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iLovu Estuarine Management Plan

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GLOSSARY

Biodiversity	The diversity of genes, species and ecosystems on Earth, and the ecological and evolutionary processes that maintain this diversity.
Best practice	A technique or methodology that, through experience and research, has proven to reliably lead to a desired result. A commitment to using the best practices in any field is a commitment to using all the knowledge and technology at one's disposal to ensure success.
Coastal management line (CML)	A line determined by a MEC in accordance with section 25 of the ICM Act in order to demarcate an area within which development will be prohibited or controlled in order to achieve the objects of the Act or coastal management objectives.
Coastal management objective	A clearly defined objective established by a coastal management programme for a specific area within the coastal zone which coastal management must be directed at achieving.
Coastal resources	Means any part of (a) the cultural heritage of the Republic within the coastal zone, including shell middens and traditional fish traps; or (b) the coastal environment that is of actual or potential benefit to humans.
Coastal waters	Means (a) the internal waters, territorial waters, exclusive economic zone (EEZ) and continental shelf of the Republic referred to in Sections 3, 4, 7 and 8 of the Maritime Zones Act (15 of 1994), respectively; and (b) an estuary.
Coastal wetland	Means (a) any wetland in the coastal zone; and (b) includes (i) land adjacent to coastal waters that is regularly or periodically inundated by water, salt marshes, mangrove areas, inter-tidal sand and mud flats, marshes, and minor coastal streams regardless of whether they are of a saline, freshwater or brackish nature; and (ii) the water, the subsoil and substrata beneath, and bed and banks of, any such wetland.
Coastal zone	The area comprising coastal public property, the coastal protection zone (CPZ), coastal access land, coastal protected areas, the seashore and coastal waters, and includes any aspect of the environment on, in, under and above such area.
Community	In ecology, a community is a group or association of populations of two or more different species occupying the same geographical area and in a particular time.
	In terms of NEMA, means any group of persons or a part of such a group who share common interests. and who regard themselves as a community.
Development	In relation to a place, means any process initiated by a person to change the use, physical nature or appearance of that place, and includes (a) the construction, erection, alteration, demolition or removal of a structure or building; (b) a process to rezone, subdivide or consolidate land; (c) changes to the existing or natural topography of the coastal zone; and (d) the destruction or removal of indigenous or protected vegetation.
D'MOSS	Durban Metropolitan Open Space System: a spatial layer of interconnecting open spaces in public, private and traditional authority ownership that seeks to protect the biodiversity and associated ecosystem services of Durban for future generations.
Effluent	Means (a) any liquid discharged into the coastal environment as waste, and includes any substance dissolved or suspended in the liquid; or (b) liquid which is a different temperature from the body of water into which it is being discharged.
Environmental authorisation	An authorisation granted in respect of coastal activities by a competent authority CA) in terms of Chapter 5 of the National Environmental Management Act.
Estuary	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.
Estuary head	The upstream part of the system where freshwater enters.

Eutrophication	A process by which a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of algae. This process may result in oxygen depletion of the water body after the bacterial degradation of the algae
Floodplain	Broad and relatively flat area on either side of a stream, river or estuary that are inundated by water during floods.
High-water mark	Means the highest line reached by coastal waters, but excluding any line reached as a result of (a) exceptional or abnormal weather or sea conditions; or (b) an estuary being closed to the sea.
Indigenous	Species within the limits of their native range.
Invasive alien species	Species whose natural range occurs outside of South Africa and which were transported to their current location by humans; where they are able to reproduce, spread and typically cause negative ecological impact.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Invertebrate	An animal without a backbone (e.g. a prawn, crab, or worm).
Legislation	Laws, legal requirements or the process of making or enacting laws.
Low-water mark	Means the lowest line to which coastal waters recede during spring tides.
Macrofauna	Animals larger than 0.5 mm.
Macrophytes	Aquatic plants large enough to be seen by the naked eye.
Microalgae	Microscopic algae, typically found in freshwater and marine systems, living in both the water column and sediment. They are unicellular species which exist individually, or in chains or group.
pH	A measure or scale used to quantify how acidic or basic (alkaline) a water-based solution is.
Phytoplankton	Microscopic organisms that live in aquatic systems that are able to photosynthesize to feed themselves.
Pollution	Any change in the environment caused by (a) substances; (b) radioactive or other waves; or (c) noise, odours, dust or heat emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition. resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.
Reclamation	Means the process of artificially creating new land within coastal waters, and includes the creation of an island or peninsula, but excludes beach replenishment by sand pumping for maintenance purposes.
Sea	Means (a) the high seas; (b) all coastal waters; and (c) land regularly or permanently submerged by sea water, including (i) the bed, subsoil and substrata beneath those waters; and land flooded by sea water which subsequently becomes part of the bed of coastal waters, including the substrata beneath such land.
Seashore	Subject to Section 26 of the ICM Act, means the area between the low-water mark and the high-water mark.
River Estuary Interface (REI)	Productive zone within an estuary where marine and freshwater meets, salinity is less than that of sea water and organic deposition due to reduced current speeds and flocculation occurs and is retained.
Watercourse	Means (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, & a reference to a watercourse includes, where relevant, its bed & banks.
Waste	Any substance, whether or not that substance can be re-used, recycled or recovered (i) that is surplus, unwanted, rejected, discarded, abandoned or disposed of; (ii) that the generator has no further use of, for the purposes of

	production, reprocessing or consumption; and (iii) that is discharged or deposited in a manner that may detrimentally impact on the environment.
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

LIST OF ABBREVIATIONS

ASP	Automotive Supply Park
CA	Competent Authority
CARA	Conservation of Agricultural Resources Act
CBO	Community-based Organisation
CML	Coastal Management Line
CMP	Coastal Management Programme
CPZ	Coastal Protection Zone
CSIR	Council for Scientific and Industrial Research
CWDP	Coastal Waters Discharge Permit
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture Land Reform and Rural Development
DD	Data Deficient
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries (merging of DAFF and DEA in June 2019)
DFFE	Department of Forestry, Fisheries and the Environment (renaming on 1 April 2021)
DFFE: O&C	Department of Forestry, Fisheries and the Environment: Oceans & Coasts
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphorous
DMR	Department of Mineral Resources
DHSWS	Department of Human Settlement, Water and Sanitation
D'MOSS	Durban Metropolitan Open Space System
DO	Dissolved Oxygen
DSW	Durban Solid Waste
DTPC	Dube Trade Port Corporation
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation (current)
EBSA	Ecologically or Biologically Significant Area
EC	Ecological Category
ECA	Environment Conservation Act
EDTEA	Department of Economic Development, Tourism and Environmental Affairs
EEZ	Exclusive Economic Zone
EFZ	Estuarine Functional Zone
EHI	Estuary Health Index
EIA	Environmental Impact Assessment
EKZNW	Ezemvelo KwaZulu-Natal Wildlife
EM	eThekwini Municipality
EMA	eThekwini Municipal Area
EMF	Estuary Management Forum
EMP	Estuarine Management Plan
EMPr	Environmental Management Programme
EN	Endangered
EWR	Ecological Water Requirement
GIS	Geographic Information System
HWM	High Water Mark
IAP	Invasive Alien Plant
I&AP	Interested and Affected Party
ICM	Integrated Coastal Management
ICMA	Integrated Coastal Management Act
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature

KZN	KwaZulu-Natal
MAR	Mean Annual Runoff
MCC	Municipal Coastal Committee
MCPP	Municipal Climate Protection Programme
MECs	Members (of the provincial) Executive Council
MLRA	Marine Living Resource Act
MMP	Mouth Management Plan
MOA	Memorandum of Agreement
MPA	Marine Protected Area
MSL	Mean Sea Level
NBA	National Biodiversity Assessment
NCMP	National Coastal Management Programme
NEMP	National Estuarine Management Protocol
NEsMP	National Estuarine Monitoring Programme
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NEMPAA	National Environmental Management: Protected Areas Act
NEMP	National Estuary Management Protocol
NFA	National Forests Act
NGO	Non-governmental Organisation
nMAR	Natural Mean Annual Runoff
NTU	Nephelometric Turbidity Unit
NWA	National Water Act
ORI	Oceanographic Research Institute
PCC	Provincial Coastal Committee
PES	Present Ecological State
pMAR	Present Mean Annual Runoff
PPP	Public Participation Process
RCP	Representative Concentration Pathways
RDM	Resource Directed Measures
REC	Recommend Ecological Category
REI	River Estuary Interface
RQO	Resource Quality Objective
RMA	Responsible Management Authority
SA	South Africa
SANBI	South African National Biodiversity Institute
SAR	Situation Assessment Report
SDF	Spatial Development Framework
SDP	Spatial Development Plan
SEMA	Specific Environmental Management Act
SEZ	Special Economic Zone
SPLUMA	Spatial Planning and Land Use Management Act
SLR	Sea Level Rise
TEC	Target Ecological Category
UNEP	United Nations Environment Programme
UW	Umgeni Water
VU	Vulnerable
WIO	Western Indian Ocean
WMA	Water Management Area
WWTW	Waste Water Treatment Works

1. INTRODUCTION

1.1 BACKGROUND

With the implementation of the Provincial Coastal Management Programme (adopted by the MEC in September 2019) that includes strategies and plans for the effective and co-operative management of the coastal zone, the KwaZulu-Natal (KZN) Department of Economic Development, Tourism and Environmental Affairs (EDTEA) has prioritised the better management of estuaries in the province. With the aim to mitigate the deterioration of KZN regional estuaries, an estuary prioritisation process was undertaken and the iLovu Estuary was prioritised for the development of an Estuarine Management Plan (EMP). In 2021 EDTEA commenced the process of developing an EMP for the iLovu Estuary situated in the jurisdictional boundary of the eThekwini Metropolitan Municipality, KZN.

1.2 PURPOSE OF ESTUARINE MANAGEMENT PLAN

The development of an EMP is required in terms of Chapter 4, Section 34 of the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008), as amended by Act 36 of 2014 (hereafter referred to as “the ICM Act”) and the National Estuarine Management Protocol published in GN533 dated 18 June 2021 (hereafter referred to as “the Protocol”). These serve as the guiding documents for the development and implementation of EMPs. The rationale for developing an EMP for the iLovu Estuary is to provide measures for the protection of estuarine natural resources and ensure that the development and use of such resources is socially and economically justifiable and ecologically sustainable in accordance with the ICM Act. An EMP must also be consistent with the National, Provincial and Municipal Coastal Management Programmes (CMPs) requiring that these be taken into account as part of the process.

In 2015 the then Department of Environmental Affairs (DEA) developed guidelines for the development and implementation of EMPs to supplement the Protocol by providing clear procedures and guidance to the responsible management authority (RMA) who develop and coordinate the implementation of EMPs. The purpose of Estuarine Management Plans, as stated in the Protocol and development guidelines “*is to provide the mechanism that will enable coordination and alignment of management activities across sectors, underpinned by a shared vision – that is integrative estuarine management*.” (DEA, 2015).

Under the Provincial CMP it is a requirement that strategies be developed for the effective and co-operative management of the coastal zone, which is where estuaries are located. In the context of this EMP management therefore refers to control of human activities in order to allow

and maintain the natural functioning of the iLovu Estuary and the sustainable utilisation of resources provided by the estuary.

1.3 APPROACH TO EMP DEVELOPMENT

The EMP development process is done as a phased approach as illustrated in Figure 1.1. Informed by the Protocol, the process is organised into three main phases:

1.3.1 Scoping phase

This phase involves collating and evaluating available information about the estuary that can assist with establishing the status of the estuary and inform management planning. It comprises a situation assessment to reflect on the current status of estuarine management relating to the estuary, in collaboration with relevant authorities and other stakeholders including estuarine scientists. This phase aims to create an overview of the status quo of the estuary by assessing its ecological condition, socio-economic context, the ecosystem services provided by the system, major threats and pressures, opportunities and constraints as well as existing legal instruments and management initiatives. Such information is collated in the form of a Situation Assessment Report (SAR) which provides the context for the following two phases.

1.3.2 Objective Setting phase

This phase primarily comprises the preparation of the EMP considering ecological, social and economic aspects. The SAR provides the basis for setting a realistic and achievable vision and list of objectives for the estuary based on limits of acceptable change and carrying capacity, current/potential goods and services provided by the estuary, current/potential threats, opportunities and constraints that the socio-ecological system provides. The geographical boundaries of the estuary are confirmed and measures that will be required to either maintain the estuary in a desired condition or to improve its current condition towards achieving a desired condition, are identified. This is addressed through the development of management objectives and associated activities/actions.

1.3.3 Implementation phase

This comprises the execution and monitoring of the EMP by responsible agents in the spirit of cooperative governance. Regular monitoring, as set out in a monitoring plan, must be executed to gauge progress towards achieving the objectives of the EMP and a detailed EMP review needs to be conducted every five years in accordance with the Protocol. An adaptive management approach should be followed where new learning gained from monitoring results is continuously used to improve implementation of the EMP, at 5-yearly intervals.

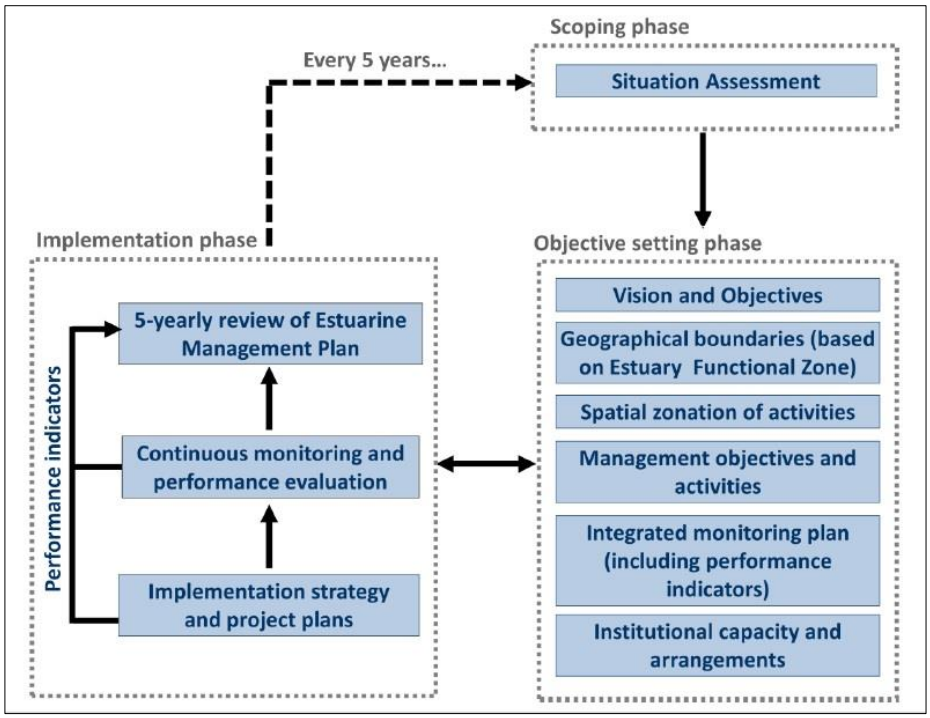

Figure 1.1. Framework for integrated estuarine management in South Africa (DEA, 2015).

As part of the Scoping Phase, a Situation Assessment Report (SAR) (Cyrus *et al.* 2021) in conjunction with several stakeholder meetings and workshops preceded this EMP to facilitate and inform the EMP development process in order to establish a platform to set management objectives and actions for the estuary to guide the sustainable use and management of estuarine resources. Table 1.1. shows the timeline of activities followed in terms of developing this draft EMP document.

Table 1.1. Timeline of activities and events followed in terms of developing the iLovu EMP.

DATE	ACTIVITY / EVENT	PURPOSE
14 May 2021	Convene first stakeholder meeting	To introduce the estuary management planning process and gauge concerns, expectations and specific issues relevant to the estuary, to identify sources of data and information required for the situation assessment and to identify specific issues relating to the estuary that should be assessed.
8 October 2021	Convene second stakeholder meeting	To present the key findings and summary of Situation Assessment and receive input from stakeholders and gain approval of the SAR.
18 November 2021	Convene first stakeholder workshop	Confirm the geographical boundaries of the estuary, identify important management issues to be addressed in the EMP and develop a shared Vision and Objectives for the estuary.
8 December 2021	Convene second stakeholder workshop	Address zonation of activities in the estuary and confirm and prioritise management objectives and associated activities/actions.
28 January 2022	Commence public participation process (PPP)	Advertise the SAR and Draft EMP to the public for a 30-day period for review and comment in terms of Chapter 6 (Part 5) the ICM Act.

2. SYNOPSIS OF SITUATION ASSESSMENT

2.1 CATCHMENT CHARACTERISTICS

Located within the province of KwaZulu Natal on the east coast of South Africa, the iLovu Estuary is approximately 37km south of central Durban at 30°51'27.2700" South and 30°6'19.5552" East and lies within the boundary of the eThekwini Metropolitan Municipality. The estuary is fed by quaternary catchment U70D and receives water from a catchment which is some 951 km^2. The estuary is 1.1km in length from the mouth, which leads into the Indian Ocean, to its head, and the total estuarine area is approximately 39.5ha.

2.2 GEOGRAPHICAL AND SOCIO-ECONOMIC CONTEXT

The iLovu Estuary is situated in the KZN South Coast between Winkelspruit and Illovo South in wards 97, 98 and 109 of the eThekwini Metropolitan Municipality. The municipal area comprises both metropolitan and rural settings which include a wide range of formal and informal land uses. Rural areas and communal lands form the majority of the municipality with commercial agriculture, notably sugarcane, being the primary crop under cultivation across both the municipality and the province. The Illovo area itself is currently still driven by the agricultural sector where sugarcane is the primary land use activity along both the north and south banks of the iLovu River including parcels of land bordering the estuary. There were approximately 27 108 people residing in the Illovo South and Illovo North areas in 2013 with a likely increase to the present date by as much as 30% if comparing the average increase over a ~10-year period in terms of the overall national census figures. The eThekwini South Region is considered an important urban development node and corridor and a collective proposal to shift largely from agricultural land use towards other sectors of development, ultimately forming part of a Special Economic Zone (SEZ), is currently underway. In terms of Gross Domestic Product, the secondary sector industry in the eThekwini South Region, particularly the manufacture of transport equipment, contributes more to the local economy in comparison to the same industry in the other municipal regions. Owing to an increasing population across the region, there is an overall demand for enhanced employment opportunities and social facilities in the Illovo area. In addition, the Covid-19 pandemic has further constrained the local socio-economy reducing the employment rate resulting in increased harvesting pressures on the estuary.

2.3 OVERVIEW OF THE ECOLOGICAL FUNCTION AND STATE OF THE ESTUARY

The 2018 National Biodiversity Assessment (NBA) defined the iLovu estuary as a “Large Temporarily Closed Estuary” which is one in which the mouth of the system is open to the sea more the 50% of the time. Records of the mouth condition from May 1978 to December 1982 indicated that, apart from the drought years of 1980 and 1982, the mouth of the iLovu Estuary was open some 95% of the time in 1979, 78% in 1981 against 45% in 1980 and 63% in 1982. No

new data is available to suggest that in recent years it has deviated from this pattern and indications are that the mouth of the iLovu Estuary is open for some 77% of the time.

No fieldwork based Ecological Reserve Determination or Ecological Water Requirement (EWR) has to date been undertaken for the iLovu Estuary. However, the estuary been assessed during a classification of Water Resources and Resource Quality Objectives (RQO) study for the Mvoti to Umzimkulu Water Management Area as well as for the 2011 and 2018 National Biodiversity Assessment (NBA). The iLovu Estuary's Present Ecological State (PES) is listed as "C" (Moderately Modified) with a Recommended Ecological Category (REC) of "A/B or BAS" (Best Attainable State). The Department of Water Affairs have made recommendations regarding the extent of protection required for the iLovu Estuary based on the determined PES and REC for the 2011 NBA and determined that there should be Partial Protection of the estuary covering 50% of the Undeveloped Margin.

It has also been gazetted that the Target Ecological Category (TEC) for the iLovu Estuary should be a "B/C" (Government Gazette 41306, Notice No. 1386 of 8 December 2017). This category represents an overall health score that ranges between roughly 67-83% of pristine estuarine health when the current state is between 40-60%. Achieving this mandated Ecological Category (EC) will require the improvement of several of the individual components of the estuarine system.

A previous assessment of pressures on the iLovu Estuary determined that Flow, Habitat Loss and Fishing Effort issues are causing the most pressure on the system, whilst several other pressures are rated as being Medium. Sand mining has also been identified as a major pressure point impacting on both the estuary as well as the coastal zone. A disturbing factor is that the Mean Annual Runoff (MAR) of the system has been reduced by some 30.5%. The iLovu Estuary is one of 122 national priority estuaries out of the 300 along our coastline that remains classified as a priority estuary in terms of biodiversity according to the 2018 National Biodiversity Assessment.

Water quality data is limited with reports from 1994 and 2000 indicating poor water quality in the system, whilst a 2008 report noted an improvement in overall water quality during 2007-2008. No records of metal or organic compound contamination in the iLovu Estuary were found. However, as noted in section 5.4, some microplastic pollution was reported in the system, albeit at much lower levels than in the estuaries around Durban. In terms of nutrients, elevated Chlorophyll-a levels (as high as 32 $mg.m^{-3}$) and phytoplankton blooms have been recorded under low flow conditions. These are probably due to lower freshwater flows in winter, reducing the flushing of accumulated nutrients and causing longer retention times. Casual observations in the early 1990s revealed periodic phytoplankton blooms and blue green algae scums on exposed sand/mud banks, suggesting eutrophication due, in part, to nutrient enrichment from return flows from sugar

cane fields. Sewage contaminated stormwater and accidental discharges from the sugar mill 3.5km up the estuary may also have been potential sources of nutrient enrichment. In addition, the microalgal component for the iLovu Estuary has been noted to be evaluated.

Whilst accurate figures are not available it would appear from statements on recent reports and consultation of aerial photo that the bulk of the iLovu floodplain has been lost to habitat transformation, with the majority of the floodplain being altered by commercial sugarcane farming. In addition, a business park has been developed on the floodplain. Smaller estuaries, like the iLovu Estuary, which experience pollution pressure and eutrophication are vulnerable to the spread of invasive alien plant species and the diversity and abundance of invasive alien plants within the estuary must have increased over time.

Information on the macrobenthos of the iLovu Estuary is limited and dated. The most recent data comes from sampling of the lower, middle and upper reaches during August 2007 (low flow conditions) and February 2008 (high flow conditions). Species richness (number of taxa) was found to generally be low, with a total of 20 taxa recorded over the entire study period. The macrobenthic community was dominated in terms of species richness by Polychaetes (5 taxa) and Amphipoda (4 taxa). In terms of abundance, the benthos was dominated by the tanaid *Halmyrapseudes cooperi*, which accounted for 46% of all organisms recorded in the system. This abundant species accounted for 44% and 58% of all organisms in the lower and middle reaches under low flow conditions, respectively. It was concluded that, being a predominantly open system with a strong marine and tidal influence, the estuary was expected to support a greater diversity and abundance than what was recorded during the 2007-2008 survey. The ecological state of the macrobenthic community was rated as fair. Given the ecological importance of the macrobenthic community as a pivotal component of the biotic composition in the estuary, it is imperative that a more detailed and up-to-date assessment of the state of the macrobenthic community be included in future biomonitoring programs.

There has been intermittent sampling of the fish community, but it was last undertaken in 2007 again indicating the need for updated data from the system. The bulk of species present represent juvenile marine species which utilize the estuary as a nursery ground. Once they reach maturity, they leave the system and do not return. Included in this group are a number of Estuarine Dependant species which require an estuarine environment to complete their life cycle. Catch and species composition has been variable. It is noteworthy that in 1984 three *Pomadasys* species, viz. *P. hasta*, *P. multimaculatum* and *P. commersonnii* (55 individuals) made up 11% of the catch, while in the late 1990's sampling yielded only four individuals of *P. commersonnii* making up less than 1% of the catch and in 2006 only 18 of the latter were netted also contributed less than 1% of the catch. The proportion increased slightly in 2007/2008 to 4%. These are benthic feeding species and the low numbers after 2000 possibly reflect changes in the

zoobenthos. It is also likely due to the loss of estuarine habitat, linked to the reduced saline intrusion (mouth condition) and declines in the water quality within the system. There is even less data on the avifauna of the iLovu Estuary however the four know counts have recorded 39 species including two IUCN listed Red Data species, the African Finfoot which is regarded as Vulnerable, and the Grey-crowned Crane is listed as Endangered. More recent and detailed data on the avifauna is required.

The Present Ecological State (PES) as determined by DWA (2013) is a Category "**C**" (Table 2.1) which is defined as **Moderately Modified:** A loss and change of the natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

According to DWA (2015a, b) and van Niekerk *et al*. (2019) the Recommended Ecological Category (REC) for the estuary is an "**A/B**" or "**BAS**". An "**A/B**" would be somewhere between an "**A**" = **Unmodified, approximates Natural Condition:** The natural abiotic processes should not be modified. The characteristic of the resources should be determined by unmodified natural disturbance regimes. There should be no human induced risks to the abiotic and biotic processes and function and a **"B**" = **Near natural with few Modifications:** A small change in the natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged. On the other hand, a "**BAS**" refers to a Best Attainable State.

Table 2.1. Ecological categories associated with individual components of the estuary based on a desktop assessment by DWA (2013).

DWA (2013) Condition Status			
Present Ecological State (2013)	D	Microalgae	C
Hydrology	D	Macrophytes	D
Hydrodynamics	C	Invertebrates	C
Water Quality	C	Fish	C
Physical habitat	D	Birds	C
Habitat Score	D	Biological Score	C
		Present Ecological State	C

2.4 ECOSYSTEM SERVICES

The 2003 Millennium Ecosystem Assessment defines ecosystem services as "the benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control), cultural services (such as recreational benefits), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth." The list of ecosystem services provided by the iLovu Estuary are varied and range from nursery function (habitats and refugia) for estuary dependent marine species, both

vertebrate and invertebrate, provision of raw materials, tourism and recreation, carbon sequestration, breakdown of waste and detoxifying of pollutants (water treatment) and the export of organisms and nutrients to the marine environment as well as some limited tourism and recreational value. The iLovu Estuary Situation Assessment Report (SAR) provides more information on the various types and categories of ecosystem services.

2.5 THREATS, IMPACTS AND MANAGEMENT ISSUES

These revolve around several issues including the presence of bridges and causeways, sedimentation within the estuary, sand mining, micro plastics, alteration of the floodplain and invasive alien plants, and water quality and wastewater discharge. The estuary has been significantly modified and the ecological functioning and provision of ecosystem services has declined. The 2018 National Biodiversity Assessment rated items related to flow modification, habitat loss and fishing effort as High, causing the most pressure on the system whilst several other components are rated as causing Medium pressure. The presence of sand mining and the occurrence of unauthorised artificial breaching of the mouth are also impacting on the system, particularly the former. Additionally, the physical impacts acting on the system include the proliferation in the estuary riparian zone and floodplain of sugar cultivation and invasive alien plants and significantly the poor water quality within the estuary and impacts of wastewater discharges. The Department of Water Affairs also list significant flow modification, poor water quality, habitat destruction as being the major causes of pressure on the system.

2.6 OPPORTUNITIES AND CONSTRAINTS

A SWOT analysis identified numerous opportunities (including strengths) and constraints (threats and weaknesses) related to the system that could be used in the planning process for developing the Estuary Management Plan. The positive factors are grouped together as ‘opportunities’ (external elements) and ‘strengths’ (usually internal elements). Constraints are grouped as ‘threats’ (external elements) and ‘weaknesses’ (generally internal elements that cannot be modified in the short-term). Information on the opportunities and constraints is documented in the iLovu Estuary SAR and derived from these are a list of management issues which are included as Appendix 1 of this document.

2.7 MAJOR INFORMATION GAPS

There has been very little research or data collection conducted in the system over the last 10 years. Spatial and temporal replication of information is valuable for enabling researchers to map the changes that occur within a system over time and how the system is responding to human activities. A list of information identified as being needed to improve on future Ecological Water Reserves studies for the iLovu Estuary has been provided in the Situation Assessment Report for the estuary.

3. GEOGRAPHICAL BOUNDARIES OF ESTUARY

The promotion of wise use of estuarine resources and the protection and conservation of estuarine biodiversity requires not only the protection of estuarine habitat and biota, but also the protection of the physical processes/functions that sustain ecological and evolutionary processes. Therefore, to ensure the present and future health of estuaries, it is necessary to define the 'space' within which estuaries function over longer time scales – these areas are known as the 'Estuarine Functional Zone' (EFZ) (van Niekerk *et al.* 2012, 2013).

The National Biodiversity Assessment (van Niekerk *et al.* 2019) defines the EFZ as "*the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes and habitats necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e. sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes, and changes due to coastal storms. It also encompasses all the multiple ecotones of floodplain and estuarine vegetation that contribute detritus (food source) and provide refuge from strong currents during high flow events.*"

The iLovu Estuary's EFZ was initially delineated by van Niekerk and Turpie (2012), however based on recent information the EFZ was re-defined in the recent 2018 NBA (van Niekerk *et al*. 2019) and moved to what is essentially the 10m contour, this can be seen in Figure 3.1. This area is based on the premise that currently the majority of estuarine functions will be protected within this area and if 50% of that area were designated as conservation area this would go a long way to protecting the estuary, its ecological functioning and biodiversity and ensuring that it will remain a priority estuary of National Importance within the 'Core Set' of priority estuaries identified to maintain South African Biodiversity.

The EFZ stretches to a point 6 km upstream which is the current head of the estuary. The lateral boundaries of the estuary are demarcated largely by the 10m amsl contour. The estuary mouth is the downstream boundary of an estuary. However, to allow for the highly dynamic nature of estuary inlets on the eastern seaboard an area known as the 'Estuarine Shore' has been introduced in the NBA 2018 to reflect the dynamic nature of the interface between estuaries and the coast (Harris *et al.* 2019). The estuarine shore in the context of the EFZ is shown more clearly in Figure 3.2 as the light blue map shading covering the beach, shoreline and a section of the marine environment.

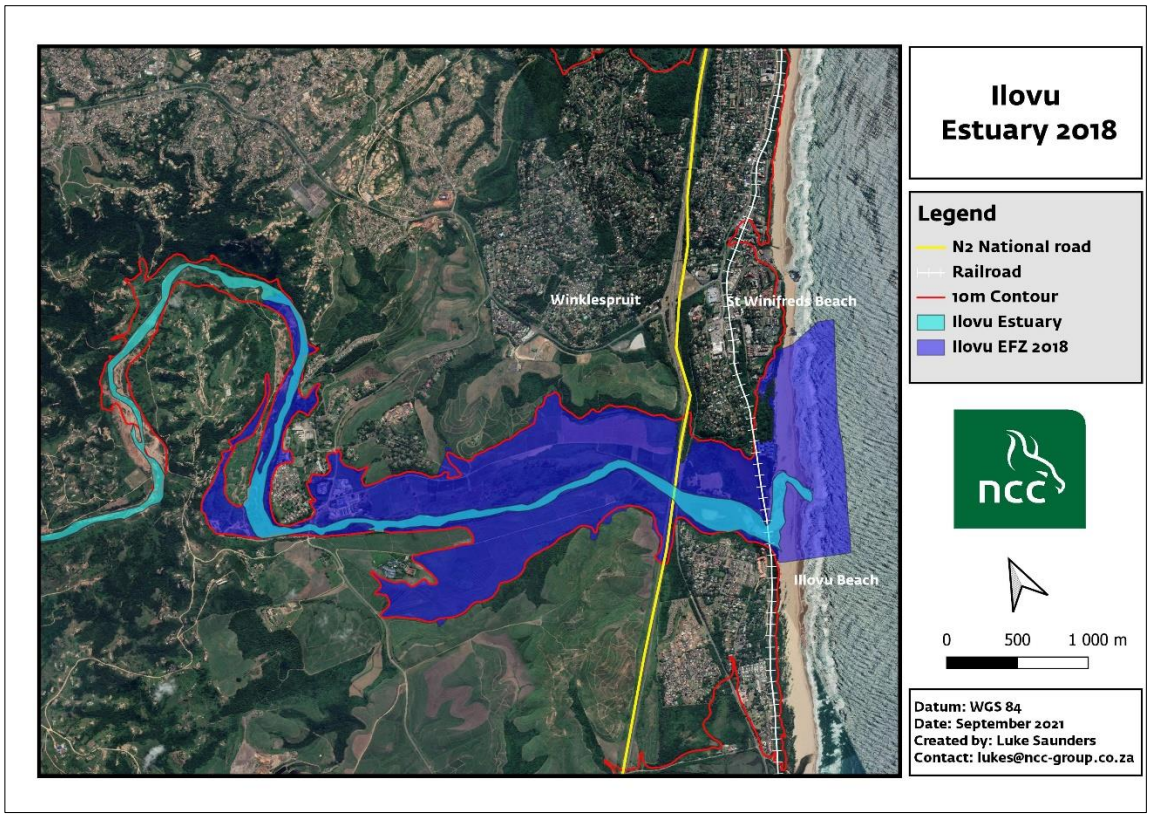

Figure 3.1. The iLovu Estuary and EFZ showing the extent of the 10m contour (Data source: Coast KZN). The 2016 water surface is shown in light blue.

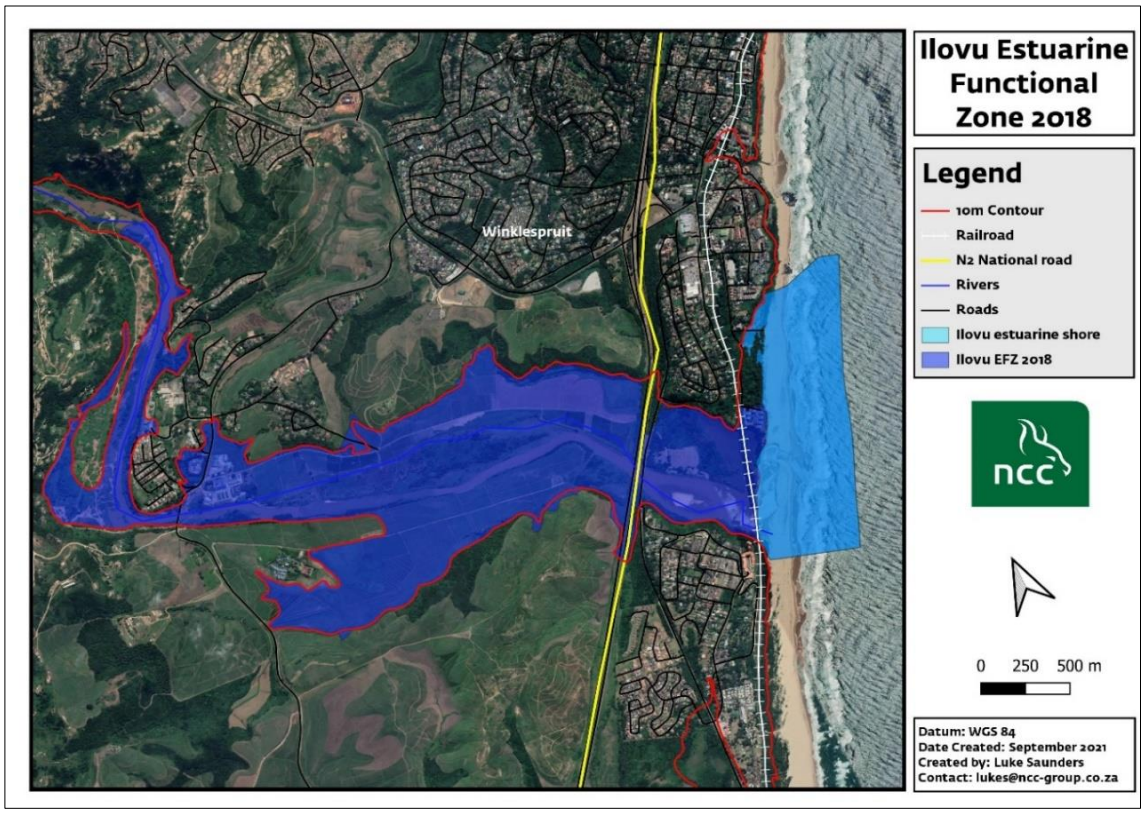

Figure 3.2. Geographical boundary of the iLovu Estuary represented as the EFZ as defined in the 2018 NBA.

The extent of the current EFZ also represents ‘climate change accommodation space’ as it allows for estuaries to retreat under sea level rise scenarios of between +0.5 and +2.0m projected for South Africa in the short to medium term (MER, 2019b). However, the Oceanographic Research Institute (ORI) are assisting KZN EDTEA with planning and developing coastal management lines (CMLs) in relation to Sea Level Rise (SLR) and climate change scenarios (present day to worst case scenarios for the next century) using the Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways (RCP). Should their preliminary findings (preliminary at this stage) be accepted by KZN EDTEA then it is highly likely that the EFZ will be extended well beyond the 10m contour in some places. The current estuarine delineations are available to view on the Coast KZN website (http://www.coastkzn.co.za) and several maps have been included under Chapter 6 of this document.

4. LOCAL VISION AND OBJECTIVES

4.1. VISION

The vision of an estuary should reflect the three pillars of sustainable development (ecological, economic and social aspects) whilst recognising the limits that estuarine resources place on development (DEA, 2015). A vision typically provides a statement which outlines in broad terms the direction in which the management plan for the estuary is aiming.

A vision should answer the following question:

'How do you (the stakeholders) envisage the estuarine environment (the "ecosystem") should look like in the future (considering the ecological, heritage and socio-economic environment)?'

In terms of the local vision for the iLovu Estuary, it must give effect to the strategic vision of the National Estuarine Management Protocol (Government Gazette 36432. No 533 of 18 June 2021) (the 'Protocol'). The local vision should therefore ensure that management interventions will suit the complex nature of the estuary. In order to do this a number of components that could improve the ecological, biophysical and socio-economic aspects of the estuary were identified and taken into account.

The proposed vision of the iLovu Estuary is as follows:

"To, in an integrated and co-operative way, improve the health of the iLovu Estuary, conserve the system and provide a functional, sustainable and safe ecosystem for all users".

4.2 OBJECTIVES

Whilst the vision provides a common goal or ideal for the local authorities and stakeholders to strive towards achieving a determined desired future state for the estuary, the objectives on the other hand help answer the question as to how one will know if and when the vision is being achieved. In terms of the Protocol, objectives should generally be qualitative statements of the values defined in the local vision and should consider the following aspects:

- The conservation and utilisation of living resources and non-living resources;
- Social issues;
- Management of water quality and quantity;

- Land use and infrastructure planning and development;
- Climate change;
- Education and awareness; and
- Compliance and enforcement.

In order to achieve the strategic objectives as guided by the National Estuarine Management Protocol (**Table 4.1**), the proposed primary objectives for the iLovu Estuary were aligned with the Protocol and are illustrated in **Figure 4.1**. **Table 4.2** describes in more detail the proposed primary objectives for the iLovu Estuary.

Table 4.1. Strategic objectives for effective integrated management of estuaries in South Africa.

No.	Objective
1	To conserve, manage and enhance sustainable economic and social use without compromising the ecological integrity and functioning of estuarine ecosystems.
2	To maintain and/or restore the ecological integrity of South African estuaries by ensuring that the ecological interactions between adjacent estuaries; between estuaries and their catchments; and between estuaries and other ecosystems, are maintained.
3	To manage estuaries co-operatively through all spheres of government; and to engage the private sector / entities and civil society in estuarine management.
4	To protect a representative sample of estuaries (such protection could range from partial protection to full protection) in order to achieve overall estuarine biodiversity targets as determined by the 2018 National Biodiversity Assessment and the subsequent updates.
5	To promote awareness, education and training that relate to the importance, value and management of South African estuaries.
6	To minimise the potential detrimental impacts of predicted climate change through a precautionary approach to development in and around estuaries and with regard to the utilisation of estuarine habitat and resources.

(National Estuarine Management Protocol, 2021).

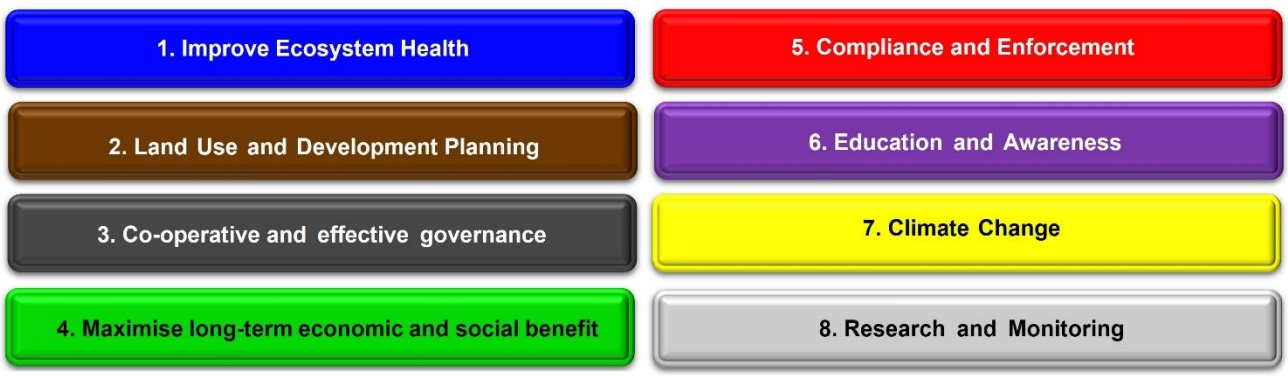

Figure 4.1. Summary diagram of proposed primary objectives for the iLovu Estuary.

Table 4.2. Proposed primary objectives for the iLovu Estuary.

Objective and Description	Performance Indicator
1. Improve Ecosystem Health	
1.1. Conservation of biodiversity Improvement of the integrity of the estuary from a Present Ecological State (PES) of a C (Moderately Modified) to a Recommended Ecological Category (REC) of "A/B or BAS" (Best Attainable State). This can be conducted by medium-term improvement and long-term maintenance of habitats, species community structure and functionality. This will allow for the estuary to continue functioning at an improved PES.	i. Identified sensitive habitats and species that reside in such habitats are protected. ii. Improvement of the integrity of the estuary and nearby surrounding watercourses. iii. Development and implementation of rehabilitation and monitoring programmes. iv. Development and implementation of an Alien Invasive Plant Management Plan which will be an on-going practice.
1.2. Improvement of water quality The estuarine integrity and functionality are improved through the implementation and monitoring of the Resource Quality Objectives (RQOs) outlined in the Reserve Determination for water resources in the Mvoti to Umzimkulu WMA (DWS, 2015), with due consideration for public health.	i. Management of the catchment activities with the assistance from the relevant key stakeholders from the municipal and provincial coastal committee. ii. Ensure that any discharge of treated effluent is within license specifications detrimental to the ecology of the estuary. iii. Strategic water quality monitoring points to be established within the estuary.
2. Land Use and Development Planning The current health status and functionality of the estuarine environment are established (NBA, 2018). Furthermore, the EFZ and 10m contour have been determined. It must be noted that residential development and municipal roads currently exist within the EFZ and 10m contour which are susceptible to flooding.	i. The municipality's spatial zonation plan must be embraced and enforced through the relevant regulations. ii. Current land-use and future land-use activities must not cause degradation and further disturbance to estuary. iii. The relevant investment in effective flood control measures. iv. Future development on the estuary is constrained to ensure that it does not compromise the ecological value of the system or become a potential flood hazard.

3. Co-operative and effective governance The iLovu Estuary's resources should be used in an ecological responsible manner through effective and cooperative management.	i. As the appropriate regulations related to the EMP have been gazetted, the EMP should be incorporated into the municipal spatial zonation plans with effective implementation of these plans being conducted by the responsible parties. ii. Effective co-operative governance through a dedicated coastal committee. iii. Roles and responsibilities of participating parties should be defined and accepted via a Memorandum of Agreement (MO). iv. The authorities and participating parties that are mandated should be well capacitated to ensure responsibilities are able to be fulfilled. v. Regular meetings should be conducted by the Responsible Management Authority (RMA) with the relevant stakeholders to ensure implementation of the EMP.
4. Maximise long-term economic and social benefit Provide a quality experience for visitors to utilise the estuary whilst sufficiently managing visitors in a manner that ensures that they do not compromise the resource that attracted them in the first place. All activities conducted within the estuary must be in a sustainable manner for the livelihoods of current and future generations. Creation of additional opportunities to gain from increased tourism (e.g. providing services such as accommodation).	i. Adequate visitor facilities (ablutions, parking, etc.) sufficient to meet visitor expectations and requirements are developed. ii. Facilities incorporating new business opportunities for the local communities to benefit from increased tourism. iii. Achievable and compatible socio- economic opportunities, e.g. recreational activities that will create tourism market and job creation. iv. IAP eradication programme providing both employment and education for local communities.
5. Compliance and Enforcement Establish a coordinated compliance and enforcement programme among the various mandated authorities of the estuary.	i. Effective compliance and enforcement will result in better protection of the estuary benefiting all users of the estuary in a more fair and equitable manner. ii. Sandmining activities should be investigated/ reviewed and any illegal mining to be halted to reduce the negative impacts on the ecosystem and recreational activities within the estuary and associated beach environment.

6. Education and Awareness The iLovu Estuary's importance as a dynamic estuarine environment can be established through effective community awareness raising and education.	i. The development and implementation of an awareness programme to make available to all users of the estuary on an ongoing basis. ii. The erection of informative signage at strategic points and regular distribution of information of the importance of the estuary to all users.
7. Climate Change The potential impacts that climate change can cause could be reduced by the following: • The planning of infrastructure around the estuary and the associated watercourses and wetlands should be conducted as a long-term precautionary approach taking into consideration SLR scenarios. • The activities within the catchment areas should be conducted in a sustainable manner as guided by principles in the National Environmental Management: Biodiversity Act (NEM:BA), which will reduce impacts on the estuary.	i. The climate change impacts on the iLovu Estuary to be determined and documented (e.g., sea level rise). ii. Sensitive environments (dune; floodplains, riparian areas, etc.) are demarcated as restricted areas. iii. Restrict/control future development within the EFZ.
8. Research and Monitoring The RMA for the estuary is the provincial department, KZN EDTEA who will steer this objective in conjunction with the provincial coastal committee and municipality and other relevant spheres of government i.e., departments responsible for tertiary education, science, technology and innovation, as well as agriculture, forestry, water affairs, mining, forestry, fisheries and environmental affairs.	i. Undertake research to confirm the Estuarine Health Index (EHI) and Present Ecological State (PES), to support Primary Objective 1 above. ii. Based on (i) above, identify issues that could be eliminated or improved upon to improve the EHI and PES, to support Primary Objective 1 above. iii. The development and implementation of research and monitoring programmes for identified problem areas. iv. Potential development of a Mouth Management Plan for exceptional emergencies.

5. MANAGEMENT OBJECTIVES AND ASSOCIATED ACTIVITIES

5.1. MANAGEMENT OBJECTIVES

The proposed management objectives for the estuary have been developed based on the opportunities and constraints identified during the Situation Assessment Report (See **Appendix 1**), the strategic objectives of the Protocol as well as the proposed local vision and primary objectives for the estuary. Detailed management objectives for each proposed primary objective identified, refined in consultation with stakeholders, are described below:

5.1.1 Improve Ecosystem Health

5.1.1.1 *Conservation of Biodiversity*

- The indigenous flora, fauna and other sensitive habitats within the estuary (floodplain wetland) are conserved in order to improve the overall integrity and functionality of the system.
- All degraded areas within the estuary and EFZ are rehabilitated and areas that have extensive amounts of IAPs are maintained in a manner that IAPs are removed and replaced with indigenous vegetation native to that area.
- Ecologically important and sensitive wetland areas adjoining / feeding into the estuary to be rehabilitated and set aside as 'open space' to maintain ecological connectivity between the terrestrial and aquatic (riverine, estuarine and marine) components via a system of ecological corridors and/or buffers.
- Ensure the extent of the undeveloped margin of the estuary does not fall below 50%.

5.1.1.2 *Improvement of Water Quality*

- Water quality can be improved by reducing and/or treating any wastewater prior to discharge into the estuary, effective catchment management and improved agricultural practice upstream of and adjacent to the estuary.
- An improvement in water quality to within acceptable limits for estuaries will aid in improving the overall integrity and functionality of the estuary.
- In-situ and catchment related pollution to the estuary is minimised.

5.1.2. Land Use and Development Planning

- Infrastructural development, current and future land use practices will follow the zonation plan in terms of policy zones, management lines and buffers. Any future developments

proposed or planned within the EFZ must undergo the regulatory authorisation and/or licensing processes.

5.1.3 Co-operative and effective governance

- The effective execution of the EMP responsibilities and activities through the RMA, which incorporates existing institutional management strategies and structures.
- The Provincial and Municipal coastal committees shall serve as the forums for monitoring the implementation of EMPs and reporting of progress and achievements related to estuarine management.
- Any existing and/or planned individual estuary forums for are regarded as informal additional advisory bodies for facilitating the implementation of the project plans identified in the EMPs and to foster continuous stakeholder engagement.
- The RMA will secure funding from various governmental and other sources if possible, for the management and monitoring of the estuary.
- Establishment of a voluntary Estuary Advisory Forum (EAF) to assist with estuarine management.

5.1.4 Maximise long-term economic and social benefit

- Enable necessary and sustainable socio-economic development.
- Promote community-based programmes to assist with local employment as well as serve to improve individual knowledge e.g., IAP and waste eradication programmes and monitoring plans.

5.1.5 Compliance and Enforcement

- Effective compliance and enforcement will better protect the estuary and benefit the users of the estuary in a more fair and sustainable way.

5.1.6 Education and awareness

- Efforts should be made to enhance the awareness of local people utilising the estuary of its biodiversity value and importance and its socio-economic value and importance.

5.1.7 Climate Change

- Infrastructure and developing in close proximity to the coastline, estuary and EFZ will follow a preventative approach and adhere to CMLs, buffers and regulations in order to minimise the risk of climate change impacts.

5.1.8 Research and monitoring

- The identification and implementation of research requirements and development of required monitoring programmes to assist the RMA to achieve improved ecosystem health as well as monitor RQOs.
- Other research as deemed appropriate by the RMA in consultation with the coastal committees and relevant specialists.

5.2. MANAGEMENT ACTIONS (ACTIVITIES)

A range of management activities/actions have been identified in order to facilitate the achievement of the operational specifications related to each of the respective management objectives. All proposed management actions under the framework of the eight primary objectives (See Figure 4.1) are shown in a series of tables below as the remainder of this chapter. For purposes of simplifying the various actions they have been broken down into sub-actions with associated deliverables/indicators. Relevant legislation has been included as well as the various agents responsible for implementing the actions.

Priorities for actions to take by management were further refined via collaboration with stakeholders during the workshops. Priorities (High, Medium or Low) were subdivided into a 'time' and 'importance' component and were assigned arbitrary rank scores (1, 2, or 3) after which a 'combined' priority was calculated for the respective actions (Refer to tables in Appendix 2 for the methodology).

To facilitate in the attainment of the management objectives, any additional and more specific actions plans which are developed by the responsible agents in addition to and beyond what is provided in this EMP, should include the following:

- A prioritised list of management actions required including deliverables and indicators;
- Related legal, policy and / or best practice requirements of relevance to management actions in this EMP;
- Priority status to each of the actions to guide subsequent management decisions and;
- A basic work plan identifying when each action should be initiated and by whom.

In accordance with any threats or gaps identified through the ongoing monitoring, as is proposed, it may be required from time to time (such as every five years in terms of the Protocol) for the addition of management actions and removal of actions which have already been taken and achieved. This will largely be driven by capacity and available budget.

5.2.1 IMPROVE ECOSYSTEM HEALTH

5.2.1.1. Conservation of Biodiversity

Management Objective:

The targets for ecosystem functionality and integrity, is to improve the integrity from a C to a B/C or 'BAS', which will also improve the functionality of the estuary. In addition, the on-going rehabilitation and long-term management of wetland/estuarine habitats must be conducted to maintain an integrity of a B/C and to potentially further improve the health/integrity of the system.

Table 5.2.1.1. Management Actions for Conservation of Biodiversity.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Conservation of flora, fauna and surrounding sensitive habitats				
i. Define areas of critical / important living resources and habitat associated within the estuary (e.g. extended wetland and riparian habitats) and incorporate these into the EFZ.	ICMA; NEMA; NWA; NEMBA	• Critically sensitive areas to be mapped. • Identify biodiversity hotspots and sensitive species habitats.	High	EDTEA; DALRRD
ii. Ensure the reduction of exploitation of marine resources by monitoring and validation of fishing licenses.	ICMA; MLRA (Sec 14 & 43); NEMBA (Chap 4, Part 2), NEMPAA (Chap 3, Sec 28)	• Enforce stringent catch and release policies. and monitoring programme to be implemented. • Subsistence fishing should be allowed (via permits/licenses) as it is generally not exploitative.	Medium	DFFE: O&C; EDTEA; eThekwini Municipality (EM)
iii. Terminate illegal sand mining activities.	MPRDA	• Number of illegal activities terminated. • Number of prosecutions.	High	DMRE

Action 2: Rehabilitation of degraded areas, removal of alien invasive vegetation and re-vegetation with indigenous vegetation				
i. Develop a rehabilitation programme, in phases as plans, which prioritises areas that have been impacted negatively by anthropogenic pressures e.g. unauthorised sand mined areas, areas where vegetation has been cleared, areas of erosion / instability, etc. The programme must incorporate expansion to cover the entire EFZ, together with continuous monitoring, inspection and follow-up eradication.	ICMA; NEMA; NEMBA	• Rehabilitated areas detailed and prioritised in series of rehabilitation plans. • Rehabilitation methods identified and costed. • Monitoring and Maintenance on-going to ensure rehabilitation is being achieved.	Medium	EDTEA; DMRE; eThekwini Municipality
ii. Clearance of alien invasive vegetation within and around the EFZ.	NWA (Section 21); NEMBA Chapter 5, Part 2); NEMA; CARA (Sec 6 & 8)	• Records from alien clearing programmes (hectares of alien vegetation cleared). • Results (reports) of on-going monitoring.	Medium	EDTEA; EM; DALRRD; SANBI
iii. Secure funding for the rehabilitation work required.	ICMA; NEMA; NEMBA; CARA	• Secured funding. • Financial plan developed with 5-year forecast.	Medium	EDTEA; EM; DFFE, DALRRD

5.2.1.2. Improvement of Water Quality

Management Objective:

Estuarine functionality and structure is conserved and improved through the execution and monitoring of the Resource Quality Objectives (RQOs) which also take into consideration public health.

Table 5.2.1.2. Management Actions for Improvement of Water Quality.

Management Action	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Improvement of water quality to improve the integrity and functionality of the estuary				
i. Implement a programme for monitoring water quality in the iLovu Estuary on a regular (quarterly) basis, results of which are available to all stakeholders on a real time basis.	NWA	• Conducting of monitoring at identified sites (upper, mid and lower estuarine regions). • Quarterly reports.	Medium	DWS, eThekwini Municipality
ii. Improve stormwater management and run-off as part of urban planning in the catchment including around the EFZ.	NEMA, NWA	• Promote the uptake of appropriate stormwater discharge methods, water quality standards and the integration of SUDS (Sustainable Urban Drainage Systems). • Implementation of appropriate buffers related to the EFZ. • Improved water quality (as per the results in reports under action 1(i) above.	Medium	eThekwini Municipality, EDTEA
Action 2: Reduction of pollution in the estuary and surrounding catchment areas				
i. Identify, trace and investigate types and sources of pollution, contamination and erosion.	NWA, NEMA	• Conduct routine assessments to identify sources and types of pollution. • Remedy erosion and pollution entering into the estuary using appropriate method(s).	High	DWS

ii. Identify and assess the effect of any agricultural and/or industrial effluent and wastewater discharges (treated and untreated) released into estuary from the upper reaches of the catchment e.g. industrial effluent, sewage systems (conservancy tanks; septic tanks; pit latrines) etc. Any negative deviations from effluent quality must be addressed.	NWA, NEMA	• Identification of any wastewater discharges coming into the estuary. • Determine if facilities are licensed to discharge wastewater. • Regularly review conditions of licenses to verify if facilities (licensees) are adhering to such conditions.	High	DWS, EDTEA

5.2.2 LAND USE PLANNING AND DEVELOPMENT

Management Objective:

Establish the current status and values of the various estuarine areas to inform future infrastructure development in the context of current land use.

Table 5.2.2. Management Actions for Planning of future infrastructure and current land use.

Management Action	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Prevent further encroachment of development within the Estuarine Function Zone				
i. Finalise and adopt a zonation plan for the iLovu Estuary including the position of the coastal protection zone (CPZ) and coastal management lines (CMLs).	ICMA; MSA 2000	• Final zonation plan ratified and adopted by all stakeholders.	Medium	EDTEA, eThekwini Municipality, All relevant authorities
ii. Incorporate the CMLs into the Integrated Development Plan (IDP), Spatial Development Framework (SDF) and the municipal Corporate GIS.	ICMA, SPLUMA	• IDP, SDF and Corporate GIS contain the CMLs and appropriate buffers.	Medium	eThekwini Municipality
iii. The development requirements and restrictions are incorporated into the IDP, SDF and municipal Corporate GIS.	ICMA, SPLUMA	• The IDP and SDF incorporates estuarine specific developments.	Medium	eThekwini Municipality
iv. Estuarine boundaries and associated buffer zones for the estuary to be clearly defined and used to inform land use and future development applications.	ICMA, SPLUMA	• The geographical boundaries and appropriate buffers related to the EFZ are incorporated into all necessary planning documentation and guidelines.	High	EDTEA, eThekwini Municipality

Action 2: The control of activities with the estuary, EFZ and surrounding landscape				
i. Determine if cadastral boundaries of surrounding properties have an influence on the management of the estuary.	Deeds Registries Act	• Number of applicable properties. • Identification of landowners. • Landowner engagement to disseminate information regarding the management of the estuary.	Medium	eThekwini Municipality, EDTEA
ii. Any future development will be in line with the agreed zonation plan for the estuary, IDP, SDF, by-laws and deeds restrictions.	ICMA; NEMA	• Development within the estuary and EFZ will not be permitted without authorisation. • Reduction of habitat loss, degradation and inappropriate activities within the estuary.	High	EDTEA, eThekwini Municipality
iii. Any new development must go through an Environmental Impact Assessment Process through NEMA and special planning regulation as per the by-laws of the municipality.	NEMA; ICMA	• Engagement with relevant authorities during the EIA process. • Inspections undertaken by relevant authorities, where required. • Good legal and environmental compliance of any new developments. • No encroachment to within buffer zones / sensitive areas.	Low	EDTEA
iv. Environmental Authorisation (EA) to be obtained before any development or management strategy that requires EA.	NEMA	• Engagement with the public and relevant authorities. • EA to be obtained for developments requiring an EA.	Low	EDTEA

5.2.3. CO-OPERATIVE AND EFFECTIVE GOVERNANCE

Management Objective:

The utilisation of the estuary and its resources are conducted in a sustainable manner through effective co-operative governance.

Table 5.2.3. Management Actions for Co-operative and Effective Governance.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Effective implementation of the EMP				
i. Establishment of a management committee inclusive of the RMA, other spheres government, relevant stakeholders and specialists for the implementation of the EMP.	ICMA	• Municipal coastal committee formally constituted and membership re-advertised. • Terms of reference for co-operative governance arrangements signed by all strategic partners.	Medium	eThekwini Municipality, EDTEA, all strategic stakeholders
ii. Establish a competent network of EMP and policy monitoring to ensure that both proactive and consequent steps are taken in support of the RMA's duties and objectives.	ICMA; MLRA	• Signed letters of commitment from all agencies to be involved with the management of iLovu Estuary. • Appointment of specialists to add to the network, as and when required.	Medium	EDTEA, eThekwini Municipality and all relevant departments
iii. RMA in conjunction with coastal committees to engage all stakeholders to identify opportunities and draft operational plans / frameworks to ensure EMP implementation.	ICMA	• Monitor and report on progress (bi-annually) with regards to initiation of new activities and their alignment with the EMP and operational plans.	Medium	EDTEA, eThekwini Municipality, all strategic stakeholders

Action 2: Secure Funding				
Government departments will source provisions for the short, medium and long term expenditure to create and fill posts, for the effective monitoring and management of the estuary.	ICMA; NWA	• Formal feedback from authorities on mandated activities. • Budget drafted and approved must be motivated. • Funding for a 5-year cycle or part thereof to be secured.	Medium	All relevant authorities
Action 3: Resources and capacity to be suitably secured				
i. Agencies involved in the EMP must secure relevant equipment (e.g. water quality meter, boat, vehicles) for effective monitoring and management.	ICMA; NWA	• Need and desirability for equipment conducted. • Drafted and approved motivation for the equipment. Equipment purchased and well maintained.	Medium	All authorities
ii. Agencies to ensure all staff are trained appropriately for the effective management of the estuary in terms of applicable regulations and by-laws.	ICMA; NWA	• Drafted and approved motivation for training staff. • Staff to attend relevant training. MOA to be drafted for secondment for certain staff.	Medium	All authorities
iii. Evaluation of staff, contractors and volunteers.	ICMA; NWA	The implementation of performance management systems for staff, contractors and volunteers.	Low	All authorities

5.2.4. MAXIMISE LONG-TERM ECONOMIC AND SOCIAL BENEFITS

Management Objective:

Create an enabling environment to allow for greater opportunities in terms of sustainable socio-economic development.

Table 5.2.4. Management Actions for Maximising Long-Term Economic and Social Benefits.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Enable applicable and sustainable socio-economic development				
i. Improve, create and maintain visitor facilities to enhance recreational value e.g. develop formal access walkways, parking areas.	White Paper for Sustainable Coastal Development (Section C, Chapter 10); ICMA (Chapter 5, Section 37).	• Larger amount of general public being aware of the estuary which will enhance recreational value for the general public.	Medium	EDTEA
ii. Monitor recreational activities occurring within the estuary in order to better quantify resource use and assess the demand for such use.	ICMA; MLRA; Municipal by- laws	• Regular counts of estuary users and recording/documentation of activities being conducted.	Low	EDTEA, eThekwini Municipality
iii. Socio-economic opportunities must be in line with the vision and priority objectives of the estuary e.g. removal of IAPs, re-vegetate with indigenous vegetation.	ICMA, NEMA	• Areas of socio-economic opportunities identified. • The initiation of community projects. • The creation of employment.	Medium	EDTEA, eThekwini Municipality, DALRRD

5.2.5. COMPLIANCE AND ENFORCEMENT

Management Objective

Establish a functional compliance and enforcement programme specifying roles and responsibilities that will enable effective utilisation of limited available resources.

Table 5.2.5. Management Actions for Compliance and Enforcement.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Identify and delegate roles and responsibilities relating to compliance and enforcement				
Prepare standard operational procedures (SOPs) on agreed roles and responsibilities relating to compliance and enforcement across various mandated authorities so as to optimally utilise limited resources.	NEMA; All SEMAs; MLRA; ICMA, MPRDA; CARA, SPLUMA	• Documented, signed and adopted SOPs for coordination of compliance and enforcement. • Signed MOA between the various mandated authorities. • Development and implementation of monitoring plan/programme.	High	EDTEA, DFFE, DWS, eThekwini Municipality, DALRRD, DMRE, EKZNW
Action 2: Maintenance of an established compliance management team				
i. Compliance monitoring to be improved within the estuary in terms of utilisation of resources.	NEMA; All SEMAs; MLRA; ICMA, MPRDA; CARA, SPLUMA	• Effectively implemented compliance monitoring programme. • Patrols to be scheduled and conducted by relevant compliance officers. • Monthly count of users of estuary in terms of compliance issues (mining, fishing, bait collection). • Audit compliance of users (permit holders / licensees).	Medium	EDTEA

5.2.6. EDUCATON AND AWARENESS

Management Objective:

Emphasise the value and importance of the iLovu Estuary through effective awareness and education.

Table 5.2.6. Management Actions for Education and Awareness.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Users of the estuary are educated and made aware of the biodiversity value of the estuary				
i. Development and implementation of a public awareness and education program.	ICMA	• Awareness programme for the iLovu Estuary developed. • Awareness and education programme implemented through interest groups and schools. • Posters and pamphlets created and distributed to surrounding community members.	Medium	EDTEA, eThekwini Municipality
ii. Create interesting strategies to educate users of the importance of the fauna and flora within the estuary.	ICMA	• Interesting strategies developed and implemented (e.g. school tours, group excursions for local communities).	Low	EDTEA, eThekwini Municipality
iii. Erect signage of the permissible and non-permissible activities that can and can't be conducted within the estuary.	ICMA	• Strategic placement of signage at areas where the estuary is most commonly accessed and utilised and at sensitive areas. • Maintenance of erected signage.	Low	EDTEA, eThekwini Municipality

5.2.7. CLIMATE CHANGE

Management Objective:

Investigate the potential impacts of climate change, such as sea level rise and future flood events, on the receiving coastal environment in order to anticipate in advance and establish appropriate adaptation and mitigation measures.

Table 5.2.7. Management Actions for Climate Change.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Instill better development planning to minimise risk from inevitable climate change				
i. Investigation of impacts of climate change on the iLovu Estuary e.g. mouth dynamics, flood dynamics and tidal influence	ICMA	• Appointment of experts to conduct studies related to climate change risk. • Findings of the studies incorporated into the EMP, as may be necessary. • Compilation of a Mouth Management Plan and if recommended, a Maintenance Management Plan to assist with minimising climate change risk.	Low	EDTEA, eThekwini Municipality
ii. Infrastructure and development prone climate change risks to be investigated	ICMA; NEMA	• Infrastructure and development prone to climate change risk to be identified. • Investigate the damage incurred by climatic hazards including the cost for repeated repairs of infrastructure as compared to developing additional control measures.	Low	EDTEA, eThekwini Municipality
iii. Climate defense mechanisms must consider sensitive environments and practice duty of care	ICMA; By-laws	• Highly sensitive areas to be excluded for any proposed development. • Appropriate building controls to be implemented to areas close to sensitive environments and considered as a risk.	Medium	EDTEA, eThekwini Municipality

5.2.8. RESEARCH AND MONITORING

Management Objective:

The management of the estuary is conducted in a collaborative manner between all relevant spheres of government, relevant stakeholders and civil society.

Table 5.2.8. Management Actions for Research and Monitoring.

Management Actions	Primary Legislation	Deliverables / Indicators	Priority (Combined)	Responsible Agent(s)
Action 1: Promote scientific research				
i. Identify information gaps and develop research programme(s) aimed at gathering / consolidating ecological data. ii. Engage local research institutes and universities to collaborate on priority research projects. iii. Solicit research funding support.	-	• Appropriate research projects conducted. • Research results guide the implementation of mechanisms to improve ecosystem health as well as guide the monitoring of RQOs (See Appendix 3). • Scientific reports, papers and publications.	High	EDTEA, eThekwini Municipality
iv. Improve data collection relating to utilisation of the estuary and its resources.	MLRA	• Appropriate data sheets created for documenting and recording utilisation of the estuary (e.g. recreational fishing and bait collection).	Medium	DFFE, EDTEA, EKZNW
Action 2: Implement monitoring programme for biological, physical and chemical indicators of estuarine health				
i. Implement a monitoring programme for biological, physical and chemical indicators of estuary health. ii. Clearly define responsible agencies for each monitoring component i.e. municipality, service providers, EKZNW, etc. iii. Ensure that each monitoring component has a clearly defined methodology. iv. Assess results in terms of RQOs for the estuary. v. Continue with monitoring programme.	National Water Act	• Monitoring data and reports available on a real time basis. • Monitoring data and reports inform short-term and long-term management interventions (e.g. dealing with fish kills, mouth management, alien clearing, unlawful activities, etc).	High	EDTEA, eThekwini Municipality, DWS, DFFE

6. PROPOSED ZONATION OF ACTIVITIES

6.1. ZONATION

In the context of estuarine management, the process of zonation (or spatial planning) can be defined as "*a process of analysing and allocating the spatial and temporal distribution of human activities and conservation areas in an estuary to achieve the vision and objectives i.e. the envisaged outcomes*". The zonation of activities therefore provides a means of spatially depicting the envisaged desired state for a particular estuary (DEA, 2015). In terms of the Protocol, details of any intended spatial zonation of an estuary should specify activities that may or may not take place in different sections of the estuary and indicate (i) which organs of state will need to be consulted given the type of zonation that is proposed and (ii) which organs of state will need to enforce the relevant laws to implement the proposed zonation.

The need for an Estuarine Zonation Plan (EZP) has been acknowledged in the Protocol as a mechanism which stipulates the zonation of activities as one of the minimum requirements in estuarine management planning. A zonation plan provides a means of spatially depicting the envisaged desired state for a particular estuary and would typically allow for:

- Partitioning of activities within the estuary and its catchments thus permitting their existence without one activity precluding or conflicting with another;
- Identifying sensitive and small habitat fragments for protection;
- Focusing management activities in specific areas;
- Guiding future land/water uses and development activities in the area.

The EZP cannot include specific management objective strategies for aspects of water quantity and quality, ensuring co-operative governance, the development of a mouth management plan or maximising economic and social benefits, as these are unable to be represented geographically (spatially). The technique used to guide the differentiation of the various zones should be based on the habitat sensitivity of the iLovu Estuary. This will assist in identifying the areas that are vulnerable, under threat, ecological important/protected habitats as well as zones of minimal disturbance. The EZP should also highlight areas which are able to support and sustain controlled exploitation of marine living resources, and areas where the introduction of various levels of water-based recreation activities e.g. paddle boating, are deemed acceptable.

The initial spatial zonation proposed for the iLovu Estuary was discussed at a stakeholder workshop on 8th December 2021 based on the situation assessment of the estuary and scientific evaluation. The requirements and rights of all users of the estuary were taken into consideration in the context of the physical and environmental restraints existing in the estuary or which should

be implemented in future. The following land uses purposes (or zonation types) adapted from the Spatial Planning and Land Use Management Act (No. 16 of 2013), Protocol and the 2015 DEA guidelines and which are applicable to the iLovu Estuary include Agriculture, Transport, Residential, Mining and Marine Resource Use (See EMP section 6.2). Different spatial datasets from the municipal corporate GIS are mapped in Figure 6.1a and 6.1b below. Based on the primary list of legislation as documented in the iLovu SAR, the proposed Zonation of Activities for the iLovu Estuary are listed in Table 6.1.

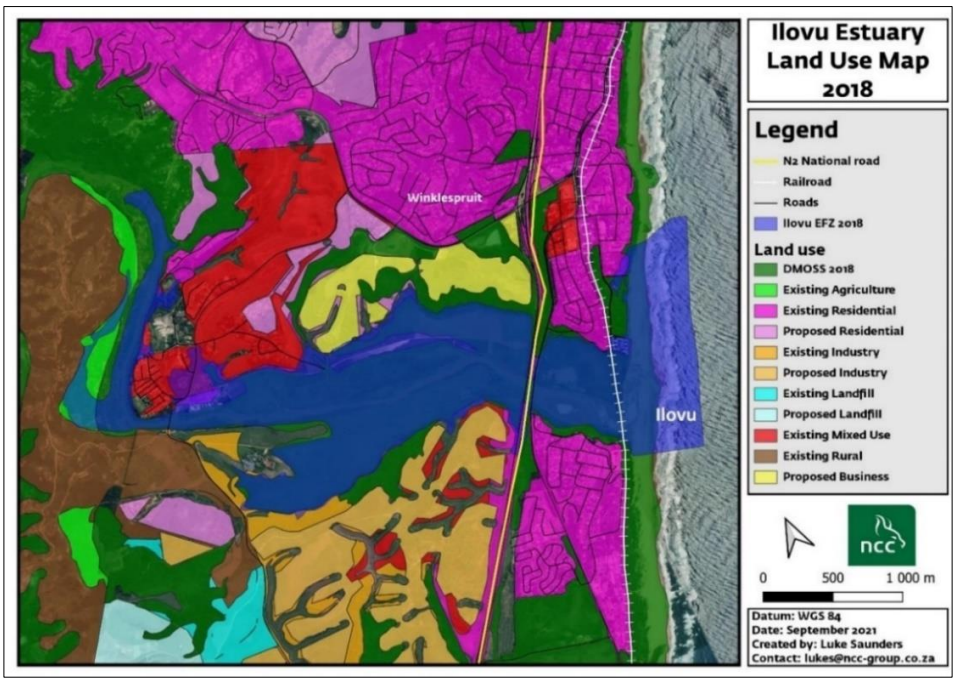

Figure 6.1a. Current land use in an around the iLovu EFZ.

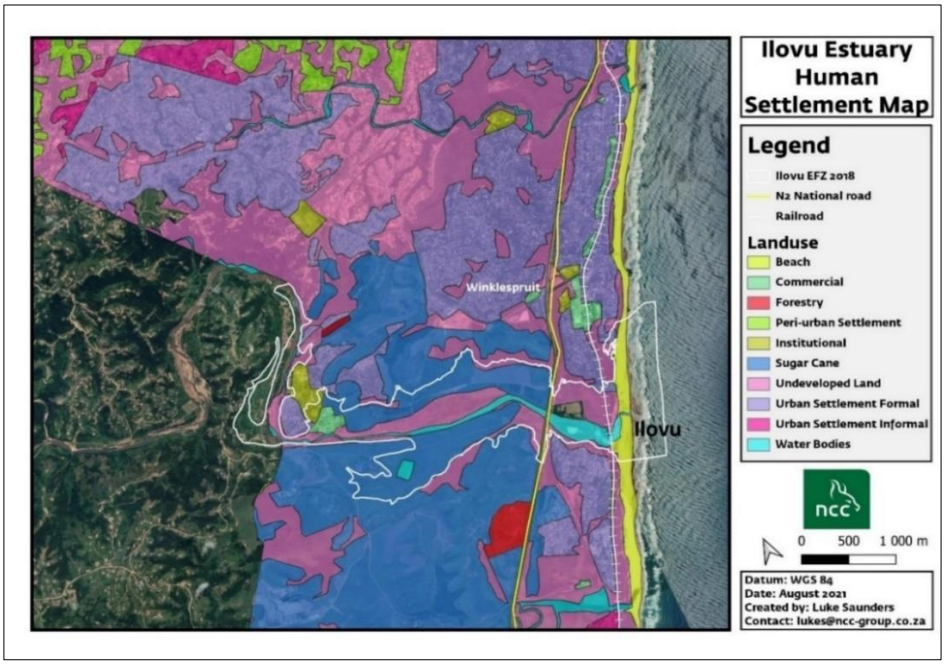

Figure 6.1b. Human settlement and other land uses within and around the iLovu EFZ.

Table 6.1: Proposed Zonation of Activities for the iLovu Estuary.

ZONATION / USE	CONDITION OF USE	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY TO CONSULT	RESPONSIBLE AUTHORITY TO ENFORCE
Fishing (Bait collection)	Compliance with species bag limits and gear restrictions	MLRA	DFFE (Fisheries)	DFFE compliance officers; EKZNW
Fishing (Recreational)	Compliance with species bag limits and gear restrictions	MLRA	DFFE (Fisheries)	DFFE; EKZNW
Fishing (Commercial)	Compliance with license conditions	MLRA	DFFE (Fisheries)	DFFE; EKZNW
Coastal/beach access (Recreational)	Public has access to coastal public property	ICMA	EDTEA	EDTEA
Swimming, snorkelling, surfing, surf-skiing, kite and wind surfing (Recreational)	Compliance with WQ guidelines for recreational use	ICMA, NWA, Health Act, By-laws	DWS, eThekwini Municipality	DWS, eThekwini Municipality
Clearing / harvesting of vegetation (indigenous or invasive)	Lawful in terms of permits	NEMA, NEMBA, CARA, Provincial legislation	DFFE (Forestry), SANBI	DFFE; EKZNW
Sand mining	Lawful in terms of permits and not recommended within the EFZ	MPRDA	DMRE	DMRE
Agriculture	Adherence to land use zoning and best practise	CARA	DALRRD (Agriculture)	DALRRD
Development & Land use planning	Lawful in terms of EAs and permits	ICMA, NEMA, SPLUMA	eThekwini Municipality	DFFE; EDTEA
Regulated water use (e.g. effluent discharge)	Lawful in terms of licenses	NWA	DWS, eThekwini Municipality, EDTEA	DWS
Solid Waste Disposal	Lawful in terms of licenses / municipal by-laws	NEMA, NEMWA	eThekwini Municipality	eThekwini Municipality

Formal protection and adoption of the EFZ within a ‘setback line’ (now referred to as the Coastal Management Lines) is a key mechanism to halt the gradual decline in habitat condition and estuarine functioning. The boundaries of the delineated coastal risk lines associated with the iLovu Estuary are shown in Figure 6.2 and other zonation considerations i.e. SLR scenarios and the Aliwal MPA are shown in Figures 6.3 and 6.4. The CMLs were still under development and in the process of being delineated at the time this EMP was compiled and are therefore not shown on any of the maps in this document.



Figure 6.2. Coastal risk lines associated with the iLovu EFZ (Source: Coast KZN).

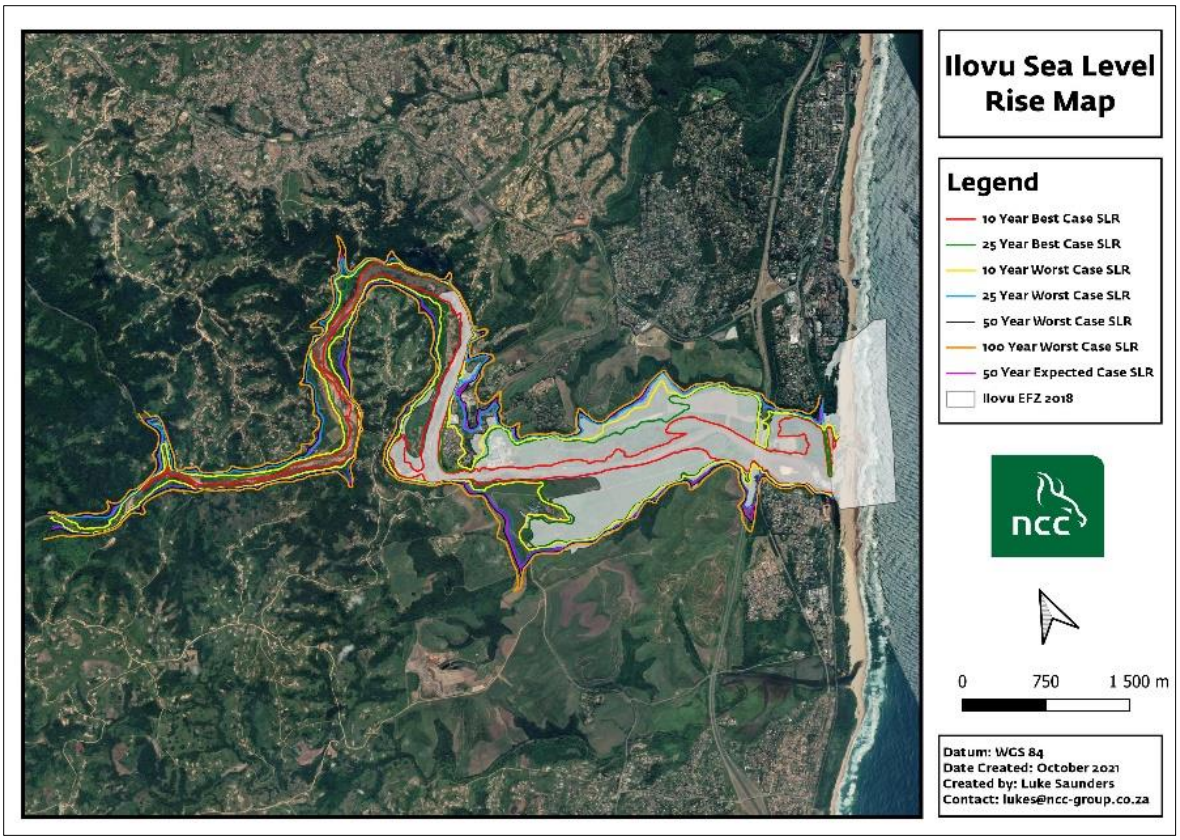

Figure 6.3. Modelled Sea Level Rise all scenarios.

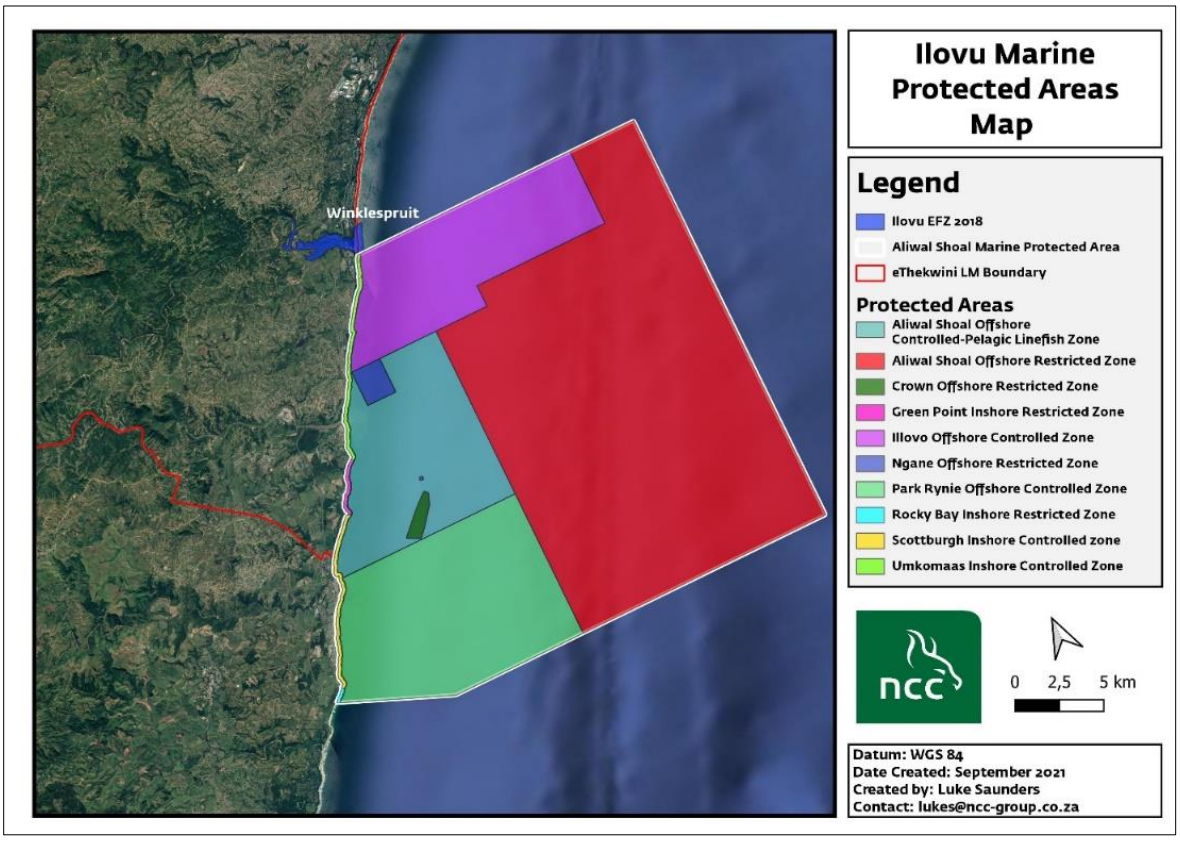

Figure 6.4. Aliwal Shoal Marine Protected Area (MPA) adjacent to and offshore from the estuary mouth in the marine realm.

In terms of Estuarine Zonation Planning cognisance also has to be taken of components that have already been developed within the EFZ and 10m contour as well as those that are currently in the planning stage that will potentially impact on the estuary if their development is not planned to fit in with the needs and requirements related to protecting the estuary. These are depicted in Figures 6.5 through to 6.8 and include:

The Lower iLovu Business Park and the Business Premises between Walsh Place and the P197 (Figure 6.5).

These premises lie well within the 10m contour of the EFZ and are areas particularly vulnerable to hazards such as back-flooding events and sea level rise. It is proposed in the NBA 2018, that the EFZ should be recognized as a natural “floodplain” and further development should be discouraged/prohibited.



Figure 6.5. Lower iLovu Business Park and the Business Premises between Walsh Place and the P197 (blue line indicates the boundary of the EFZ).

The Boardwalk 35 Housing Development (Figure 6.6)

These premises lie well within the 10m contour of the EFZ and is particularly vulnerable to hazards, such as estuarine exit meandering (which has already threatened the development), back-flooding and sea level rise. It is proposed in the NBA 2018 that the EFZ should be recognized as a natural “floodplain” and further development should be discouraged/prohibited.



Figure 6.6. The Boardwalk 35 Housing Development (blue line indicates the boundary of the EFZ).

Proposed Desalination Plant (Figure 6.7)

The Department of Forestry, Fisheries and Environment (DFFE) has already issued an EA to Umgeni Water for the proposed desalination plant. Although this plant will be positioned just outside the EFZ, there will be potential impacts on the estuary related to the required power lines, sea water intake and brine disposal pipelines and the bridge across the estuary that will carry these if the Preferred route or Alternative 1 are used which traverse along the north side of the estuary in the EFZ. Alternative 2 will also traverse the EFZ but on the south side and will include a tunnel taking the pipes across the estuary and under the road bridges to the intake works on the beach.

The EA (ref no: 14/12/16/3/3/2/636), which expires in 2022, contains all the environmental conditions that need to be met for this development to go ahead. There will be a need for rigorous monitoring of this development by an experienced independent body as well as by the respective authorities in conjunction with the EMF (should one be established), as the potential for impacts on the estuary could be high. Should the EA lapse before construction starts, careful consideration related to anticipated impacts on the estuary should be given to objecting to this development it its present form and location, particularly the pipeline and power line route alignment.

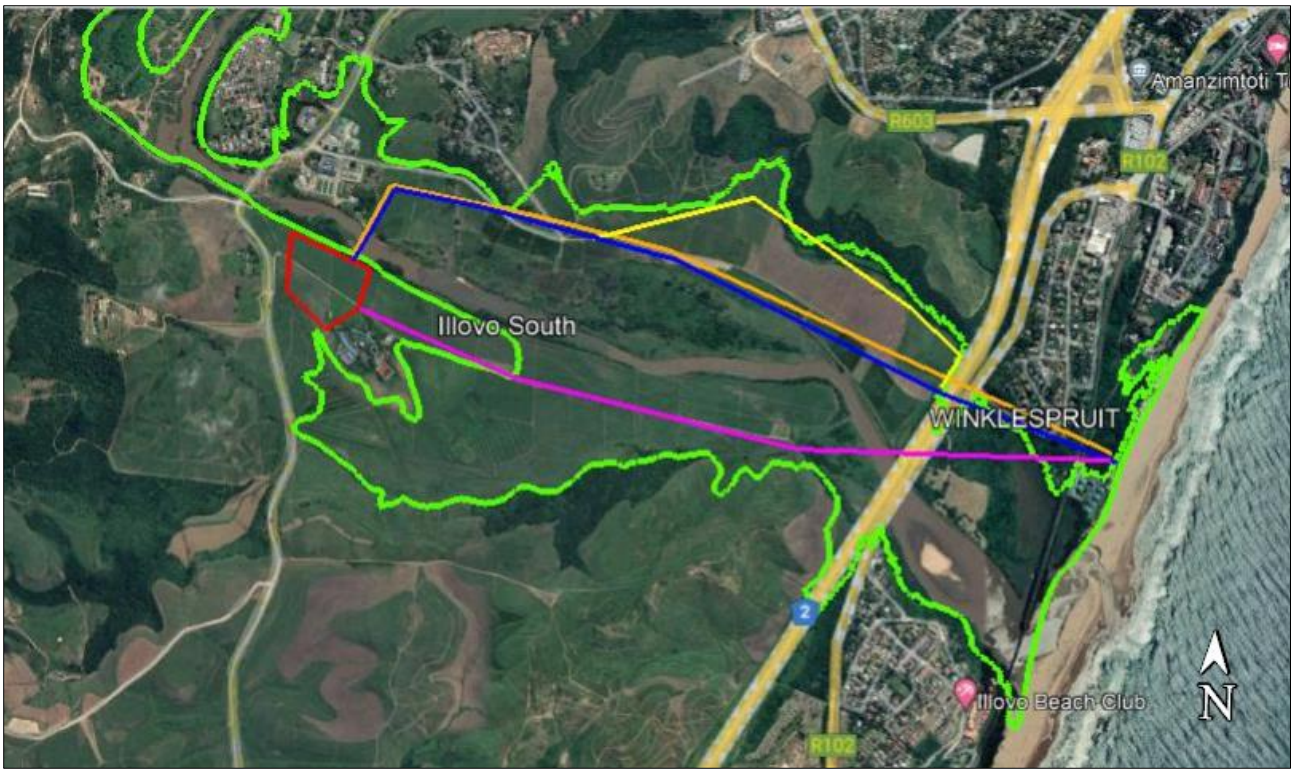

Figure 6.7. Umgeni Water's Proposed Desalination Plant (red line) showing options for the piped in sea water and brine disposal. The Preferred Route (blue line), Alternative 1 (yellow line) and Alternative 2, the Tunnel Option (purple line). The required Power Line Route (orange line) and Preferred Pipeline Route will both have to cross the estuary, with the latter requiring the construction of a bridge. Green line indicates the boundary of the EFZ).

Proposed Automotive Supply Park (Figure 6.8)

This development is situated almost entirely outside the EFZ, however the potential impacts of the proposed layout, changes to contour structure, businesses, and the components they will be producing, rank this development as having a very high potential for impacting on the EFZ and the estuary itself. Not only is there a need for the protection of water courses and wetlands that feed from the site into the EFZ but there will be a need for offsets related to the wetlands that will be lost. These will need to be outside the EFZ.



Figure 6.8. Dube TradePort's Proposed Automotive Park (blue shading indicates the iLovu EFZ).

6.2. LAND USE

The Spatial Planning and Land Use Management Act (No. 16 of 2013) and SPLUMA Regulations (still to be gazetted) will stipulate uniform zonation categories for land use schemes. Five land uses (or zonation types) were identified in the iLovu EFZ:

6.2.1 Agriculture

The cultivated-commercial sugarcane farming sector is the primary economic activity of the area (see Figure 6.1b). The cultivated sugarcane farms cover areas on both side of the estuary. Large portions of which are noted to encroach within the iLovu EFZ, in addition these areas appear to lack substantial riparian buffers. These serve as the primary livelihood and thus, should be monitored in-order to minimise future impacts to the system.

6.2.2 Transport

There are three major roadways (N2, R102 and Old Main Road) and a railway line that traverse across the estuary (Figure 6.1a).

6.2.3 Residential

Only one residential block is currently situated in the EFZ, this is The Boardwalk 35 Housing Development (Figure 6.6). This site is particularly vulnerable to hazards such as back-flooding events and changes in the flow pattern of the estuary mouth.

6.2.4 Mining

Sand mining is a consumptive activity that results in removing stabilising vegetation, which subsequently causes excessive erosion, and an overall decrease in the resource, such that there may be insufficient sand available for other functions i.e. coastal beach replenishment. Often large quantities of sand are removed, which exceed the regenerative capacity of many rivers and estuarine ecosystems. Sand mining upsets the natural functioning and balance of coastal systems. The cost of these unsustainable activities is far-reaching, with large economic, social and ecological consequences (CSIR, 2008 & CoastKZN, 2020).

Many estuaries are now under threat from sand mining activities and this is the case for the iLovu Estuary where there is overwhelming evidence of sand mining activities located at the upper limits of the EFZ and well within the 10m contour along the iLovu River (Figure 6.9). This activity has most likely contributed to downstream impacts such as excessive sedimentation which inevitably undermines the overall habitat integrity of the iLovu system. As such all illegal mining activities should be stopped and the area rehabilitated. Should there be legal mining activities present, when their licenses come up for renewal the EMF should interrogate what impacts are being caused by these activities and if necessary, challenge the extension of the mining licenses.



Figure 6.9. Areas identified as already being or having been mined for sand on the iLovu Estuary (white shading), most falling within the EFZ, that require rehabilitation and conservation.

6.2.5 Marine Resource Use

The 2018 NBA (Van Niekerk et al. 2019) indicates that fishing pressure on the iLovu Estuary is considered as Very High. It is currently not known what areas are utilised for consumptive resource utilisation and therefore no depiction of such areas is included on any of the zonation figures. The use of marine living and estuarine resources within the estuary is currently not controlled or sufficiently monitored. This is one of the priority components of the authorities who are tasked with managing the estuary.

There is a possibility that by creating ease of access to the system, it will encourage greater subsistence (usually employees from neighbouring farmlands and rural communities) and recreational fishing to occur more frequently. Bait collection for sand and mud prawns are apparently quite a common activity that occurs within the estuary, however it is unknown if they are at exploitative levels at this stage. Negligence of monitoring can lead to degradation of the estuary by creating a disturbance and altering sediment and water quality dynamics. The 2018 NBA lists reducing bait collection and fishing pressure as a restoration measure to improve productivity and condition of the iLovu Estuary (Van Niekerk et al., 2019).

6.3. SPATIAL ZONATION PLAN

Sensitive habitat delineation will need to be undertaken as part of the initial research activities to be initiated by the relative authority once the EMP has been approved. The EMP makes provision for the following zones:

- **Restricted Zones**
  These will need to be established by the Estuarine Management Form (EMF) once it is established and has been able to assess the estuarine situation.

- **Controlled Zones**
  These will need to be established by the EMF once it is established and has been able to assess the estuarine situation following additional research and monitoring of the system.

- **Development Zones**
  Based on the area covered by the EFZ it is recommended that no further Development Zones be established within the iLovu EFZ.

- **Recreational Zones**
  In terms of recreational zones, the proposed areas are indicated on Figure 6.10. It is

considered that the coastal area within the where the estuary reached the sea should also be considered a recreational zone.

- **Rehabilitation Zones**

  Based on the draft spatial zonation plan for the iLovu Estuary presented at the stakeholder meeting on 8th December 2021, the areas shown on Figure 6.11 are suggested for consideration as rehabilitation and conservation zones. These will need to be considered by the EMF once it is established.

It was raised at the second stakeholder workshop whether there were any further or specific recommendations relating to these types of zones to include in the EMP. A comment made at workshop suggested that consideration should be given to rehabilitating the terrestrial section of the proposed recreational area on the north bank, east of the N2 freeway back, to being part of the estuary as it was in the past. However, it appears that that area was in the past used as a waste disposal area and it is not known what problems may arise (chemical or other) should the land be dug out to allow the estuarine tidal flow to access the area. This suggestion should be investigated by the EMF once it is established and has been able to assess the estuarine situation.



Figure 6.10. Proposed Recreation Zone (outline in pink) within the iLovu EFZ.

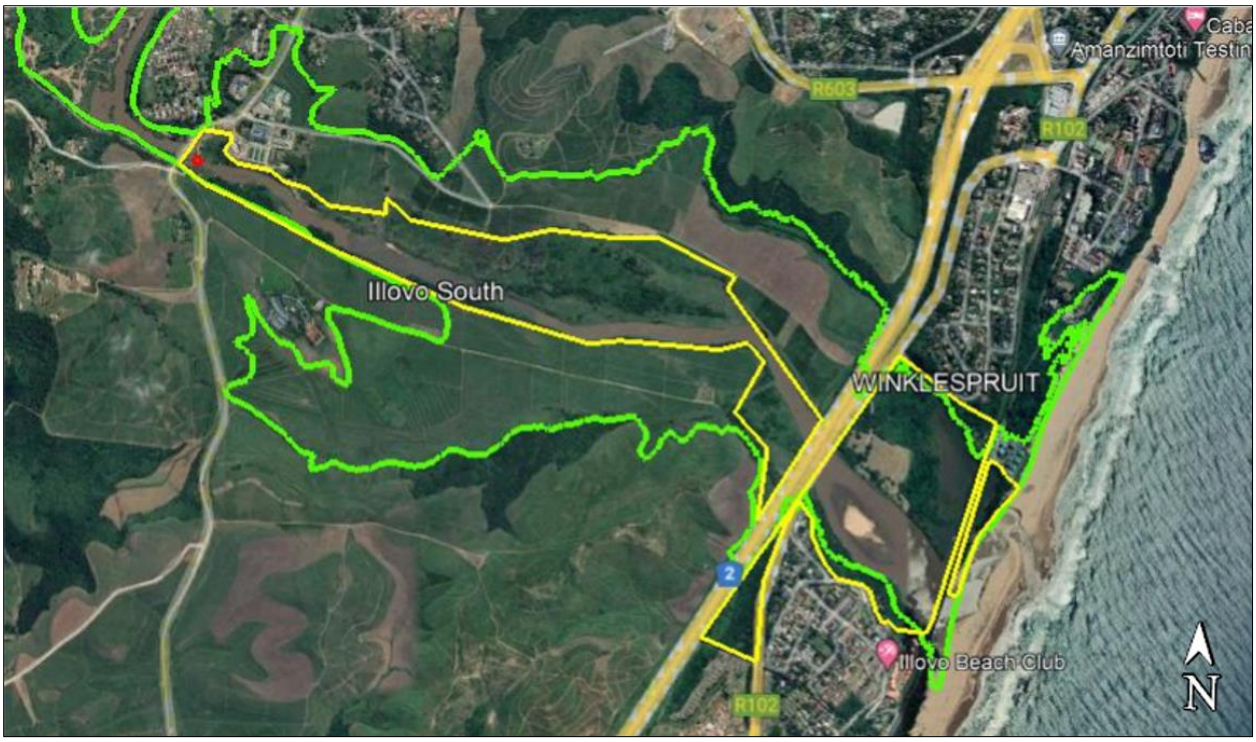

Figure 6.11. Proposed Rehabilitation and Conservation Zones (yellow line) within the EFZ (green line) of the iLovu Estuary. The red dot indicates the position of a stone/rubble causeway that needs to be removed and the area rehabilitated.

7. RECOMMENDED MANAGEMENT PRIORITIES

Based on the management objectives, actions and sub-actions presented in the various tables in section 5 of this document, a list of 9 out of 39 were identified as being high priority actions (Table 7.1) to ideally be taken within one year from the date when the EMP is formally adopted. Appendix 2 indicates the methodology followed to rank the priorities in terms of time and importance.

Table 7.1. Recommended [1]high priority actions for management.

ACTION	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY	PERFORMANCE INDICATOR	PRIORITY		
				IMPORTANCE RANK	TIME RANK	COMBINED
Terminate illegal sand mining activities and review of any mining within the EFZ	MPRDA	DMRE	Number of illegal activities terminated.	3	3	**High**
Define areas of critical / important living resources and habitat and incorporate into EFZ.	ICMA; NEMA; NWA; NEMBA	EDTEA; DALRRD	• Critically sensitive areas mapped. • Biodiversity hotspots & sensitive habitats identified.	3	3	**High**
Prepare SOPs on agreed roles & responsibilities relating to compliance & enforcement across various mandated authorities to optimally utilise limited resources.	NEMA; SEMAs; MLRA; ICMA, MPRDA; CARA, SPLUMA	EDTEA, DFFE, EM, DWS, DMRE, DALRRD, EKZNW	• Documented, signed & adopted SOPs for coordination of compliance & enforcement. • Signed MOA between the various mandated authorities. • Development & implementation of monitoring plan/programme.	3	3	**High**
Identify, trace and investigate types and sources of pollution, contamination & erosion.	NWA, NEMA	DWS	• Routine assessments conducted. • Erosion & pollution entering estuary remedied using appropriate methods.	2	3	**High**
Identify & assess the effect of any agricultural & / or industrial effluent & wastewater discharges released into estuary from upper reaches of the catchment.	NWA, NEMA	DWS, EDTEA	• Any wastewater discharges entering estuary identified. • Determine if facilities are licensed to discharge wastewater. • Regularly reviewing conditions of licenses.	2	3	**High**
Estuarine boundaries & associated buffer zones to be clearly defined to inform land use and future development applications.	ICMA, SPLUMA	EDTEA, EM	The geographical boundaries & appropriate buffers related to the EFZ are incorporated into all necessary planning documentation & guidelines.	2	3	**High**
Future development will be in line with the agreed zonation plan for the estuary, IDP, by-laws & deeds restrictions.	ICMA; NEMA	EM	Reduction of habitat loss, degradation & inappropriate activities within the EFZ.	3	2	**High**
Promote scientific research		EDTEA, EM, DFFE	• Appropriate research projects conducted where research results / outcomes guide the implementation of mechanisms to improve ecosystem health & the monitoring of RQOs. • Scientific reports, papers & publications.	2	3	**High**
Implement monitoring programme for biological, physical and chemical indicators of estuarine health	NWA, NEMA	EDTEA, EM, DWS, DFFE	Monitoring data & reports available on a real time basis to inform short- and long-term management interventions (e.g. dealing with fish kills, mouth management, alien clearing, unlawful activities, etc).	2	3	**High**

[1]The 'combined' priority is calculated by multiplying the ranking factor for the 'importance' priority by the ranking factor for the 'time' priority. A 'combined' high priority scores either **6** (2 x 3) or **9** (3 x 3).

8. INSTITUTIONAL CAPACITY AND ARRANGEMENTS

8.1. BACKGROUND

Effective institutional structures and arrangements are crucial support elements for the successful implementation and co-ordination of actions in terms of the Protocol and by extension, this EMP. The Protocol, based on the requirements stipulated in the ICM Act, stipulates the responsible management authorities for the development and coordination of the individual EMP. Chapter 5 of the ICM Act details the institutional arrangements that would, once implemented, contribute to co-operative coastal governance in South Africa. These arrangements are made at national, provincial and municipal levels and the embodiment of cooperative coastal governance is vested in coastal committees. The Provincial and Municipal coastal committees shall serve as the forums for monitoring the implementation of EMPs and reporting of progress and achievements related to estuarine management.

The iLovu Estuary is located solely within the geographical boundaries of the eThekwini Metropolitan Municipality; KZN and according to the Protocol amended in June 2021, the provincial authority (EDTEA) is the responsible management authority (RMA) for the development and implementation of the EMP in collaboration with the other relevant government departments. There is also scope for the implementation of the EMP to be effected through a range of informal forums and organisations. Any existing and/or planned estuary management forum (EMF) or estuary advisory forum (EAF) can be regarded as an informal additional advisory body for facilitating the implementation of the project plans identified in the EMPs and to foster continuous stakeholder engagement.

8.2. EMP IMPLEMENTATION

The iLovu EMP should be considered as a framework document to guide the implementation of priority actions and identify responsible agents to implement such actions. It presents a phased implementation approach including capacity building at the local level over a period of five years. However, it does not specify the human and financial resources required for the management of the estuary. The various authorities with jurisdiction over resources and land within the EFZ must identify project leaders and teams for the development of specific action plans for implementation. The keystone to the efficient management of the iLovu Estuary is co-management and effective governance.

The fulfilment of roles and responsibilities by responsible management authorities is fundamental to the achievement of the vision and objectives in this EMP. The relevant government departments are required to develop internal project plans related to the management actions identified and in

compliance with legislative mandates. Departments will need to provide funding and resources for respective sectors or fund other entities to conduct the required monitoring on their behalf.

8.3. MANAGEMENT FUNCTIONS

8.3.1 Responsible Management Authority

The main functions of the RMA, (EDTEA) include, but are not limited to:

- Put into effect recommendations of the EMP;
- Ensure promulgation of rules and regulatory framework;
- Solicit funding and budget for management strategies of the RMA;
- Development of a memorandum of agreement (MOA) between various relevant authorities in terms of management, regulatory functions and funding;
- Collaboration with the local authority to develop and implement the integrated development plan (IDP) and strategic development plans (SDPs);
- Monitor the implementation of management strategies;
- Develop a communication strategy for stakeholders, authorities and the public, regarding rules and regulations as well as environmental information;
- Develop an environmental awareness and education programme for the iLovu Estuary. The programme may include strategies for land use and stewardship;
- Keep a record of all meetings, decisions-making and correspondence.

8.3.2 Other Responsible Agents

The successful implementation of the EMP involves the contribution of several governmental departments, including:

- The Department of Forestry, Fisheries and the Environment: Oceans and Coast (DFFE: O&C) is the lead national agent for coastal management in South Africa including KZN.
- The eThekwini Metropolitan Municipality is responsible for providing key municipal services relating *inter alia* to water and sanitation, spatial and development planning, disaster management as well as the provision of management, technical and legislative support.
- Other national government departments which include the Department of Water and Sanitation (DWS) and the Department of Agriculture, Land Reform and Rural Development (DALRRD).
- Organs of State such as Provincial Disaster Management and the Mvoti to Umzimkulu Proto-CMA.
- Research organisations and NGOs *inter alia* the Council for Scientific and Industrial Research (CSIR) and the Oceanographic Research Institute (ORI).

An overview diagram indicating the role-players involved in implementation of the EMP is illustrated in Figure 8.1.

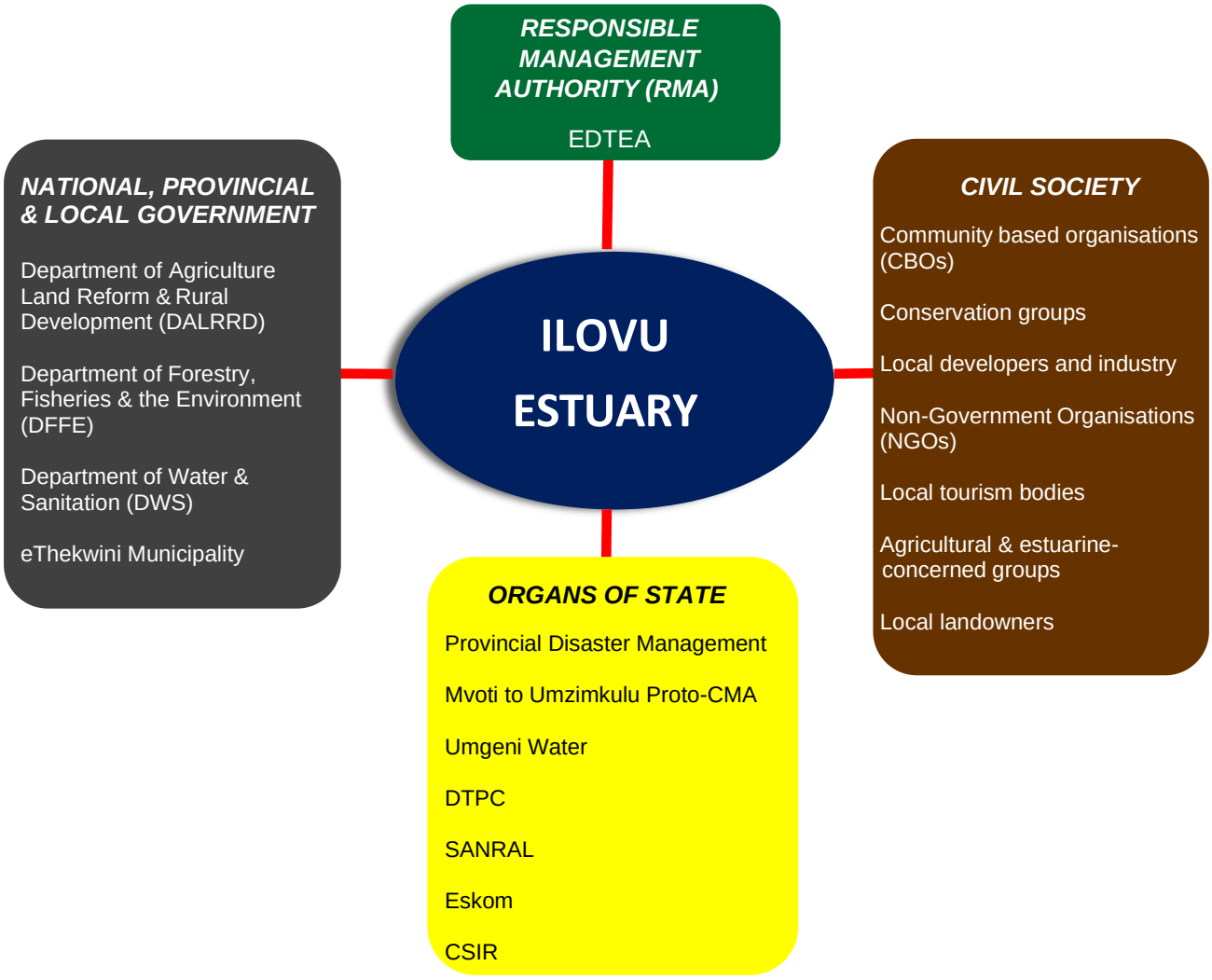

Figure 8.1. Overview of the various role-players involved in implementation of the iLovu EMP.

9. RECOMMENDATIONS TO ADDRESS MAJOR INFORMATION GAPS

Sections 3.2 and 3.3 of the iLovu Situation Assessment Report (SAR) clearly showed that there has been very little research or data collection conducted in the system over the last 10 years. Spatial and temporal replication of information is vital for enabling researchers to map the changes that occur within a system over time and to determine how the system is responding to human activities.

One of the major information gaps is related to the health of this estuarine system. The studies determining the Ecological Reserve or Ecological Water Requirement (EWR) Estuarine Reserve, Estuarine Health Index (EHI) and Present Ecological State (PES) have all been conducted at a desktop level (DWA 2013, DWS 2015a, b, c, van Niekerk and Turpie 2012 and van Niekerk *et al*. 2019). It is therefore imperative that one of the first step as part of the initiation of the iLovu Estuarine Management Plan that the current health of the system be determined, this would include both the EHI and PES.

The following is a list of information identified as being needed to improve on future EWR studies for the iLovu Estuary (DWS 2015a). This list will also help provide information as to which aspects of the estuary need more management;

- An improved understanding of the catchment water quality, i.e. sources of contamination, concentrations, seasonal fluctuations, potential for remedial actions to improve water quality,
- Better quantification of inflows to the estuary (river and WWTW) that drive the mouth condition including the mode of delivery. Ideally, river inflow to these small systems needs to be resolved at daily or hourly time scales. It is not sufficient to evaluate these on monthly time steps as required by EWR process,
- Continuous mouth state data are lacking and need to be acquired (i.e. water level recorder near the mouth),
- Information on the bioaccumulation of toxic substances (e.g. metal, herbicides and pesticides), and the current impact associated with such accumulation needs investigation, especially in systems in urban area or those receiving extensive runoff from agricultural areas,
- Improved understanding on the responses of microalgae and macrophytes to various nutrient loading and assimilative capacities is required, as well as the effect on dissolved oxygen processes, and
- Long-term data on the composition of biotic communities and the link with ecosystem functioning re also lacking and need to be improved.

To the above there is a need to add the vital issue of obtaining current data on legal and illegal sand mining operations in the system (Figure 9.1 and 9.2), as well as determining to what extent such operations are currently impacting on the estuary as well as resulting in a sediment deficit in the estuary as well as causing a negative delivery of sediment to the coastal zone.



Figure 9.1. Sand mining operation on the iLovu Estuary, clearly illustrating infilling, river diversion and destruction of riverine habitat (from Demetriadies 2007).



Figure 9.2. Sand Mining in the iLovu Estuary upper reaches (Source: Coast KZN, ORI).

10. MONITORING AND EVALUATION

As a result of both natural processes and anthropogenic activities estuaries are dynamic systems which are continuously experiencing changing conditions. Consequently, an effective management plan for the estuary must retain flexibility in order that modifications can be made in relation to environmental change and changes in human activities. The EMP therefore needs to be considered as an evolving programme of co-operative government, communication and action, rather than a one-off, all-embracing management plan. The management actions outlined in this EMP are not exhaustive and should be added to as the plan progresses, and goals are achieved. Additionally, when new issues arise, and as existing issues are resolved, the necessary adjustments to the EMP should be made. This EMP is regarded as the first in a series of evolving/rolling five-year plans, with the EMP being subject to on-going review and performance monitoring to ensure continuing validity and relevance.

A significant constraint to change detection in estuaries is the lack of long-term measured data on South African estuaries. One of the challenges that has led to this situation is the existence of a range of mandated Departments involved in estuary management and therefore monitoring. However, some progress has been made since the National Biodiversity Assessment in 2011 (van Niekerk and Turpie 2012).

The Department of Water and Sanitation established the National Estuarine Monitoring Programme, NEsMP, in 2008. However, currently, the National Estuary Monitoring Programme implemented by DWS is under resourced (Cilliers and Adams 2016). This multi-tier, multi-parameter (include biotic and abiotic components) programme is based on current best practice and with sufficient funding, and support from other organs of state, could go a long way in addressing data deficiencies in future estuary assessments. The purpose of NEsMP is the monitoring of water quality, physico-chemical and biological aspects for determining long-term trends and changes in the condition of South African estuaries. The NEsMP coordinates national monitoring efforts and provides support in the form of sampling equipment, training, data management and information dissemination, while collaborating institutions collect physico-chemical data and water samples. Unfortunately to date this has not rolled out to the iLovu Estuary but has focused more on the protected area systems e.g. Mpenjati. However, the DEA (2015) estuary management guideline stipulates that an integrated monitoring plan should be developed for each estuary and must cover three categories, namely:

- Resource monitoring, which is directed at specific ecological indicators (to monitoring the state or health of the natural resource – in this case the iLovu Estuary as defined by the EFZ).

- Compliance monitoring, which aims to monitor the effectiveness of the implementation of the EMP by assessing the intensity and nature of the activities occurring within the iLovu Estuary. It would also serve to identify activities that are not compliant with the relevant legislation, policies and guidelines as described in the EMP, as well as timeously identify potential threats to estuary health.
- Performance monitoring, which is aimed at gauging progress in terms of achieving the management objectives, and ultimately, the vision (and associated outcomes) for the iLovu Estuary, relative to its management plan.

To address these categories an integrated monitoring plan, as recommended by MER (2021), has been provided that indicates the activity/output, the indicator, the temporal scale, the target, and the responsible authority. The details related to each monitoring component are contained in Tables 10.1 and 10.2.

Table 10.1. Abiotic components recommended for monitoring in the iLovu Estuary (Based on MER 2021).

Ecological Component	Action	Spatial Scale	Temporal Scale	Responsible Agent
BATHYMETRY				
Depth profiles of the estuary	Measure depth across sectional profiles and longitudinal profile at 200m intervals to a high level of accuracy	Every 200 m	Baseline and thereafter every 5 years	EMF
WATER QUANTITY				
Hydrology	Measure freshwater inflows just above the estuary.	Install a flow meter or recorder at or above the head of the estuary	Continuous	DWS
	Record Water Level in the estuary relative to mean sea level.	As close to the estuary mouth as possible (railway bridge likely position)	Continuous	DWS
	Record scale, frequency and duration of episodic events.	The estuarine area whenever events occur e.g. flood, fish kill, pollutant contamination	Episodic	EMF
Hydrodynamics	Visual record of mouth.	Fixed point photography of mouth	Weekly	EMF
Mouth dynamics	Ensure daily mouth record is maintained.	Mouth	Daily	EMF
Sediment fluxes	Collect grab samples across and along the estuary for analysis of particle size distribution.	Whole estuary at sampling sites	Baseline and thereafterevery 2 years	EMF
WATER QUALITY				
Physical and chemical variables	Measure temperature, salinity, pH, dissolved oxygen (DO), turbidity and toxins.	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Quarterly (seasonal)	DFFE/DWS
	Measure nutrients (nitrate, nitrite, ammonia and phosphate) and suspended solids.	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Monthly	DFFE/DWS
	Analyse water samples for pathogens such as bacteria,*Staphylococci* and *Enterococci* species such as *Escherichia coli.*	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Monthly Weekly for one month if a sewage spill has occurred	DFFE/DWS
	If contaminated water reaches the estuary measure dissolved oxygen concentration in the water.	Longitudinal axis of estuary (at least 5stations)	Daily for one month before sunrise	DFFE/DWS

Table 10.2. Biotic Components recommended for monitoring in the iLovu Estuary (Based on MER 2021).

Ecological Component	Action	Spatial Scale	Temporal Scale	Responsible Agent
BIOTA				
Microalgae	Water chlorophyll-a measurements taken at the surfaceand 1 m depths, under typically high and low flow conditions. Intertidal and subtidal benthic chlorophyll- a measurements using a recognised technique or SANAS accredited laboratory.	Longitudinal axis of estuary (at least 5stations)	Quarterly (seasonal)	DFFE/ DWS/ EMF
	Record relative abundance of dominant phytoplankton groups, i.e. flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae (cyanobacteria).	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	DFFE/ DWS/ EMF
Macrophytes	Map macrophyte communities in EFZ using hi-res aerial photography. This must be ground-truthed by field surveys. Red-data, protected and invasive species must be noted.	Whole EFZ	Once a year in summer	DFFE/ DWS/ EMF
Invertebrates	Surveys of the zooplankton, benthic invertebrate and larger crustaceans must be conducted. This should include burrowing species such as *Kraussilichirus kraussi*	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	DFFE/ DWS/ EM
	Collect sediment samples using the grab for particle size analysis and organic content (at same sites as zooplankton) (preferably link with sediment dynamics)	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	
Fish	Record species and abundance of fish, based on seine net sampling. Gill nets should not be deployed in sucha small estuary as they will result in fish deaths	Longitudinal axis of estuary (at least 3-5 stations)	Quarterly (seasonal)	DFFE/ DWS/ EM
Birds	Undertake counts of all water-associated birds. All birds should be identified to species level and total number of each counted, covering as much of the estuarine area as possible, from a boat and on foot.	Whole EFZ	Seasonal (winter and summer counts must be conducted annually)	

11. RESEARCH

Research is an essential component for all management activities, with regards to the iLovu Estuary, the scope for research is large, primarily due to the limited studies that have been on this system. New information enables comparative assessments that may initiate new investigations relating to the ecological characteristics of the estuary in conjunction with resource use and provision.

The iLovu Estuarine Management Plan has been drafted based on the current understanding of the functioning of the estuary. It is evident that ongoing research and monitoring is required to fill information gaps and to improve the management plan. Post implementation monitoring of the EMP is critical given that the determination of the Present Ecological State was undertaken in 2015 and revised in 2018. Updated baseline data is also vital to ascertain whether the measures that have been put in place are adequate to ensure that there is no further deterioration in the health of the estuary. The responsibility for this monitoring resides with the Department of Human Settlements, Water & Sanitation (DHSWS) but may be delegated to another agency.

Research and Monitoring are essential in enabling the respective agencies responsible for management of the estuary to adapt management plans, operational plans and activities to changing circumstances. Key focal areas for monitoring and research associated with the iLovu Estuary include water quantity and quality, physical characteristics, biota and rehabilitation. Recommended protocols for monitoring the health of the iLovu Estuary are included in Section 10 and the Resource Quality objectives (RQOs) for the iLovu Estuary (Appendix 3) should guide the monitoring programme. In addition to monitoring the biotic and abiotic health of the iLovu Estuary,

Much of the research required on the system is detailed in Sections 9 and 10, however there is also a need to undertake a fishing survey in terms of user groups, species, and effort and a social survey regarding the uses and perception of the estuary. Such a survey should also determine visitor numbers, profiles, behaviour and opinions which should be monitored on a regular basis to gauge management effectiveness and user responses to management.

Furthermore, some sources have indicated that there is a need to consider developing a Mouth Management Plan (MMP) as at times flooding may affect adjacent properties and livelihoods, this would involve a breaching policy. However, the known ecological impacts on the estuarine environment caused by artificial mouth breaching clearly indicate that such a policy, if developed, should only be implemented as a last resort.

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13. APPENDICES

Appendix 1. Important management issues discussed in stakeholder workshops.
(Source: Cyrus *et al*. 2021).

A. Important management issues i.e. constraints

A1. Ecological issues
- Unregulated and/or excessive sand mining
- Over- and unlicensed abstraction of water upstream (flow modification)
- Pollution (diffuse and point source from the upstream catchment)
- High and intensifying fishing effort
- Unregulated gill netting / poaching
- Habitat / biodiversity loss and a low level of formal protection
- Alien vegetation encroachment

A2. Management issues

A2.1. Capacity
- Delays in decentralised water resource management i.e. CMA not fully functional
- Capacity constraints within the provincial conservation authority with inadequate support and lack of enforcement
- Communication gaps between management authorities and other users of the estuary
- Multiple authorities control various legal aspects of the estuary

A2.2. Monitoring issues
- Lack of a field based Estuarine Health Index determination
- Scientific data collection and availability is limited / lacking capacity of the NEsMP

A3. Access issues
- Lack of safety and access control to the estuary
- Private land ownership inhibits public access directly to and around the south side of the estuary

A4. Other issues
- Flood risk and loss of property and life for any further or proposed developments in the EFZ

B. Important management opportunities

B1. Ecological
- Scope to rehabilitate wetlands and improve the EHI and PES of the estuary
- A lack of high-density infrastructure along the estuary / within the EFZ
- Commitment in terms of the eThekwini IDP and SDF that estuaries are assets that need to be conserved and managed sustainably in accordance with the D'MOSS development control plan
- Local residents and homeowners are committed to biodiversity conservation

B2. Management
- Improve levels of cooperative governance
- Potential to establish a forum of honorary conservation officers and citizen scientists to assist with management and law enforcement i.e. an Estuarine Forum

B3. Tourism, recreation and research
- Accessibility to the northern bank of the estuary
- Aliwal Shoal MPA is a nearby eco-tourism attraction
- Opportunity to attract various classes of visitors e.g. canoeists, recreational boating, recreational fishing, birders, etc
- Research opportunities offered by the estuary

Appendix 2. Management priority calculation tables.

PRIORITY (IMPORTANCE)	HIGH	MEDIUM	LOW
RANKING FACTOR	3	2	1

PRIORITY (TIMESCALE)	HIGH	MEDIUM	LOW
	Within one year (≤ 1 year)	Between one & three years (≥ 1 & ≤ 3 years)	Between three & five years (≥ 3 & ≤ 5 years)
RANKING FACTOR	3	2	1

IMPORTANCE PRIORITY			
	3	6	9
	2	4	6
	1	2	3
	TIME PRIORITY		

IMPORTANCE PRIORITY			
	MEDIUM	HIGH	HIGH
	LOW	MEDIUM	HIGH
	LOW	LOW	MEDIUM
	TIME PRIORITY		

The 'combined' priority is calculated by multiplying the ranking factor for the importance priority by the ranking factor for the time priority. A combined low priority scores 1 or 2, a combined medium priority scores 3 or 4 and a combined high priority scores 6 or 9.

Appendix 3. iLovu Estuary RQOs (After DWS, 2015).

PES:	C/D	REC:	B	TEC:	B/C

Components that require interventions to achieve the TEC:
- Improve water quality.
- Partial restoration of estuarine habitat.

Flow:

PES	nMAR (MCM)	pMAR (MCM)
D	**119.10**	**82.47**
	Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. Distribution patterns of the flood components differ by no more than 10% (magnitude, timing and variability) from that of the Present (2015).**The Present baseflows/ low flows poses a risk to the REC and should be elevated.**	

Sediment processes:

D	▪ The flood regime maintains the sediment distribution patterns and aquatic habitat (instream physical habitat).The suspended sediment concentration from river inflow does not deviate by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined). ▪ Changes in tidal amplitude of less than 20% from present (to be determined). ▪ Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameterdeviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.

Mouth state:

C	Mouth open conditions should be maintained within the current range: 77% (± 5%).

Water quality: Salinity

C	The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middlereaches during the low flow season. PES: Mid-waters in the lower reaches should exceed 25, the middle reaches it should exceed 20, while theupper reaches should vary between 10 to 15. REC: Mid-waters in the lower reaches should vary between 20 to 35, the middle reaches it should exceed 15,while the upper reaches should vary between 5 to 10.

Water quality: Other

C↑	**Ecosystem health:**	**Recreational use:**	Yes
	Water quality poses risk to REC/TEC, sufficiently reduced if: ▪ DIN: Freshwater inflow, 50%ile < 0.2 mg/l (high risk). ▪ DIP: Freshwater inflow, 50%ile < 0.015 mg/l (high risk). ▪ DO: Entire estuary, average ≥ 6 mg/l (high risk). ▪ Turbidity: Estuary, clear (< 10 NTU) accept during high inflow events. Toxic substances: ▪ Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995). ▪ Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009).	Microbiology: Sufficient levels(DEA, 2012).	

Macrophytes (plants):

D↑	▪ Maintain the distribution of current macrophyte habitats (< 20% change in the area covered by differentmacrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). In particular the swamp forest habitat is important. ▪ Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along thebanks. Prevent further disturbance and development of the floodplain habitat. ▪ No invasive floating aquatic species present in the estuary e.g. water hyacinth. ▪ Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina,Spanish reed, black wattle, Brazilian pepper tree) cover < 5% of total macrophyte area. ▪ Improve the salinity regime to encourage the re-establishment of mangrove habitat.
Invertebrates:	
C	As sampled by plankton net, grab and dip nets/traps (as appropriate): ▪ Population abundances of plankton and benthic assemblages (baselines to be set) not deviate by > 30%. ▪ Zooplankton should be dominated by estuarine copepods *A. natalensis* and *P. hessei*, but include othergroups such as mysids. Meroplankton are abundant. ▪ Macrobenthos should be abundant and dominated by amphipods and polycheates, but should include isopods, tanaids and the crab *H. projectum and* insect taxa. ▪ Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos. ▪ Penaeid and carid (*Caridina* and *Macrobrachium*) prawns should occur. ▪ Sandprawn *C. kraussi* should occur in sandy areas in the systems lower reaches (to be confirmed). ▪ Large brachyuran crabs (macrocrustacea) should include *S. serrata* and *V. litterata.* ▪ Molluscan assemblage should include bivalves and gastropods. ▪ Invasive alien species should not occur in abundance.
Fish:	
C	As sampled by seine and gill net in open waters: ▪ 25 species should occur to include freshwater, estuarine resident and estuarine dependent marine fishes. ▪ Estuarine resident species should comprise a minimum of five species. ▪ Estuarine resident and estuarine dependent marine fishes should dominate catches by abundance. ▪ *G. callidus, M. capensis* and *R. holubi* should occur with 100% frequency of occurrence (every samplingtrip). ▪ *P. commersonni* and *A. japonicas* should be sampled with 80% frequency of occurrence. ▪ Pelagic piscivores should occur (including *Caranx* spp). ▪ No alien fish species should occur. ▪ Fish should be free of lesions and other anomalies related to water quality. ▪ No fish kills should occur.