within the estuary thus permitting their co-existence without one activity precluding or conflicting with another. It will also reduce management costs as it will focus activities in particular geographic areas and hence eliminate the need to deploy management staff across the whole estuary at all times.

Requirements, for which the greatest scope for conflict exists, most likely include exploitative resource use, high intensity recreation, and biodiversity conservation. For example, in the Situation Assessment for the Olifants estuary (Anchor Environmental Consultants 2008) the lower and middle reaches of the estuary (4-14 km upstream) are identified as being the core nursery area for estuarine dependant marine fish species in the estuary. Banning all forms of fishing across much of this area, which represents a relatively small portion of the estuary, will ensure that these consumptive activities do not conflict with the conservation objectives for the estuary.

Similarly, establishment of a bait sanctuary on the west bank of the estuary near the mouth, which is home to the largest concentrations of waterbirds in the estuary, will minimise disturbance to bird populations on the system (often often severely disturbed, albeit unintentionally, by bait collectors) and at the same time promote ecotourism (birdwatching), without seriously compromising access to bait resources for anglers.

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

To this end, the estuary has been split up into five zones for which different management strategies are proposed. Brief motivation for the location and extent of each zone is provided below and is presented in more detail in the Situation Assessment report for the estuary (Anchor Environmental Consultants 2009).

Zone A (pink) is a bait, water bird and water fowl sanctuary. Collection of bait species (invertebrates) is not permitted in this area, and disturbance to avifauna will be minimised through a minimum height restriction for aircraft (minimum altitude 1 500 m) and a ban on the use of motorised transport (ORVs, motor cycles and quad bikes). The historic ban on gill netting in this area will remain in force.

Zone B (turquoise) is a water bird and water fowl sanctuary where disturbance to avifauna will be minimised through imposition of restrictions as for Zone A (minimum height restriction for aircraft and a ban on the use of motorised transport). The historic ban on gill netting in this area will remain in force.

Zone C (light blue) is a corridor for fish species moving between the mouth and the principal nursery area in the middle reaches of the estuary. Gill net fishing will be banned in this zone to allow uninterrupted movement of juvenile marine fish between the mouth and their main nursery area (Zone D).¹

¹ Banning gill net fishing in the lower reaches of the estuary (Zones A-D) should be seen as a possible alternative to the proposed phase out the gillnet fishery as has been suggested in 2005 rights allocation process for net fisheries (DEAT: MCM 2005), and would allow for the maintenance of this locally important fishery, hopefully without compromising the nursery function of the estuary. (Note that the latter conjecture would have to be confirmed through intensive monitoring of juvenile marine fish stocks in the estuary and of the catches taken by the gill net fishery, and that the continued existence of the gill net fishery should be contingent on evidence for recovery of juvenile marine fish stocks in the system).

Zone D (dark blue) incorporates the main nursery area for estuarine dependant marine fish species in the estuary. All forms of fishing shall be banned in this zone to ensure that juvenile marine fish utilising this area can do so without risk of capture or harm; and

Zone E (the remainder of the estuary) is a multiple use zone in which both consumptive and non-consumptive activities will be permitted.

Use of motorised vessels other than electrically powered motors shall be prohibited in all zones within the estuary. However, exemption from this restriction may be granted for a limited number of vessels in use by registered tourism operators, for bone fide scientific research and management purposes. Mariculture is not explicitly catered for within the zonation plan. However, should the development of such an industry be deemed acceptable by stakeholders, this would have to be small-scale in nature and could be accommodated within Zones C or E.

Boundaries between zones are indicated in Figure 3 and will be clearly demarcated on the ground with beacons and signage, indicating what restrictions are in force in each zone of the estuary. Coordinates for the boundaries between each of the zones are as follows:

Lower (westward) boundary of Zone A – a line drawn through the point 31°42'1.22"S; 18°11'15.30"E extending along an east-west trajectory from the high water mark on the west to the high water mark on the east bank of the estuary

Upper (northern) boundary of Zones A & B – a line drawn through the point 31°41'20.75"S; 18°11'54.01"E extending along an east-west trajectory from the high water mark on the west to the high water mark on the east bank of the estuary

Boundary between Zone A and B – a line drawn from the point 31°41'1.22"S; 18°11'15.30"E in the middle of the estuary channel extending on a bearing of 219° out through the mouth of the estuary, and in the opposite (upstream) direction on a bearing of 1.5° to the point of intersection with the upper (northern) boundary of Zone A

Boundary between Zone C and D – a line drawn through the point 31°39'30.74"S; 18°11'44.64"E extending along an east-west trajectory from the high water mark on the west to the high water mark on the east bank of the estuary

Boundary between Zone D and E – a line drawn through the point 31°36'24.19"S; 18°13'31.49"E extending along a north-south trajectory from the high water mark on the west to the high water mark on the east bank of the estuary

Upper (eastern) boundary of Zone E - a line drawn through the point 31°33'52.67"S; 18°19'38.70"E extending along a north-south trajectory from the high water mark on the north to the high water mark on the east bank of the estuary

The lateral boundaries of each zone correspond to the high water mark on each bank respectively.

Olifants Estuary MPA (up to high tide mark)

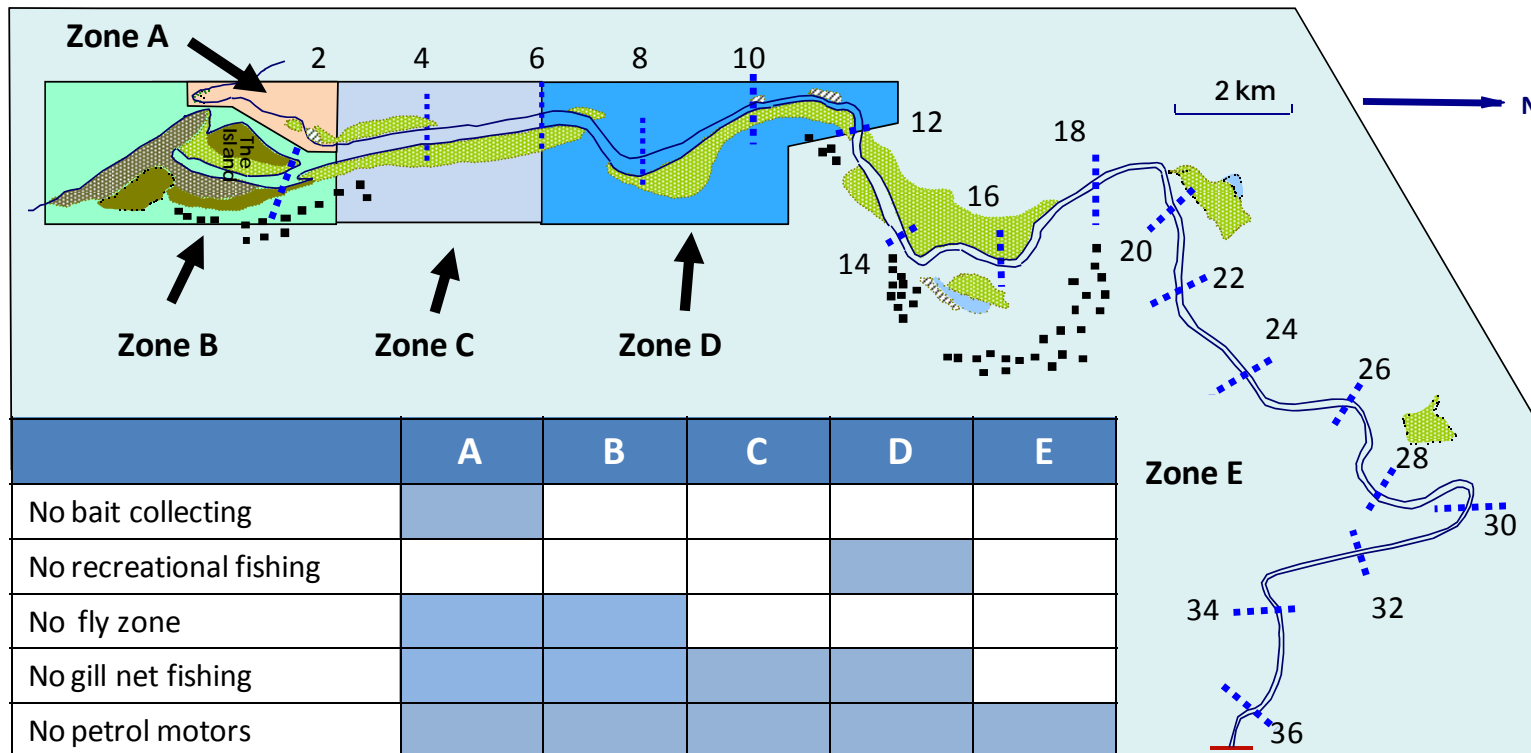


Figure 3 Zonation plan for the proposed Olifants Estuary MPA. Note that the lateral extent of all zones is up to the high tide mark only and the sizes of boxes shown here are exacerbated for clarity. Dotted lines show distance from the mouth in kilometres. Area shaded green is floodplain saltmarsh (above the high tide mark).

Development set back zone around the estuary

The Provincial MEC in consultation with the Local Municipalities is required to define a **coastal protection zone** of at least 1km from the coastal and estuarine high tide mark under the ***Integrated Coastal Management Act*** for all areas zoned agricultural or undetermined use and that are not part of a lawfully-established township, urban area or other human settlement, and a corresponding zone of 100 m for all other land. The Integrated Coastal Management Bill also provides for the establishment of a **coastal setback line**, designed to protect the coastal protection zone. Any future development within this zone would automatically be subject to an Environmental Impact Assessment (EIA) and would have to be compatible with the vision and objectives defined within this management plan. These will restrict future development and ensure an adequate buffer for the estuary. It is also essential for the protection of saltmarsh areas which occur above the high tide mark and which would not be included in the marine protected area. The proposed development setback line for the Olifants estuary is demarcated in Figure 4. It should be noted that agricultural activities on all land between the Olifants estuary and the irrigation canal (i.e. as far downstream as Big River Bend - Zoutpansheuwel) are designated exempt from the requirements of existing legislation whereby application has to be made for land clearance activities in terms of Conservation of Agricultural Resources Act of 1983 & National Environmental Management Act of 2006. Whether this exemption extends to development other than land clearance is being investigated.

In its lower reaches (below the Ebenhaesar settlement), the Olifants estuary channel passes through a fairly steep sided gorge which is likely to be completely inundated during large flood events. Much of the supratidal saltmarsh surrounding the Olifants estuary (a nationally rare vegetation community type) occurs adjacent to the estuary channel above and below this gorge area. Existing development in the lower reaches is mostly confined to the east bank at present and includes the Papendorp and Viswater settlements. Visitor access to the estuary also occurs mostly from the east bank through two existing settlements. For these reasons, development would be considered undesirable on the east bank of the estuary up to the

20m contour (which more or less follows the top of the gorge from the mouth to the upstream boundary of the Farm Zoutpansheuwel). Above this point the estuary banks become much less steep and agriculture and development tends to encroach much closer to the estuary channel, with much of the area within the 1km buffer being under cultivation.

On the west bank it is recommended that development setback lines be drawn some considerable distance back from the estuary, corresponding in fact to the height of the ridge above this bank, at least up as far as the upstream boundary of Erf 616. The purpose of maintaining such a conservative development setback line is to preserve views from the east bank and hence maintain the current wilderness sense of place. This proposal conforms with recommendations provided in the 1998 Management Plan Guideline document (Urban Dynamics 1998) prepared for the lower Olifants River as part of the West Coast District Municipality's IDP development process.

The land incorporated in this area includes:

- Farm 267/2 "The Point" (Olifantsmondbellegings Pty Ltd)
- Portion of Farm 267 The Point (De Punt Plase Pty Ltd), west of a line extending from the southern-most coastal point of the farm north through height beacons 154 and 19 (Olifantshoogte) to the northern (boundary of the property).

Future development can only take place within the development setback zone under permit from the minister. While it is recommended that no development be allowed on the west bank, limited development nodes should be identified on the east bank which provide development for existing communities without compromising sense of place, and to provide low density ecotourism opportunities. Response from owners of the land in question to this proposition is currently being sought. If their support is not forthcoming it is likely that the setback zones will be limited to 1km from the HWM.

5.4 Potential for a terrestrial protected area

Ownership of much of the land surrounding the Olifants estuary is vested with the Ebenhaesar and Papendorp communities but is currently held in trust by the state, and will in due course be handed over to the community. Most of the remaining land around the estuary is privately owned as indicated below and on Figure 4:

- Farm 269 Papendorp (communal land);
- Farm 464 Papendorp (communal land);
- Portion of the farm Ebenhaeser Colony No 187 east of Main road No 362 (communal land);
- Farm 268 Zoutpansheuwel (private);

With agreement from the community, state and private land owners, it may be possible to establish a protected area surrounding the estuary under the Protected Areas Act (2003), to compliment and expand the conservation potential of the area contained within the setback line as indicated on Figure 4.

A surrounding protected area will serve to retain the wilderness character of the estuary and enhance its ecotourism appeal, and may thus generate greater income for the community than simply using it for grazing or agriculture. The attributes of the surrounding areas would need to be analysed so that boundaries of an adjacent terrestrial protected area can take into account factors such as priority areas for protection of terrestrial vegetation types.

The potential also exists to establish a conservancy linking the estuarine protected area to the proposed Namaqualand National Park to the north. This land is largely owned by mining companies and not intensively utilised at present.

Negotiations need to be initiated with the relevant state departments and further consultation with other interested and affected parties under the auspices of a duly constituted Estuary Management Forum need to be undertaken before a firm proposal can be tabled. The establishment of a terrestrial protected area does not form part of this Estuary Management Plan

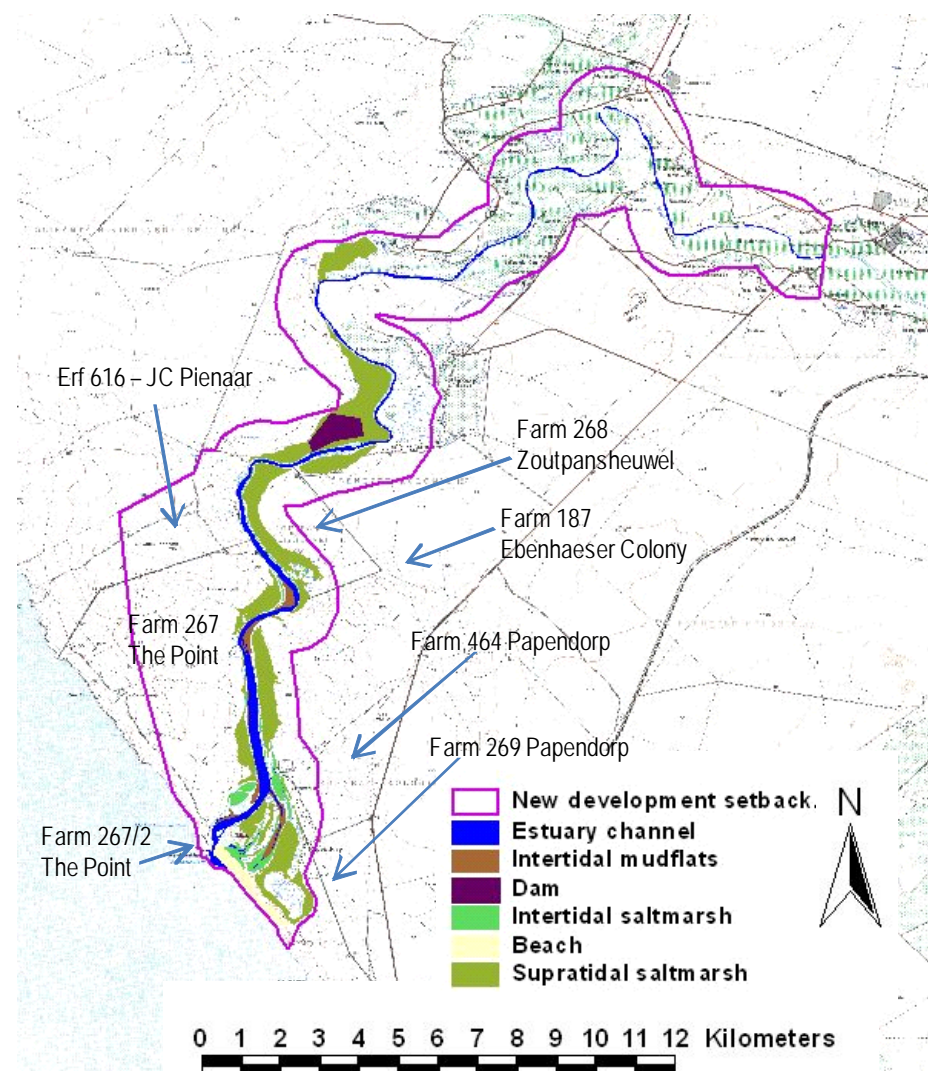


Figure 4. Proposed development setback line for the Olifants Estuary

6 KEY RESULT AREAS AND ACTION PLANS

6.1 Protection of biodiversity and wilderness character

The Olifants Estuary Management Plan (OEMP) makes provision for the establishment of a new Marine Protected Area (MPA) on the lower reaches of the Olifants Estuary. It is proposed that the MPA be zoned to allow for protection of key elements of biodiversity on the estuary (particularly waterbirds) as well as stocks of exploited species (fish and invertebrates), to enhance the ecotourism potential of the estuary, and to maximise educational opportunities and prospects for scientific research. Provided gill net fishing was banned within the MPA it would also have the added benefit of serving as a possible alternative to the proposed phase out the gillnet fishery as has been suggested in 2005 rights allocation process for net fisheries (DEAT:

MCM 2005), and would allow for the maintenance of this locally important fishery. In

In addition, it is important that the provincial and municipal planning documents (SDFs and IDPs) embrace and support the objectives of this EMP. Positive steps in this respect would be the inclusion of the setback line in planning documents and ensuring that the style and density of development around the estuary does not compromise the wilderness feel and sense of place, and limiting development to one bank of the estuary only such that views from the opposite bank retain their natural vista.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
1. Protection of biodiversity and wilderness character	a. Establish a Marine Protected Area (MPA) that incorporates the lower reaches of the Olifants estuary (from the mouth to 12 km upstream, the lateral boundaries being the high water mark) gazetted in terms of the Marine Living Resources Act, 1998, zoned in accordance with the Zonation plan in Section 5 to ensure sustainable use. [Marine Living Resources Act, 1998]	i. OEMF, C.A.P.E. and MCM to draft and submit request to the Minister, DEAT, to establish an MPA on the Olifants estuary that includes sanctuary and control use zones as per the zonation plan prepared for the estuary (Figure 3)	<ul style="list-style-type: none"> Joint memorandum from OEMF, C.A.P.E. and MCM to Minister DEAT requesting proclamation of a new MPA on the Olifants estuary 	2009-10	OEMF, C.A.P.E. and MCM	C.A.P.E R4 000
		ii. With endorsement from DEAT, enlist legal support to prepare notice of intent to proclaim the MPA to be published in the government gazette	<ul style="list-style-type: none"> Notice of intent in government gazette 			
		iii. DEAT MPA Working Group to consider comments on gazette notice and to and prepare responses to I&APs and Minister	<ul style="list-style-type: none"> Response letters 			
		iv. Preparation of final gazette notice	<ul style="list-style-type: none"> Proclamation notice in government gazette 			
	b. Integrate Olifants estuary management plan into development planning [Coastal Management Bill, Municipal Systems Act, 2000]	i. Ensure that setback lines and other developmental needs and restrictions are integrated into IDPs and SDFs	<ul style="list-style-type: none"> SDFs reflect requirements of Estuary Management Plan Setback line gazetted 	2010	Matzikama Municipality	
		ii. Apply for legal status of the setback line under the Integrated Coastal Management Act (when gazetted)				
	c. Regulate boat traffic on the estuary to minimise impacts on biodiversity, enhance	iii. West Coast District Municipality or Matizikamma Local Municipality to publish regulations requiring permits for using a	<ul style="list-style-type: none"> Regulations/Bylaws Launch site application(s) 	2010	West Coast District or Matzikama	

	safety, reduce pollution and nuisance value [Coastal Management Bill, Sea Shore Act 1935]	boat on the Olifants estuary and banning the use of outboard motors other than electric motors for all purposes other than research and management iv. OEMF to identify a short list of desired legal launch sites on the estuary and with assistance from the designated Estuary Management Authority to apply to Marine & Coastal Management and Cape Nature to register these sites	<ul style="list-style-type: none"> Launch site register 		Municipality OEMF Estuary Management Authority	
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6.3 Co-management and effective governance

The Olifants Estuary Management Forum (OEMF) was established by C.A.P.E. at a workshop in Strandfontein in January 2008. The next step will be for the OEMF to agree on a lead agency for the management of the proposed Olifants Estuary (Marine) Protected Area, and to improve coordination between participating management agencies in working towards the realization of a common vision for the Olifants estuary. Candidate management agencies include Marine & Coastal Management (MCM), Cape Nature, the Matzikama Municipality, Department of Water Affairs (DWAF), and the West Coastal District Municipality (WCDM). MCM has jurisdiction over living resources in the estuary, DWAF has jurisdiction of freshwater flows to the estuary, and the Matzikama

municipality has jurisdiction over land-use around the estuary and recreational use of the estuary. Capacity (human, infrastructure and financial resources) available within each of these agencies for management of the Olifants estuary is currently limited and will need to be bolstered. It is essential that all these agencies work cooperatively to ensure the vision and defined management objectives can be realised.

The effective governance of the estuary will require suitably-trained staff and adequate equipment, all of which require adequate start-up funding as well as ongoing funds for management.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
2. Co-operative and effective governance	a. Appoint an Olifants Estuary Management Forum (OEMF) [Coastal Management Bill]	ii. Invite representative members of stakeholders and government to be members of the Olifants Estuary Management Forum (OEMF)	<ul style="list-style-type: none"> A list of members of the forum and their contact details 	2009	C.A.P.E.	
	b. Define co-operative governance arrangements for management of the proposed Olifants Estuary (Marine) Protected Area [Coastal Management Bill ; Protected Areas Act 2003]	i. Estuary Management Forum to meet to identify the preferred lead agency (CapeNature, Matzikama Municipality or MCM) and to define clear roles and responsibility for the lead agency and the other participating agencies in respect of the management of the Olifants Estuary (Marine) Protected Area.	<ul style="list-style-type: none"> Proceedings 	2009	OEMF, C.A.P.E. CapeNature, Matzikama Municipality, MCM and DWAF	C.A.P.E R56 000
		ii. Estuary management Forum to obtain agreement from the proposed lead agency and other participating agencies in respect of their roles and responsibilities.	<ul style="list-style-type: none"> Signed letters from all agencies to be involved with the management of the Olifants Estuary (Marine) Protected Area and the 	2009		C.A.P.E R16 000

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
			OEMF clearly outlining respective roles and responsibilities			
	c. Secure financing	i. Secure start-up financing for estuary management, capacity building and research and monitoring programmes	<ul style="list-style-type: none"> Funds secured for 5 years An action plan for securing future funding 	2009-10	Estuary management agency and key partners	
		ii. Lobby respective agencies to allocate resources, create and fill posts, and acquire necessary infrastructure and resources				
		iii. Develop a long-term financing plan				C.A.P.E R56 000
	d. Adequate resources and capacity	i. Establish an office at the estuary, preferably at Viswater/Papendorp	<ul style="list-style-type: none"> Office building 	2010	Estuary management agency and key partners	EMA R350 000
		ii. Acquire necessary equipment (office equip, water quality meter, boat, vehicle)	<ul style="list-style-type: none"> Office is adequately equipped 			EMA R340 000
		iii. Recruit estuary manager and two field rangers as permanent staff.	<ul style="list-style-type: none"> Staff & resources deployed for management of Olifants Estuary (Marine) Protected Area 			EMA R1 960 000
		iv. Identify and address training needs among management staff and staff (involved in estuary) of CapeNature, Matzikama Municipality and MCM (e.g. for monitoring, visitor regulation and assistance)	<ul style="list-style-type: none"> Training records 			
		v. Evaluate performance of staff, contractors and volunteers	<ul style="list-style-type: none"> Performance evaluations 			2011+

6.4 Restoring estuary health

Two focal areas have been identified for restoration or rehabilitation on the Olifants estuary.

The first relates to quantity and quality of freshwater flow reaching the estuary and the second to historic diamond mining operations on the estuary. The estuary currently receives some 69% of the natural mean annual runoff (MAR). While this does not affect mouth condition, since the Olifants has not so far shown evidence of being sensitive to closure due to its rocky sill at the mouth, reduction in flow has had a considerable impact on water quality, both due to reduced ability to dilute pollution and due to the increase in polluted return flows as a result of use of the water in irrigation. The reduced flows have also altered the physical habitat of the estuary in that the depth and profile has changed. The reduction in flows has also resulted in considerable changes to the biota of the estuary. Primary productivity by microalgae is thought to have increased due to the nutrient input and reduction in flushing of the estuary. Plants have also been significantly affected. The stagnation and enrichment of water in the upper reaches of the estuary has led to an increase in the biomass and extent of *Potamogeton pectinatus* and macroalgae. The distribution of brackish reeds and sedges has

probably diminished as a result of increased salinity. The biomass of zooplankton and bottom-living invertebrates such as amphipods and prawns is likely to have increased as a result of the increase in salinity. The fish community composition is thought to have changed radically as a result of changes in salinity. Numbers of estuarine round herring and flathead mullet as well as indigenous freshwater species have decreased, but harders are thought to be more abundant now than in the past, although this may not be evident due to high fishing pressure at present. Changes in the bird community have probably been only slight, with species associated with fresher conditions becoming less common on the estuary. A recently completed ecological reserve determination study has recommended that summer freshwater flows to the estuary be boosted to alleviate the impacts described above, but must still be signed off by the Minister of DWAF, before it can be implemented.

Prospecting trenches excavated along the west bank of the Olifants estuary are also an issue of concern as these have developed into erosion gully that carry large volumes of silt into the estuary and are destabilising the banks in places. These trenches are also very unsightly and need to be stabilised, refilled and revegetated.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
3. Restoring estuary health	a. Secure adequate quantity and quality of freshwater input to restore and maintain ecosystem health and functioning [National Water Act 1998]	i. Lobby minister DWAF to sign off the recommended freshwater reserve for the estuary	<ul style="list-style-type: none"> Improvements in ecological health indices 	2009	C.A.P.E. Estuary management agency	
	b. Rehabilitate estuarine habitat damaged by historic mining operations [Minerals and Petroleum Resources Development Act (2002)]	ii. Identify companies responsible for existing mining damages to the estuary banks and lobby for rehabilitation of damage inflicted by historic diamond mining operations on the estuary	<ul style="list-style-type: none"> Improvements in ecological health and aesthetic indices 	2010	C.A.P.E. Estuary management agency	

6.5 Research and Monitoring

This management plan has been devised based on current understanding of the functioning of the estuary and its economic value. There are gaps in this understanding, and there will be an ongoing need to improve understanding through research.

Increasing use by visitors, surrounding development, changes in freshwater supply from the catchment, and climate and sea-level change can impact on the health and ecological functioning of the estuary, as well as its value at different spatial scales.

Monitoring and research are essential to enable the respective agencies responsible for management of the Olifants Estuary to adapt management plans, operational plans and activities to changing circumstances. Three key focal areas for monitoring and research associated with the Olifants estuary include visitor numbers and behaviour, water quantity and quality, physical characteristics, nutrients, biodiversity, and populations of exploited species.

The recently completed reserve determination study for the Olifants estuary has recommended that flows released from the Clanwilliam Dam be improved in order to restore the health of this nationally

important estuary. While these recommendations have yet to be adopted by DWAF, proper assessment of the efficacy of these interventions requires detailed baseline information from before and after implementation. Recommended protocols for monitoring the implementation of the freshwater reserve for the Olifants estuary have been prepared by Taljaard *et al.* (2006) and are included in Appendix 1. These protocols serve to monitor the health of the estuary. Related to this, the “Ecological Specifications” and “Thresholds of Potential Concern” (TPC) for the Olifants estuary are included as Appendix 2.

Similarly, impacts of reducing gill netting effort in the estuary as effected by MCM in recent years, on target and bycatch species as well as the socio-economic circumstances of the fishers on the estuary, needs to be carefully monitored to ensure desired results are achieved and ancillary impacts are not overly severe. In addition, it will be advisable to monitor visitor numbers, profiles, behaviour and opinions. It is recommended that these protocols be adopted as a monitoring programme for the proposed Olifants Estuary (Marine) Protected Area.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
4. Research and monitoring	a. Promote scientific research	i. Identify information gaps and develop research programme(s) aimed at gathering/ consolidating data on biodiversity and exploited species	<ul style="list-style-type: none"> • Research projects • Scientific reports, paper and publications 	20011-13	Estuary management agency C.A.P.E. OEMP	
		ii. Engage local research institutes and universities to collaborate on priority research projects				
		iii. Solicit research funding support				
	b. Monitor biophysical indicators of estuary health [National Water Act 1998]	i. Carry out monitoring programme as outlined in Appendix 1 and assess results in terms of thresholds of potential concern (Appendix 2)	<ul style="list-style-type: none"> • Monitoring data and reports 	2011	Estuary management agency	DWAF R672 000
c. Monitor human use of the estuary [National Water Act 1998]	i. Carry out monitoring programme as outlined in Appendix 1	<ul style="list-style-type: none"> • Monitoring data and reports 	2010 - 13	Estuary management agency	EMA R40 000	

6.6 Increasing public awareness

Effective management of the estuary will be dependent on stakeholder buy-in (through adequate consultation and communication) and visitors' appreciation of the management regulations. Education is also considered to be among the most important functions provided by a protected area along with biodiversity conservation, maintenance of population of exploited species. Protected areas provide opportunities where the public are able to view species in their natural environments, and to experience ecosystems in a largely undisturbed state. Provision of interpretive and educational material at these sites can greatly enhance this

experience as it focuses attention of visitors on goods and services provided by the environment of which they may not have been aware, highlights key aspects of the environment that are special or unique to the area, and can be used to highlight the impact of human activities on the environment. Furthermore, the better people understand the issues surrounding the management of a protected area, the more they are likely to respect the management requirements and regulations. Thus the Management agencies for the Olifants Estuary (Marine) Protected Area will need to provide state of the art service in this field.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
5. Increasing public awareness	a. Create effective mechanisms for on-going communication with stakeholders	Develop an effective communication strategy	<ul style="list-style-type: none"> Communication strategy 	2010-11	Estuary management agency OEMF	EMA R8 000
		Maintain stakeholder database	<ul style="list-style-type: none"> Stakeholder database 			
		Explore alternative communications mechanisms (workshops, signage, radio etc)	<ul style="list-style-type: none"> Record of Communications 			
	b. Develop an effective education and awareness programme for the protected area that enhances visitor experiences and facilitates compliance with regulations	Establish a visitor centre within the estuary protected area which acts as a focal point where visitors can go to learn more about the estuary, its conservation importance, the ecology of the system, the cultural and archaeological significance of the area, and the need for rationale behind existing management interventions	<ul style="list-style-type: none"> Visitor centre open to public 	2010-11	Estuary management agency	EMA R150 000
		Source and/ or commission educational and informative material including signage, posters, pamphlets, and relevant literature to be housed in the visitor centre and other appropriate localities that will enhance visitor experiences	<ul style="list-style-type: none"> Posters, pamphlets, signage, literature 	2011+		EMA R300 000
		Encourage field excursions to the estuary by local schools, community groups, and other stakeholder groupings	Reports	2011+		
		Erect signage at the main access points to the estuary and on the banks of the estuary between zones that depict the zonation plan for the system and provide information on regulations applicable within each zone	Signage	2011		EMA R300 000

6.7 Promoting ecotourism

The Olifants estuary is one of the most scenic and least developed of the large permanently-open estuaries in South Africa. It is widely referred to as being “the jewel of the West Coast”. The primary challenge facing the future management agency of the estuary is to

provide a quality experience for visitors to the estuary while at the same time managing visitors in a manner that ensures that they do not compromise the resource that attracted them in the first place.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
6. Promoting ecotourism	a. Establish and manage visitor facilities	i. Develop appropriate nature friendly infrastructure for visitors to the estuary including accommodation (e.g. camping facilities, lodges, guest houses) as well as other facilities (roads, boat launching facilities, bird hides, walking paths, nature trails, mountain bike trails) in collaboration with local communities and independent contractors that does not detract from sense of place of the area or impact on the environment	Visitor infrastructure and facilities	2011-13	Estuary management agency, Matzikama Municipality	EMA R500 000
		ii. Facilitate opportunities for commercial operators and local communities to develop visitor facilities and provide services in the EPA	Number of tourism businesses increases			
		iii. Ensure that visitor facilities are maintained in good condition at all times to maximise visitor experiences	Facilities receive good reviews			
	b. Market the Olifants Estuary Protected Area as a wilderness and nature based ecotourism destination	i. Develop and distribute promotional material for the Olifants Estuary (Marine) Protected Area to key national, provincial and local tourism agencies and info centres	Brochures, pamphlets, magazine articles, website and road signage	2011-13	Estuary management agency, Matzikama Municipality	EMA R50 000
		ii. Develop a website				EMA R5000
		iii. Lobby relevant agencies to ensure the estuary is featured in local, regional and national tourism marketing and included on tourism routes				
		iv. Petition national road agencies to erect appropriate road signage informing passing visitors and tourists of the existence of the EPA				

6.8 Improving local livelihoods

Relationships of the proposed Olifants Estuary (Marine) Protected Area with local communities (particularly those from the disadvantaged sector) will be essential to the conservation of biodiversity and sustainability of livelihood benefits derived from the estuary. Local communities and neighbours need to derive benefits from the estuary if they are to support it. Direct tangible benefits must accrue to the surrounding communities as a result of the establishment of the Olifants Estuary (Marine) Protected Area which will compensate for any real or perceived lost opportunities or benefits arising from the establishment of this protected area. The

management agency must take clear decisive steps to identify and facilitate the delivery of benefits to adjacent and broader communities. Such benefits could include community access to facilities and opportunities (educational, recreational use, and economic opportunities) and cultural interpretation, and must be communicated to local stakeholders in a clear and unambiguous way. Delivery of direct benefits must focus on gill net fishers that may be negatively affected by the reduction in the extent of their fishing area and/or through withdrawal of gill net fishing rights as per the policy decision by MCM on this matter.

KRA	Strategies	Actions	Deliverables / Indicators	Timing	Implementation	Indicative budget
7. Enhancing local livelihoods	a. Sustainable use of estuary resources [Marine Living Resources Act 1998]	i. Establish the number of gillnet fishing rights on the estuary that can be sustained with adequate no-take protection of part of the estuary as defined in this management plan	Recommended number of permits based on adequate research	2010-11	DEAT: MCM	
		ii. Issue gill-net fishing permits to the most deserving members of the local community	Gill net permits issued			
		iii. Assess economic and ecological feasibility of establishing a small scale mariculture operation on the estuary	Economic and ecological feasibility report	2010-11	Matzikama Municipality	Matzikama Municipality R50 000
	b. Provide alternative livelihoods	i. Promote economic development in the local area that provides employment opportunities and reduces reliance on estuary fisheries ii. Identify opportunities whereby local communities (particularly those from the disadvantaged sector) and stakeholders can benefit from the establishment of the Olifants Estuary (Marine) Protected Area through job creation and business opportunities (e.g. protected area management, ecotourism businesses, guiding, etc.)	Employment opportunities	2010+	Matzikama Municipality Estuary management agency	

	c. Empower local communities	i. Assist people from local communities (particularly those from the disadvantaged sector) to realise available opportunities through training programmes (e.g. guiding courses), and by creating links with NGOs, CBOs, donors and commercial operators.	Trained members of the local communities	2012+	Matzikama Municipality Estuary management agency	Matzikama Municipality R200 000
	d. Favour local communities	i. Develop and implement preferential employment and procurement policies that favour local communities (particularly those from the disadvantaged sector).	Employment and procurement policies	2012+	Matzikama Municipality Estuary management agency	
		ii. Identify, quantify and publicise direct and indirect benefits to local communities and stakeholders that accrue from the establishment of the protected area	Employment records Report on benefits			

7 SUMMARY OF MANAGEMENT ACTIONS, GANTT CHART AND BUDGET

Table 7.1 provides a summary of the budget required to implement the Olifants Estuary Management Plan over the next 4 years. C.A.P.E.'s main contribution is towards establishment of the protected area. DWAF is required to finance the monitoring of estuary health in terms of the recently-completed Resource Directed Measures study on the system. Most of this monitoring will be done only every three years. The contribution attributed to the estuary management agency includes capital and staffing costs, much of which will have to be sourced from government (e.g. DEAT, which is responsible for MPA management), non-government organisations (e.g. WWF) and the private sector. Costs associated with community development have been allocated to Matzikama Municipality.

Table 7.2 provides a summary of the tasks to be carried out over the next 4 years, and their timing.

Table 7.1. Summary of estimated budget and its distribution among key institutions for the first four years

Institution	Indicative budget (excluding in-house)
C.A.P.E.	R116 000
DWAF	R672 100
EMA	R3 995 000
Matzikama	R200 000
TOTAL	R4 983 100

Table 7.2. Summary of actions and timing of actions pertaining to each of the key result areas over the period Jul 2008 – Jun 2012.

Key result area	Action	2009 Jul-Dec	2010 Jan-Jun	2010 Jul-Dec	2011 Jan-Jun	2011 Jul-Dec	2012 Jan-Jun	2012 Jul-Dec	2013 Jan-Jun
1. Protection of biodiversity and sense of place	a. Establish a Marine Protected Area (MPA)								
	b. Integrate into IDP/SDF								
2. Co-operative and effective governance	a. Appoint Olifants Estuary Management Forum								
	b. Define co-operative governance arrangements								
	c. Secure financing								
	d. Provide resources and capacity								
3. Restoration of estuary health	a. Secure freshwater input								
	b. Lobby to rehabilitate mined habitat								
4. Research and monitoring	a. Promote scientific research								
	b. Monitor estuary health								
	c. Monitor human use								
5. Increasing public awareness	a. Create mechanisms for communication with stakeholders								
	b. Develop education and awareness programme								
6. Promoting ecotourism	a. Establish and manage visitor facilities								
	b. Market the Olifants Estuary								
7. Enhancing local livelihoods	a. Sustainable use of estuary resources								
	b. Provide alternative livelihoods								
	c. Empower local communities								
	d. Favour local communities								

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APPENDIX 1: RECOMMENDED MONITORING PROTOCOLS

The following table provides a list of recommended abiotic and biotic parameters to be monitored on the Olifants estuary to assess compliance with the recommended ecological freshwater reserve for the estuary

(based on Taljaard *et al.* 2006). Additional recommendations have been included for monitoring of visitor numbers, profiles and opinions required in terms of the management plan.

COMPONENT	MONITORING ACTION	RELATED TPC (see Appendix 2)	TEMPORAL SCALE (frequency and when)	SPATIAL SCALE (No. Stations)
1. BIRDS	Undertake counts of all water-associated birds. All birds should be identified to species level and total number of each counted.	1.1 – 1.2	Winter and summer survey, yearly	Entire estuary
2. FISH	Conduct fish surveys using both seine and gill nets as primary gear.	2.1 – 2.6	Winter and summer survey every 3 years starting 2009	Entire estuary (12 stns)
3. INVERTEBRATES	Zooplankton: Collect quantitative samples using a flow meter <u>after dark</u> , preferably during neap tides (mid to high tide). Sampling to be done at mid- water level, i.e. not surface. (Include chlorophyll a measurements on benthic microalgae and water column chlorophyll as to establish feeding links)	3.1	Same as for fish	Entire estuary (12 stns)
	Benthic invertebrates: Collect (subtidal) samples using a Zabalocki-type Eckman grab sampler with 5-9 randomly placed grabs (replicates) at each station. Collect intertidal samples at spring low tide using core sampling.	3.2	Same as for fish	Entire estuary (12 stns)
	Macrocrustaceans: Collected quantitative samples during neap tides (mid to high tide), at the same stations used for zooplankton, using a benthic sled with flow meter.	3.3	Same as for fish	Entire estuary (12 stns)
4. MACROPHYTES	Map main macrophyte communities using aerial photos or GPS	4.1 – 4.5	Every 3 years	Entire estuary
5. MICROALGAE	Phytoplankton: Conduct water column chlorophyll a measurements and counts of dominant phytoplankton group.	5.1 – 5.3, 5.5	Same as for fish	Entire estuary (8 stns)
	Benthic microalgae: Conduct benthic chlorophyll a measurements	5.4	Same as for fish	Entire estuary (8 stns)
6. WATER QUALITY	Collect data on conductivity, temperature, suspended matter/turbidity, dissolved oxygen, pH, inorganic nutrients and organic content in river inflow	6.6, 6.7 & 6.8	At least monthly	At Lutzville causeway
	Monitor inorganic nutrient inflow from agricultural return flow in upper reaches (e.g. bore hole sampling)	6.6, 6.7 & 6.8	At least monthly	4 stns along upper banks
	Collected longitudinal salinity & temperature profiles (<i>in situ</i>)	6.1 – 6.5	To be measured when biotic surveys require information for interpretation	Entire estuary (12 stns)
	Water quality measurements taken along the length of the estuary (surface and bottom samples) for pH, dissolved oxygen, suspended solids/turbidity and inorganic nutrients.	6.7 – 6.9		Entire estuary (12 stns)
	Baseline data set for pesticides/herbicides accumulation in sediments	6.13	Every 3 years	Focus on depositional areas

COMPONENT	MONITORING ACTION	RELATED TPC (see Appendix 2)	TEMPORAL SCALE (frequency and when)	SPATIAL SCALE (No. Stations)
7. HYDRODYNAMICS	Water level recordings	8.6	Continuous	Near mouth
	Flow gauging	7.1 – 7.3 & 8.1	Continuous	Near Lutzville causeway
	Aerial photographs of estuary (spring low tide)	4.1 – 4.4 & 8.5	Annually	Entire estuary
8. SEDIMENT DYNAMICS	Bathymetric survey: Series of cross-section profiles and a longitudinal profile collected at fixed 500 m intervals, but more detailed in the mouth (vertical accuracy better than 300 mm)	8.5	Every 3 years,	Entire estuary
	Set sediment grab samples (at cross section profiles) for analysis of particle size distribution (PSD) and origin (i.e. using microscopic observations)	8.3 - 8.4		Entire estuary
	Daily sampling of suspended sediment (and organic matter)	8.2	Daily	Sishen-Saldanha train bridge
9. HUMAN USE	Collect statistics on the profile (origin, sex, age, income category) and activities of visitors to the Olifants estuary using self-fill in questionnaires,		Continuous	Visitor entry points
	Conduct regular counts of users and boats, separated by type.		Twice per week	Entire estuary
	Collect data on catch (species composition, abundance, size composition) and effort for the estuarine gill net and recreational angling fisheries		Daily	Entire estuary
	Survey visitor and resident opinions on impacts of key management interventions.		Every five years	Entire estuary
10. ECONOMIC DEVELOPMENT	Collect statistics on income, poverty, and education levels of people in local communities surrounding the Olifants estuary to gauge impacts of key management interventions.		Every five years	Surrounding area

APPENDIX 2: ECOLOGICAL SPECIFICATIONS AND THRESHOLDS OF POTENTIAL CONCERN (TPC) FOR MONITORING PARAMETERS LISTED IN APPENDIX 1

The following table provides “Ecological Specifications/Resource Quality Objectives” and “Thresholds of Potential Concern” (TPC) for the Olifants estuary as defined for the ecological freshwater requirements study completed for the Olifants estuary (Taljaard *et al.* 2006). In this context, “Ecological Specifications/Resource Quality Objectives” are defined as being 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 reserve category, in this case a Category B, while “Thresholds of Potential Concern” 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) should prompt management action. Note that thresholds of potential concern endpoints are generally defined such that they provide early warning signals of potential non-compliance to ecological specification (i.e. not the point of ‘no return’). Thus, indicators (or monitoring activities) included here incorporate biotic and abiotic components that are considered particularly sensitive to ecological changes associated with changes in river inflow and should be interpreted as such.

COMPONENT	ECOLOGICAL SPECIFICATIONS/RESOURCE QUALITY OBJECTIVES	THRESHOLD OF POTENTIAL CONCERN	POTENTIAL CAUSES
1. Birds	Retain the species richness, abundance and diversity of the bird community, representative of resident and migrant waders, wading birds and water fowl as under the Present State, except for that there would be an higher abundance of water fowl (increasing by about 10% from Present State numbers)	1.1 Community composition or bird numbers deviates by more than 50% of average seasonal baseline counts for two consecutive summer or winter seasons, focusing on waders, wading birds, terns & water fowl (summer and winter), and specifically red data species which are supported by the system (e.g. Pelican, Oyster catchers, Chestnut banded plover) 1.2 In the case of water fowl densities decline by 20% of average seasonal baseline counts for two consecutive summer or winter seasons	Changes in: Salinity Invertebrate biomass/abundance Fish biomass/abundance in smaller size classes Vegetation habitats (e.g. reed beds, submerged macrophytes, salt marsh) Mud flats Human disturbance (not at moment)
2. Fish	Retain the following fish assemblages in the estuary: estuarine species (35%), partially estuarine dependent species (50-60%), obligate estuarine dependent (e.g. white steenbras) (>1%) and indigenous freshwater species (>1%). Exotic freshwater species (<0.5%)	2.1 Level of estuarine species drop below 30% of total abundance 2.2 Levels of obligate estuarine dependent species drop below 1% of total abundance 2.3 Levels of partially estuarine dependent species drop below 50% or above 60% of total abundance 2.4 Levels of exotic freshwater species above 0.5% (e.g. Mozambique tilapia out-competing resident species) 2.5 Benthic dwellers species drop below 2% of total abundance in estuary above 18 km from the mouth	Changes in: Insufficient spawn biomass (national stock – marine) Spawning failure due to environmental conditions (marine) Recruitment failure (e.g. no cues reaching the sea from the estuary) Habitat (macrophytes) Water column (temperature, salinity, turbidity, dissolved oxygen) Toxic substances (?) Food availability (Invertebrate & fish) Exploitation Introduction in aliens

COMPONENT	ECOLOGICAL SPECIFICATIONS/RESOURCE QUALITY OBJECTIVES	THRESHOLD OF POTENTIAL CONCERN	POTENTIAL CAUSES
	Maintain recruitment of adult and juvenile fish at Reference Condition levels. This requires maintaining sufficient flow for freshwater plume (temperature, salinity and olfactory gradient) entering the sea. This implies that there should be a significant number of 0 -1 year old fish and no missing year classes.	2.6 There are a missing year classes within a species	Blockage of eel migrations due to sand bar at mouth, Bad catchment practises/destruction of habitat, Blockage of migration due to dams.
3. Invertebrates	Retain Present State species richness and mix (low species abundance, high dominance). However, under the present state one or two species are always present at high densities compared to others (e.g. <i>Pseudodiaptomus hessei</i> & <i>Ceratonereis keiskama</i>). For a B Category the higher densities need to be more variable in abundance during the year.	3.1 Species richness is greater than 30 for zooplankton and macroinvertebrates respectively (50% increase)	Changes in: Variability in intra-annual flow, e.g. loss of high flow pulses (>20 m ³ /s) in autumn/spring (salinity) Sediment grain size distribution and organic content
	Indicator species such as <i>Capitella capitata</i> , should not dominate benthic species at any site	3.2 <i>Capitella capitata</i> exceeds 50% abundance of benthic species at any site	Increase in pollution (low oxygen high organic loading)
	<i>Callinassa</i> and <i>Upogebia</i> distribution patterns as under Present State	3.3 Abundance levels or areas of distribution decreases by more than 50% (mainly lower sandy reaches)	Changes in sediment characteristics along the estuary
4. Macrophytes	Maintain the present distribution (summer 2004) and abundance of the different plant community types (<i>Zostera capensis</i> (48 ha), intertidal salt marsh (92 ha), supratidal salt marsh (143 ha), floodplain salt marsh (797 ha), reeds and sedges (60 ha)	4.1 Greater than 20% change in the area covered by different plant community types	Increase in salinity and reduced flooding influencing depth to groundwater and groundwater salinity. Increase in turbidity would reduce submerged macrophyte cover.
	Reduce the areas covered by water weeds in the upper reaches by 50% compared to the Present State (summer 2004). Therefore area covered by invasive waterweeds (<i>Azolla filiculoides</i>), nuisance filamentous algae (e.g. <i>Enteromorpha</i> , <i>Ulva</i> , <i>Cladophora</i>) and pondweed (<i>Potamogeton pectinatus</i>) should be 30 ha (half of channel)	4.2 Upper 15 km of estuary with greater than 50% of estuary water channel covered by invasive waterweeds (<i>Azolla filiculoides</i>), nuisance filamentous algae (e.g. <i>Enteromorpha</i> , <i>Ulva</i> , <i>Cladophora</i>) and pondweed (<i>Potamogeton pectinatus</i>).	Low flow, lack of flushing and reduced current speeds. Reduced flooding that resets the estuary. High nutrient input from agricultural activities and return flow.
	Control the spread of invasive aliens in the riparian zone (e.g. <i>Sesbania punicea</i> and <i>Eucalyptus</i> spp.).	4.3 Greater than 20 % increase in area covered by invasive plants.	Disturbance of riparian zone due to human impacts such as bulldozing and clearing of natural vegetation
	Maintain reed and sedge areas (60 ha) and brackish salt marsh (~10 ha) as for the Present State (summer 2004) (by preventing salinity of 20 ppt to move further upstream than 8.5 km and remain there for greater than 3 months).	4.4 Dieback of reeds and brackish salt marsh at 8.5 km and further upstream from the mouth.	Reduced flow and an increase in saline intrusion.
	Prevent an increase in bare ground in the floodplain salt marsh by maintaining groundwater salinity at <70 ppt and depth to the water table at < 1.5 m	4.5 Greater than 20% increase in bare ground in salt marsh.	Reduced flow and flooding, increase in groundwater salinity and depth to groundwater.

5. Microalgae	Maintain a low phytoplankton biomass with a small REI (i.e. 10 ppt to river +1 ppt) zone	5.1 Phytoplankton biomass exceeds 15 µg/l chlorophyll a in summer and 10 ug/l chlorophyll a in winter 5.2 Blue-green algae exceeds 10% of phytoplankton cell counts	Water flow rates falling too low in winter or summer.
	Maintain microalgal group diversity as measured under Present State (2004)	5.3 Flagellates cease to be the dominant group and diatoms become less diverse (<10 taxa per site)	Reduced freshwater inflow rates and high salinity near the upper areas of the estuary.
	Maintain intertidal and subtidal microphytobenthic biomass as measured under Present State (2004).	5.4 Benthic microphytobenthic biomass exceed 40 mg/m ² chlorophyll a	Elevated nutrient in the inflowing freshwater.
	Maintain a low frequency of dinoflagellates	5.5 The frequency of dinoflagellates exceeds 5% of the total phytoplankton counts	Eutrophication of inflowing river water.
6. Water quality	Salinity intrusion should not to cause exceedence of TPCs for fish, invertebrates, macrophytes and microalgae (see above)	6.1 Salinity greater than 20 ppt for long than 3 months at 7 km upstream from the mouth (brackish saltmarsh, reeds and sedges & invertebrates)	Modification of volume of river inflow Quality of agricultural return flow
		6.2 Salinity of groundwater increases to 50 ppt and depth to water table to 1 m. (flood plain salt marsh)	
		6.3 Total dissolved solids (measure of 'salinity') of river inflow exceeds 3500 mg/l (phytoplankton)	
		6.4 Salinity in estuary exceeds 35 ppt (prevent hyper- salinity) (phytoplankton)	
		6.5 Salinity greater than 10 ppt occurs above 16 km upstream of the mouth (fish)	
System variables (Temperature, pH, turbidity, dissolved oxygen, suspended solids and turbidity) not to cause exceedence of TPCs for biota (see above)	6.6 River inflow: Summer temp < 20°C pH < 6.5 'Turbid' river inflow (to be determined) Dissolved oxygen < 4 mg/l	Changes in water quality of river inflow at head of estuary and as a result of agricultural return flow along the banks of the upper estuary. Excessive macroalgal/microalgal growth in the estuary	
	6.7 Secchi disc reading above 8 km from the mouth is greater than 1 m (proxy for turbidity in estuary)		
	6.8 pH > 8.5 or < 6.5 in river inflow or in estuary		
	6.9 Water column DO drops below 4 mg/l (1 m above bottom except in deep holes) (need to investigate DO level at night in dense macrophyte beds)		

	Inorganic nutrient concentrations not to cause exceedance of TPCs for macrophytes and microalgae (see above).	<p>6.10 When average river inflow is less than 5 m³/s and average DIN concentrations exceed 100 µg/l in river inflow and DIN concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 100 µg/l</p> <p>6.11 During high flow season (flows > 20 m³/s) average DIN concentrations exceed 500 µg/l in river inflow and average DIN concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 500 µg/l</p> <p>6.12 Average DRP concentration exceed 100 µg/l in river inflow and average DRP concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 100 µg/l</p>	Changes in water quality of river inflow at head of estuary and as a result of agricultural return flow along the banks of the upper estuary.
	Presence of toxic substances not to cause exceedance of TPCs for biota (see above).	6.13 For pesticides/herbicides baseline studies still need to be undertaken before TPCs can be set (special concern in upper reaches with extensive agricultural activities along banks of estuary)	Inputs from agricultural activities in the catchment and along the banks of the estuary in upper reaches
7. Hydro-dynamics	Maintain a flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality	<p>7.1 River inflow distribution patterns differ by more than 5% from that of Scenario 2 (i.e. recommended flow scenario for the Olifants)</p> <p>7.2 River inflow decreases to below 1.5 m³/s at any time</p> <p>7.3 River inflow below 2 m³/s persist for longer than 4 months</p>	Modification to inflow at head of estuary
8. 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)	<p>8.1 River inflow distribution patterns (flood components) differ by more than 10% (in terms of magnitude, timing and variability) from that of the Present State (2004)</p> <p>8.2 Suspended sediment concentration from river inflow deviates by more than 10% of the sediment load discharge relationship to be determine as part of baseline studies (Present State 2004)</p>	Modification to inflow at head of estuary
	Changes in sediment grain size distribution patterns not to cause exceedance of TPCs in benthic invertebrates (see above).	<p>8.3 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).</p> <p>8.4 Sand/mud distribution in middle reaches (8-20 km) change by more than 20% from Present State (2004)</p> <p>8.5 Changes in the channel bathymetry in the upper reaches (above 20 km upstream of the mouth) change by more than 20% from Present State (2004)</p> <p>8.6 Changes in tidal amplitude below the Lutzville causeway of more than 20% from Present State (2004)</p>	Modification to inflow at head of estuary; Catchment activities