DRAFT ESTUARY MANAGEMENT PLAN (EstMP) FOR MGOBOZELENI ESTUARY WITHIN

ISIMANGALISO WETLAND PARK

COMPILED IN TERMS OF THE NATIONAL ESTUARINE MANAGEMENT PROTOCOL (2021) & THE NATIONAL ENVIRONMENTAL MANAGEMENT: INTERGRATED COASTAL MANAGEMENT ACT (ICMA, ACT 24 OF 2008)

DRAFT EstMP - Phase 2

MAY 2023

Executive Summary

Anthropogenic impacts are escalating in estuaries worldwide because of increasing population growth and associated land-use alteration in adjacent coastal watersheds and the broader catchments. Establishing estuarine health and the system's response to catchment activities is complex, although many of the more extreme symptoms such as algal blooms and fish kills are by now well known. More difficulty is encountered when trying to understand the vulnerability of estuaries and the rate at which they respond to both improvements and deteriorations in catchment influences.

This Estuary Management Plan (EstMP) of the Mgobozeleni provides a framework for coordinated conservation planning. It is anticipated that through time, most estuaries will be under increasing pressures from recreational and commercial uses, which, if not carefully managed, could lead to the degradation of the natural resources upon which many people directly or indirectly rely. This EstMP should be seen as an active working document, which should be updated on an ongoing basis to encourage current best practise - potentially based on the precautionary principle and/or current best knowledge, adapting to changes and opportunities, and evolving day by day with the living processes of the estuary, the local community, conservation, environmental management practices and scientific knowledge. In line with the National Estuarine Management Protocol (2021) published in terms of section 33(2) of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICMA), the iSimangaliso Authority has developed an EstMP for each of the three estuaries within the iSimangaliso Wetland Park. This EstMP is based on the current environmental situation (biophysical and socio-economic aspects included) of the Mgobozeleni Estuary as described in the Situation Assessment Report.

The iSimangaliso Wetland Park has three major estuarine systems, namely Lake St Lucia, Mgobozeleni and Kosi Bay, all of which are categorised as Estuarine Lake estuary types and which fall within the boundaries of the World Heritage Site. The Mgobozeleni Estuary is situated on the Mozambique coastal plain to the east of the Lubombo mountains in the uMkhanyakude District Municipality. While it serves as an important steppingstone between the larger estuarine lakes of Lake St Lucia and Kosi Bay to its north and south, it has different and unique characteristics making it quite different from the adjacent estuaries despite their similar categorisation and location.
For the purposes of this EstMP and in the absence of a completed Environmental Water Requirements (EWR) study, the geographical boundaries of the Mgobozeleni Estuary are defined

by the 5 m topographical contour and the area within this boundary is known as the Estuarine Functional Zone (EFZ). Within this boundary, the Mgobozeleni Estuary comprises of two interconnected water bodies, Mgobozeleni in the south and Lake Shazibe in the north, and a broad channel leading to the tidal inlet or estuary mouth. Its tidal inlet exits to the sea at Sodwana Bay, a popular holiday resort for both local and international tourists. Unfortunately, not much scientific information exists which allows a detailed assessment of the estuary. Existing information from the 1970s and 1980s provides some indication of the biodiversity of this system but recent information is scarce, with the exception of work on the invasive alien snail *Tarebia granifera*, which is present in the estuary.

The estuary falls within the tropical region and this determines the nature of the plants and animals which are found within its boundaries. In addition, the geology of the area in which this estuary is situated determines the nature of its catchment. High porosity results in the rapid infiltration of surface water which means that groundwater recharge is the main driver of this estuary. The estuary sits within quaternary catchment W70A. The groundwater capture zone feeding the system with freshwater is estimated to be 8,500 – 10,000 ha. Two thirds of this catchment have been moderately to severely transformed, the remaining one third within the iSimangaliso Wetland Park is largely undeveloped.

The mouth of the Mgobozeleni is dynamic and migrates northward with longshore drift. The protection of Jesser Point allows water outflows and tidal currents to maintain an open mouth state at lower flow conditions than other estuaries with comparable outflows. A long history of artificial breaching is documented in the literature and this is considered to affect the Estuarine Health Index and the physical state of the estuary. The physio-chemical character of the system has not been well documented with only few references dating back 35 years, documenting salinity, temperature, pH and other abiotic parameters including pollutants. This EstMP contains nine chapters as stipulated in the Guidelines for the Development and Implementation of Estuarine Management (2015).

Table of Contents

Table of Figures

List of Tables

Glossary and Abbreviations

Amsl	above mean sea level
Anthropogenic	Having to do with people, or caused by humans
Benthic Macroinvertebrates	Or benthos, refers to invertebrates attached to, living on (epifauna) or in (infauna) the substratum, that can be captured by a 500 µm net or sieve
BGIS	Biodiversity Geographic Information System (GIS) developed and managed by the South African National Biodiversity Institute and accessed at http://www.bgis.sanbi.org/
Biodiversity	The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems
Catchment	In relation to a watercourse or watercourses or part of a watercourse, this term means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points
Community	Assemblage of organisms characterised by a distinctive combination of species that occupy a common environment and interact with one another
Community composition	All taxa, plants and animals, present in a community
Cumulative impact	Impact on the environment which results from the incremental or combined effects of one or more developmental activities in a specified area over a particular time period, which may occur simultaneously, sequentially, or in an interactive manner
CWDP	Coastal Waters Discharge Permit under the National Environmental Management: Integrated Coastal Management Act No. 24 of 2008
DAFF	Department of Agriculture, Forestry and Fisheries
DDT	Dichloro-diphenyl-trichloroethane is a colourless, odourless substance used as an insecticide
DEA	Department of Environmental Affairs (National)
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs (KwaZulu-Natal)
DFFE	Department of Forestry, Fisheries and Environment
Dilution	The reduction in concentration of a substance due to mixing with water
DWS	Department of Water and Sanitation (formerly Department of Water Affairs (DWA) and Department of Water Affairs & Forestry (DWAF))
EFZ	Estuarine Functional Zone. Low lying land adjacent to the river or estuary periodically flooded and where river borne materials are deposited, including areas adjacent to the estuary banks and below the 5 m amsl for the intermittently open estuaries along the KZN coastline, as described on BGIS
EIA	Environmental Impact Assessment in terms of the 2014 Regulations under the National Environmental Management Act No. 107 of 1998
ENSO	El Nino Southern Oscillation is a recurring climatic pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean
Environmental Flows	The quantity and quality of water required to sustainably keep aquatic systems healthy and in the classified ecological management category
Environmental impact	A discrete (definable) interaction between a project activity and one or more components of the environment (biophysical and social)
EPA	Estuarine Protected Areas
EstMP	Estuary Management Plan. A document that is pivotal in protecting estuaries from pressures such as activity within and around estuaries, changes to the flow of freshwater into estuaries, and detrimental land-use practices throughout the

	catchment
Eutrophic	Rich in mineral and organic nutrients that facilitate prolific plant growth
EWR	Environmental Water Requirements
GIS	Geographic Information System. GIS is a combination of computer software and hardware tools used for creating maps and analysing spatial data. GIS links the map and database information so that questions can be asked and answers given in map or visual form
Guidelines	Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol, published by the Department of Environmental Affairs in March 2015

Habitat	The natural home of an organism or community of organisms (this also includes the surrounding area). This includes biotic and abiotic features. Habitat loss or fragmentation is one of the primary causes of the loss of biodiversity and resilience
Hypertrophic	Conditions characterized by elevated mineral and organic nutrients in aquatic environments resulting in boom-and-bust cycles of plant growth often leading to cycles of oxygen super-saturation and oxygen depletion in the water column
IAP	Invasive Alien Plant. A plant species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health
ICM Act	National Environmental Management: Integrated Coastal Management Act No.24 of 2008
IMP	Integrated Management Plan. A plan that strives to integrate conservation, tourism development and the local economic development and empowerment of historically disadvantaged communities.
Invasive alien species	A species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health
IOE	Intermittently Open Estuary, also known as Temporarily Open/Closed Estuary. This is an estuarine classification that groups all estuaries that are periodically closed off from the sea by a sand bar. These systems can close for varying lengths of time, and during closure, the areas upstream from the mouth are back-flooded. The highest water level reached by KwaZulu-Natal estuaries during natural mouth closure events is approximately 5 m above mean sea level
IPCC	Intergovernmental Panel on Climate Change
KZN	KwaZulu-Natal
MAR	Mean Annual Runoff
MER	Marine & Estuarine Research cc
NEMA	National Environmental Management Act No. 107 of 1998
NEMP	National Estuarine Management Protocol in terms of section 33 of the National Environmental Management: Integrated Coastal Management Act No. 24 of 2008; Government Notice No. 341, published in Government Gazette No. 36432 on 10th May 2013
NEMPAA	National Environmental Management Protected Areas Act 57 0f 2003 (Act No 57 of 2003) (as amended) provides for the protection and conservation of ecologically viable areas of South Africa's biological diversity, natural landscapes and seascapes, and for the establishment of a register of protected areas (SAPAD).
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act No. 36 of 1998
Oligotrophic	Conditions characterised by low mineral and organic nutrients resulting in limitations to plant growth / primary production
PDO	Pacific Decadal Oscillation is a climatic event experienced over 20 to 30 years covering the Pacific Ocean
PES	Present Ecological Status. This is a measure of the health of a water resource. The status is based on a comparison between the original / reference condition and the present state according to the reserve determination method of the Department of Water and Sanitation (DWAF 2008. Water Resource Protection and Assessment Policy Implementation Process. Resource Directed Measures for protection of water resources: Methodology for the Determination of the Ecological Water Requirements for Estuaries. Version 2). This is generally denoted by a classification that can range from an "A" being unmodified to an "F" being critically modified

PFMA	Philippine Fish Marketing authority
POM	Particulate Organic Matter
Runoff	Runoff is the water yield from an individual catchment – the sub-catchment plus the runoff from all upstream sub-catchments. Runoff includes any seepage, environmental flow releases and overflows from the reservoirs in a catchment, if they are present
SANBI	South African National Biodiversity Institute
SAR	Situation Assessment Report. The report provides an overview of the spatial and physical characteristics of an estuary.
Special Limit Values	Department of Water Affairs and Sanitation's more stringent water quality limits / requirements that are applied when wastewater / effluent quality should be higher than General Limit Values for release to a water resource without a water use license in accordance with GN 169 of 2013
Stormwater run-off	Stormwater run-off from paved areas, including parking lots, streets, residential subdivisions, buildings, roofs, highways, etc.
TOCE	Temporarily Open/Closed Estuary. Also known as an Intermittently Open Estuary
TWQR	Target Water Quality Range established by the Department of Water Affairs and Forestry in a set of guidelines published in 1996
Wastewater	Water containing solid, suspended or dissolved material (including sediment) in such volumes, composition or manner that, if spilled or deposited in the natural environment, will cause, or is reasonably likely to cause, a negative impact
WWTW	Wastewater treatment works. Facility for the treatment of domestic or industrial wastewater designed to remove biological or chemical waste products from water to ensure that water discharged downstream/to the environment is of an acceptable quality
WULA	Water Use License Application under the National Water Act No. 36 of 199

1. Introduction

Estuaries are among the most productive types of ecosystems worldwide. They are focal points for community and business activities along the coast, as they provide a wide range of opportunities and benefits. An estuary is an area where a freshwater river or stream meets the ocean (Lassiter, 2021). Estuaries require integrated cross-sectorial planning and management as they include stakeholders that are involved in land use planning, management of freshwater and marine resources. EstMPs seek to achieve greater harmony between ecological processes and human activities while accommodating orderly and balanced estuarine resource utilisation. iSimangaliso Authority has developed an EstMP for each of the three estuaries within the iSimangaliso Wetland Park in line with the National Estuarine Management Protocol (2021). The Mgobozeleni EstMP (2016) provides a summary of the estuary's situation assessment, management objectives and programme of actions for estuary management. According to the NEMP (2021), an EstMP is to be reviewed every 5 years in order to ensure that it is up to date with current legislative requirements, national and international best practice and informed by most recent situational assessments at a local level. This document is therefore a reviewed version of the 2016 EstMP. Information from the 2016 EstMP was used as a foundation for the development of this reviewed EstMP. This document provided a summary of the updated situation assessment of the Mgobozeleni which speaks to the current state of the estuary. Estuaries are subjected to influences from marine, riverine and terrestrial ecosystems, which subjects them to a lot of change over the years. This reviewed EstMP had to take into account those changes in order to formulate updated management objectives and programme of actions. This updated information is not entirely new but builds on the existing objectives and actions stipulated in the 2016 EstMP.

1.1 Background

The iSimangaliso Wetland Park is located in an area known as Maputaland, within the uMkhanyakude District Municipality, northern KwaZulu-Natal Province, South Africa. The Park stretches across open seas, reefs, beaches, forests, savannahs, lakes, rivers and mountains to include all the natural wonders that have drawn travellers and explorers to Africa for centuries. The terrestrial component of the iSimangaliso Wetland Park is approximately 332 000 hectares in size. The Indian Ocean forms the eastern boundary of the park, which extends from the Mozambican border in the north, to Maphelane in the south and includes the uMkhuze section in the west. The Park traverses approximately one third of the KwaZulu-Natal coastline.

The Park is under the management of the iSimangaliso Authority and reports to the Minister and is mandated to implement the policies and principles of the World Heritage Convention, the Act and the National Environmental Management Protected Areas (NEMPAA). The iSimangaliso Authority is listed as a Schedule 3a Public Entity under the Public Finance Management Act (PFMA) and is the protected area manager in terms of the National Environmental Management Protected Areas (NEMPAA) Act. The name "iSimangaliso" means miracle and wonder, which aptly describes this unique place. ISimangaliso was proclaimed a World Heritage site in December 1999 in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. With an additional 970,66.57 hectares of ocean now falling under the iSimangaliso MPA, iSimangaliso's combined terrestrial and marine area is some 1,328,900ha (or 13,289 square kilometres), also making it the second largest protected area in the country after the Kruger National Park.

In South Africa, estuaries are generally classified on the basis of physiographic (tidal prism and size), hydrographic (mouth state and mixing process) and salinity characteristics (Whitfield, 1992). iSimangaliso has three major estuarine systems, viz. Lake St Lucia, Mgobozeleni and Kosi Bay, all of which are categorized as estuarine coastal lakes. Estuarine coastal lakes typically comprise one or more large circular waterbodies which are connected to the sea by an inlet channel (Van Niekerk et al., 2020).

These systems are usually drowned river valleys filled in by reworked sediments and separated from the sea by vegetated sand dune systems. Estuarine coastal lakes can be permanently open or closed for periods when the link with the sea is lost and can have large salinity fluctuations driven by changes in freshwater input, evaporation, and sea condition. The tidal prism is small and marine and river input have little influence on water temperatures, which are directly related to solar heating and radiation. Estuarine, marine and freshwater organisms all occur depending on the salinity condition of the system. These are three of twelve estuarine coastal lakes on the South African coast and are now the only three intact systems within the sub-tropical and tropical bioregions. All estuarine lakes are under threat from infrastructure development, flow reduction, nutrient pollution, overfishing, mouth manipulation and climate change (Van Niekerk et al., 2019).

The Mgobozeleni estuarine lake system, which incorporates two lake areas linked physically and biologically to the sea via a narrow channel, lies strategically between the other two

iSimangaliso estuary systems, Kosi Bay in the north and Lake St Lucia in the south (Figure 1). Like Kosi Bay, it is situated on the Mozambique coastal plain and is composed of two interconnected lakes and has a reed-lined channel leading to the Indian Ocean at the coastal resort of Sodwana Bay. This document details the updated Estuary Management Plan (EstMP) for the Mgobozeleni system and draws on the Situation Assessment background report and other supporting documents.

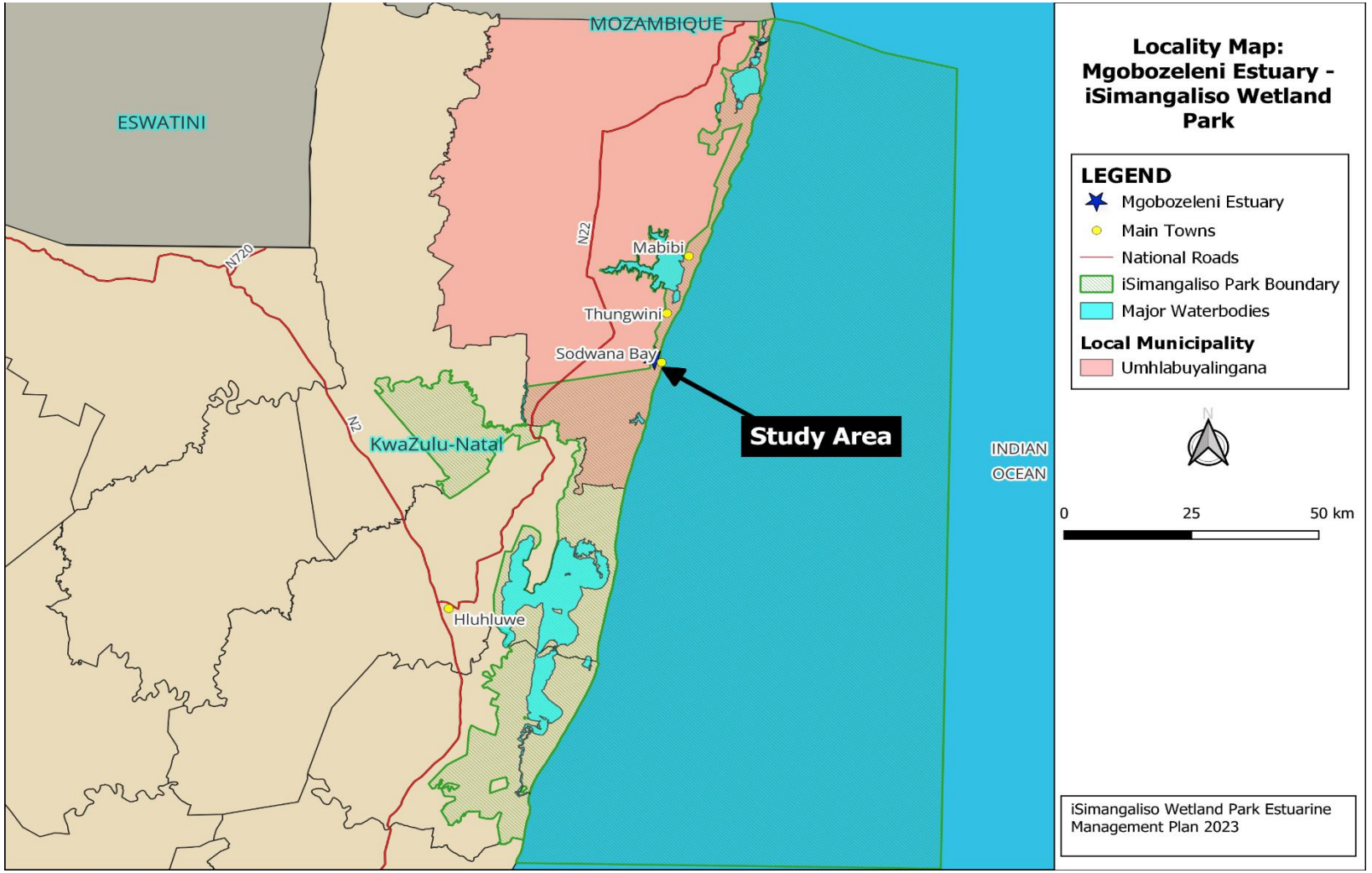


Figure 1: Locality map of the Mgobozeleni Estuary within the iSimangaliso Wetland Park.

1.2 Legal Framework

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

In South Africa, this is addressed in terms of Chapter 4, Section 34 of the National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) together with the National Estuarine Management Protocol of 2021. The Act stipulates that Estuary Management Plans (EstMP) are required for all estuaries along the South African coastline, while the Protocol provides guidance for the development and implementation of EstMP. EstMPs must be consistent with the relevant Coastal Management Programmes, while further guidance is provided by the Department of Forestry, Fisheries and the Environment's (DFFE) "Guidelines for the development and implementation of EstMPs".

The EstMP is also aligned with related legislation, notably relevant provisions of the World Heritage Convention Act (Act No. 49 of 1999) (WHC Act), the Marine Living Resources Act, 1998 (Act 18 of 1998), the National Environmental Management: Biodiversity Act (Act 10 of 2004), National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003), National Environmental Management: Integrated Coastal Management Act 2008 (Act 24 of 2008), the Public Finance Management Act, 1999 (Act 1 of 1999) and the Disaster Management Act (Act 57 of 2002), read with the Disaster Management Amendment Act (Act 16 of 2015). Further, in terms of development planning, the EstMP also needs to be aligned with the National Development Plan, 2030, the KZN Provincial Growth and Development Strategy, 2035, Integrated Development Plan (IMP) and the District Municipality Integrated Development Plan.

According to the National Estuarine Management Protocol (2021), a detailed review of an EstMP must be conducted at least every five (5) years. A previous EstMP for the Mgobozeleni Estuary was compiled in 2016; as such, this EstMP reviews the previous EstMP and builds on this version to provide an updated and more comprehensive EstMP that follows the updated National Estuarine Management Protocol 2021 Protocol.

The Protocol states that as the responsible authority, iSimangaliso must develop the EstMPs. Also, section 34 (1) (b) (i & ii) states that the EstMP must be consistent with the Protocol and the National Coastal Management Programme (NCMP). The Protocol is silent about the adoption of one or more EstMPs in the iSimangaliso circumstances. Neither a provincial management programme nor a municipal coastal programme is applicable to iSimangaliso. However, the national coastal management programme is applicable to iSimangaliso. Section 52 of the ICM Act requires consistency between coastal management programmes and other statutory plans. A statutory plan means a plan, policy or programme adopted by an organ of state. The Integrated Management Plan (IMP) for iSimangaliso is such a statutory plan. The Minister approves the IMP and, consequently, to give effect to the purpose of the ICM Act, the EstMP must, therefore, form part of the IMP.

This EstMP has taken into consideration all the requirements of the ICM Act and the Protocol. In terms of section 34(1) (d) of the ICM Act, iSimangaliso is required to submit an annual report to the Minister on the implementation of the EstMPs. iSimangaliso already reports to the Minister through the DFFE annually and will include this EstMP reporting requirement in that annual report.

The development of an EstMP follows a three-step process that involved a scoping phase (Situation Assessment Report), objecting setting phase and the development of the implementation phase (Figure 2). An adaptive management approach should be adopted during the latter phase with detailed reviews being conducted at five-yearly intervals.

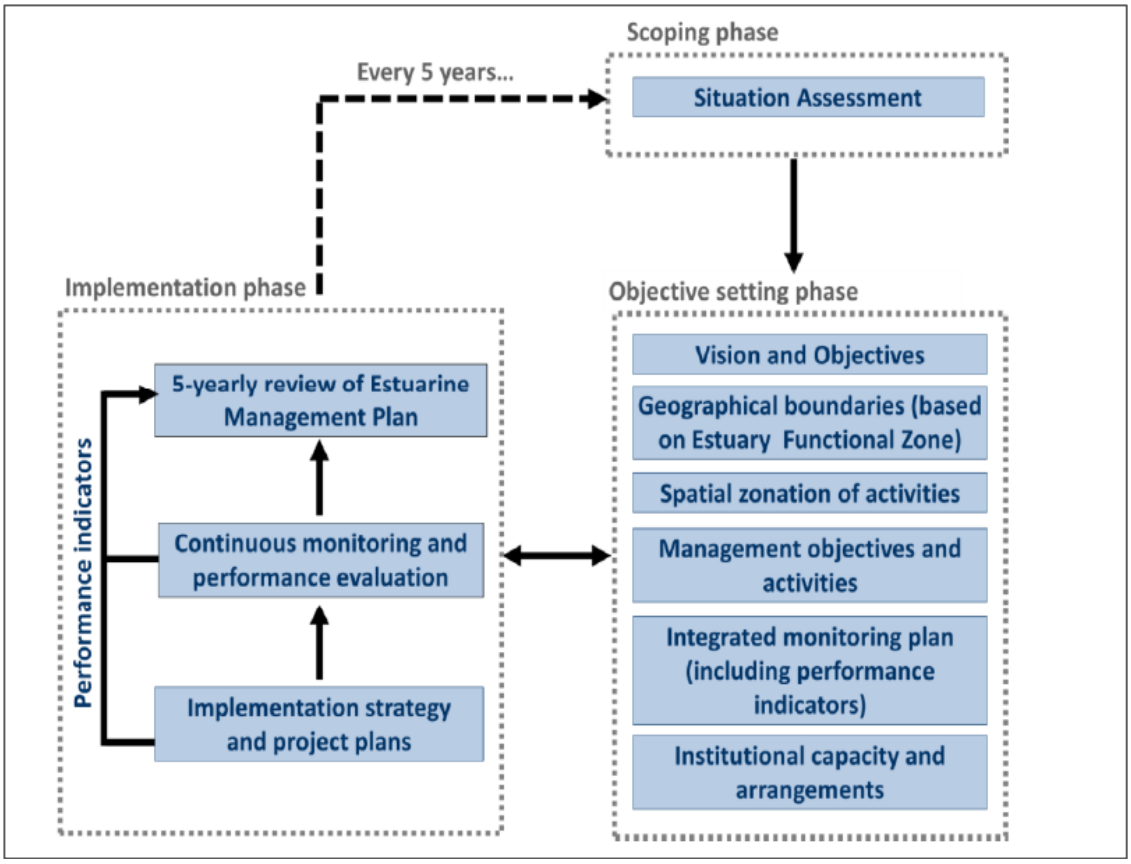


Figure 2: A framework for integrated estuary management in South Africa (DEA, 2015).

Prior to the ICM Act and the Protocol, all the estuaries in iSimangaliso were managed in terms of the provisions of the IMP and various statutes, including:

National Estuarine Management Protocol and Section 53 of the NEM: ICMA.

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) ("the ICM Act") which was promulgated in December 2009, requires estuaries of the Republic to be managed in a coordinated and efficient manner, in accordance with a National Estuarine Management Protocol ("the Protocol"). Section 33(2) of the ICM Act empowers the Minister responsible for Environmental Affairs with the concurrence of the Minister responsible for Water Affairs to publish a Protocol that will provide guidance for the management of estuaries through the development and implementation of estuarine management plans (EstMPs). The EstMPs seek to achieve greater harmony between ecological processes and human activities while accommodating orderly and balanced estuarine resource utilization

National Water act (1998)

The purpose of this Act is to ensure that the nation's water resources are protected, used,

developed, conserved, managed and controlled in ways which take into account amongst other factors –

- meeting the basic human needs of present and future generations;
- promoting equitable access to water;
- redressing the results of past racial and gender discrimination
- promoting the efficient, sustainable and beneficial use of water in the public interest;
- facilitating social and economic development; providing for growing demand for water use;
- protecting aquatic and associated ecosystems and their biological diversity;
- reducing and preventing pollution and degradation of water resources
- meeting international obligations;
- promoting dam safety;
- managing floods and droughts.

World Heritage Convention Act, 1999 (Act 49 of 1999) (WHCA) and associated operational guidelines.

In 2000, iSimangaliso was proclaimed a World Heritage site in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. The World Heritage Convention Act provides a fundamental commitment to the protection, conservation, preservation and presentation of World Heritage values, with a strong emphasis on local economic development. This balance is appropriate in the South African context in which high levels of poverty necessitate an approach that optimises the economic potential of World Heritage sites without compromising their natural and cultural integrity.

National Environmental Management: Biodiversity Act,2004 (Act 10 of 2004) (NEM:BA)

The National Biodiversity Act, 2004 (Act 10 of 2004) provides for the management and conservation of South Africa's biodiversity. This includes the protection of specific ecosystems and species, equitable and sustainable use of indigenous biological resources.

National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) (NEM:PA).

As a World Heritage site and protected area, the iSimangaliso Wetland Park is also governed by the National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) which affords

additional protection and makes provision for management and management plans in support of what is provided for in the World Heritage Convention Act. Regulations promulgated under the National Environmental Management: Protected Areas Act also contain provisions regarding Management Plans.

National Environmental Management: Integrated Coastal Management Act, 2008 (Act 24 of 2008) (NEM: ICMA)

The National Environmental Management: Integrated Coastal Management Act 24 of 2008 aims to establish a system of integrated coastal and estuarine management in the Republic, including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable; to define rights and duties in relation to coastal areas; to determine the responsibilities of organs of state in relation to coastal areas; to prohibit incineration at sea; to control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment to give effect to South Africa's international obligations in relation to coastal matters; and to provide for matters connected therewith.

National Environmental Management Act, 1998 (Act No 107 of 1998) (as amended) and relevant Regulations there under, including the EIA Regulations (2017)

The National Environmental Management Act 107 of 1998 intends to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith.

National Forests Act, 1998 (Act No. 84 of 1998).

The purposes of this Act are to

- promote the sustainable management and development of forests for the
- benefit of all;
- create the conditions necessary to restructure forestry in State forests;

- provide special measures for the protection of certain forests and trees:
- promote the sustainable use of forests for environmental, economic.
- educational. recreational, cultural, health and spiritual purposes:
- promote community forestry;
- promote greater participation in all aspects of forestry and the forest products industry by persons disadvantaged by unfair discrimination.

Marine Living Resources Act, 1998 (Act 18 of 1998) (MLRA).

The entire coastline of the iSimangaliso Wetland Park is a proclaimed World Heritage site under the World Heritage Convention Act. Approximately three quarters of this coastline (from Kosi Bay to 1 km south of Cape Vidal) was proclaimed as two Marine Protected Areas (MPAs) (St Lucia and Maputaland) through Government Notice3 under the Marine Living Resources Act, 1998 (Act 18 of 1998), which provided specific protection to the marine environment. Subsequently these were consolidated into a single iSimangaliso Marine Protected Area proclaimed on the 23rd of May 2019 in terms of the National Environmental Management: Protected Areas Act.

ISimangaliso Wetland Park integrated management plan

The terrestrial portion of the iSimangaliso Wetland Park occupies an area of approximately 358,534 ha comprising fifteen ecosystems and a number of notable and diverse landscapes. In 2000, iSimangaliso was proclaimed a World Heritage site in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. It is under this Act that the iSimangaliso Wetland Park Authority has prepared an Integrated Management Plan (IMP). The IMP is aligned with related legislation, notably relevant provisions of the Marine Living Resources Act, 1998 (Act 18 of 1998), the National Environmental Management: Biodiversity Act (Act 10 of 2004), National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) and the Public Finance Management Act, 1999 (Act 1 of 1999). The objective of the IMP is to provide measures to protect and manage the World Heritage site in a manner that is consistent with the objectives and principles of the governing Acts. The IMP document is, therefore, the statutory decision-making framework that the iSimangaliso Authority uses to develop and manage the Park. Currently the 2022 iteration has not yet been approved by the Ministry of the DFFE but will be mentioned.

Before the proclamation of iSimangaliso, all the estuaries in iSimangaliso were in protected areas

and were managed as part of a greater conservation area by the duly appointed conservation manager for the particular area. The iSimangaliso Wetland Park Authority is accordingly the responsible authority for the development and implementation of an Estuary Management Plan for Mgobozeleni Estuary and any other activity that influences the system[1].

Given the legislative and institutional complexity of coastal management in South Africa, the purpose of an EstMP is to provide for the integrated and coordinated management of activities affecting estuarine resources. The top six such activities prioritised in the National Biodiversity Assessment (Van Niekerk et al., 2019) were:

i. Flow modification e.g., water abstraction (either directly from the system or indirectly by alien plants, timber plantations), urban stormwater runoff, etc.
ii. Pollution e.g., wastewater treatment works, industrial effluent, agrochemicals, etc.
iii. Exploitation of living resources e.g., fish, invertebrates, plants and plant-parts.
iv. Habitat destruction (e.g., low-lying development, bridges, mining, etc.).
v. Climate change (reflected in modified rainfall patterns, temperature changes, increased storminess, and sea level rise).
vi. Biological Invasions (Invasive alien plants, invertebrates and fish)

The EstMP Guidelines have, therefore, determined the core sectors to be addressed by the management objectives within each EstMP. These are:

i. Sustainable resource use.
ii. Conservation.
iii. Water quantity and quality.
iv. Socio-cultural values.
v. Capacity building.
vi. Land use regulation.
vii. Compliance monitoring and enforcement.
viii. Climate change.

The EstMP for Mgobozeleni has been developed using existing and available information to:

i. Update the Situation Assessment.

ii. Set a vision and management objectives, which are aligned with iSimangaliso's IMP.
iii. Provide an updated description and guidance for the key management actions and programme.

1.3 Purpose of this report

The purpose of the report is to reveal to interested and affected parties, stakeholders and partners the proposed content of the Estuarine Management Plans for the Mgobozeleni Estuary to be reviewed and updated. The objective is to review the Mgobozeleni Estuary Management Plan (EstMP) to ensure it is up to date with current legislative requirements, national and international best practice and informed by most recent situational assessments at a local level. The development of a revised Mgobozeleni Estuary Management Plan is informed by the National Estuarine Management Protocol (2021) and the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) ("the ICM Act"). It is understood that the overall objective is to identify and streamline estuarine activities and improve the health status of the system and its ability to provide goods and services; and ensure integration of the roles and responsibilities of various state organs and municipalities.

1.4 Estuary Management Plan Structure

As per NEMP (2021) the key elements of an EstMP are:

- An executive summary of the Situation Assessment Report (SAR) that highlights the key information that would inform and/or influence the management decisions within the estuary;
- A geographical description and a map of the estuary based on the Estuarine Functional Zone (EFZ) clearly identifying the boundaries of the system. Any deviation from the EFZ should be motivated for;
- The local vision and objectives that give effect to the strategic vision and objectives of the protocol;
- A list of management objectives and activities, that at minimum addresses the following: conservation and utilisation of living and non-living resources (taking into account the priority biodiversity list in the 2018 National Biodiversity Assessment and subsequent updates), social issues, land-use and infrastructure planning and development, water quality and quantity, climate change, education and awareness; compliance and enforcement, and any other activities that will be required to maintain and or improve the

condition of the estuary;

- Details of intended spatial zonation of the estuary specifying activities that may or may not take place in different sections of the estuary, and indicating:

  (a) which organs of state will need to be consulted given the type of zonation that is proposed; and

  (b) which organs of state will need to enact the relevant laws to implement the proposed zonation (for example, if a no-fishing zone is proposed then either the relevant department or departments responsible for fisheries and protected areas will be required to consider declaring a closed area or a protected area, respectively);
- A detailed integrated monitoring plan with a list of performance indicators for gauging the progress with respect to achieving the objectives of the EstMP; and
- Details of the institutional capacity and arrangements required for managing different elements of the EstMP, taking into account different departmental mandates.

2. Synopsis of situation assessment

This section provides an overview of the key features, concerns and issues of the Mgobozeleni system to provide context for the management objectives and actions (Section 3). Since 2016, our knowledge of the Mgobozeleni system has been greatly enhanced from a detailed report produced under a dedicated Water Research Commission project (Bate et al., 2016), together with a PhD on the hydro chemical aspects (Millicent, 2019) and macrophyte vegetation analysis (Taylor, 2016). This information is adopted from the Situation Assessment Report. (SAR). The SAR forms an integral part of the development of an EstMP, providing a clear understanding of the status quo, as well as important considerations for estuarine management planning. The inputs of the Estuarine specialists contribute towards updating of the current EstMP by providing a SAR. The Situation Assessment report provides a framework of relevant and available information that enables the development of the Estuary Management Plan, as stipulated under the National Environmental Management: Integrated Coastal Management Act 2008 (As amended in Act No 36 of 2014) (ICMA Act). The report provides an overview of the spatial and physical characteristics of the estuary, describes the current state of the estuary and provides a review of the legal framework relevant to the system; a summary of the social and economic context including land-use patterns; a description of the estuaries biophysical characteristics; assessments undertaken in relation to

ecological water quality and quantity, flow rates and ecosystems goods and services and related management recommendations; management opportunities and constraints; and information gaps currently faced in the system. Although the Mgobozeleni is the smallest of iSimangaliso' s three estuaries, it is intricate and complex and there are many threats to its hydrological and ecological function. The Mgobozeleni is one of five estuarine lakes in the country (with the St Lucia and Kosi estuaries also been classified as estuarine lakes) (Van Niekerk, 2023).

2.1 Catchment Characteristics

The estuary falls within the tropical region, and this determines the nature of the plants and animals which are found within its boundaries. The geology of the area in which this estuary is located determines its catchment characteristics. The geology underlying the iSimangaliso Wetland Park consists of Jurassic Period (201 – 145 Ma7) lavas, followed by sediments of the Cretaceous (145 – 65 Ma), Tertiary (65 – 2.5 Ma) and Quaternary Periods (2.5 Ma – Present) covering the Makhatini Flats of the Zululand Coastal Plain. "During the Cretaceous Period, much of the area was below sea level during periods of transgression, creating a hydrogeological unit of claystone and siltstone with very low hydraulic conductivity and storativity. The Zululand Group behaves as an aquiclude with residual brackish water and forms the base of the regional aquifer" (Bate, et al., 2016). Coverage of the coastal plain is dominated by sediments of the Maputaland Group, reflecting the last circa 13 Ma years of earth's geological history. The uppermost, youngest Holocene sediments of the *Sibaya Fm* and reworked sands from the *Kwa Mbonambi Fm* cover a large section of the Mgobozeleni area and have relatively high hydraulic conductivity and drain rapidly (DLP 1992). Soil pH is acidic, ranging from 3.18 to 6.55 (mean = 4.5). The Maputaland coastline is aligned NNE-SSW and is fairly straight, apart from a series of small aeoleonite (rock formed from sediments deposited by wind) or beach rock headlands and coastal platforms, which give rise to gentle log-spiral shaped sandy bays to their north; this is in response to the predominant south-south-easterly swells and northward longshore drift.

The estuary sits within quaternary catchment W70A and lies strategically between the other two iSimangaliso estuary systems, viz. Kosi Bay in the north and Lake St Lucia in the south. The Mgobozeleni comprises of low-lying palaeodunes with interdunal depressions that are aligned with the coastline. These were incised by fluvial processes to form the main streams feeding into Lakes Mgobozeleni and Shazibe upstream of the estuary" (Bate, et al., 2016). Due to the absence of large volume rivers discharging into these water bodies, siltation has not been

considered to be an issue. The estuary system is largely groundwater driven and is relatively shallow with a maximum depth of 2m. The groundwater capture zone feeding the system with freshwater is estimated to be 8,500 – 10,000 ha. Two thirds of this catchment have been moderately to severely transformed, the remaining one third within the iSimangaliso Wetland Park is largely undeveloped. Dominant land cover types surrounding the Mgobozeleni include plantations, cultivated land and built-up areas which include towns and infrastructure (Figure 4).

Figure 3:Images showing the Mgobozeleni estuary system

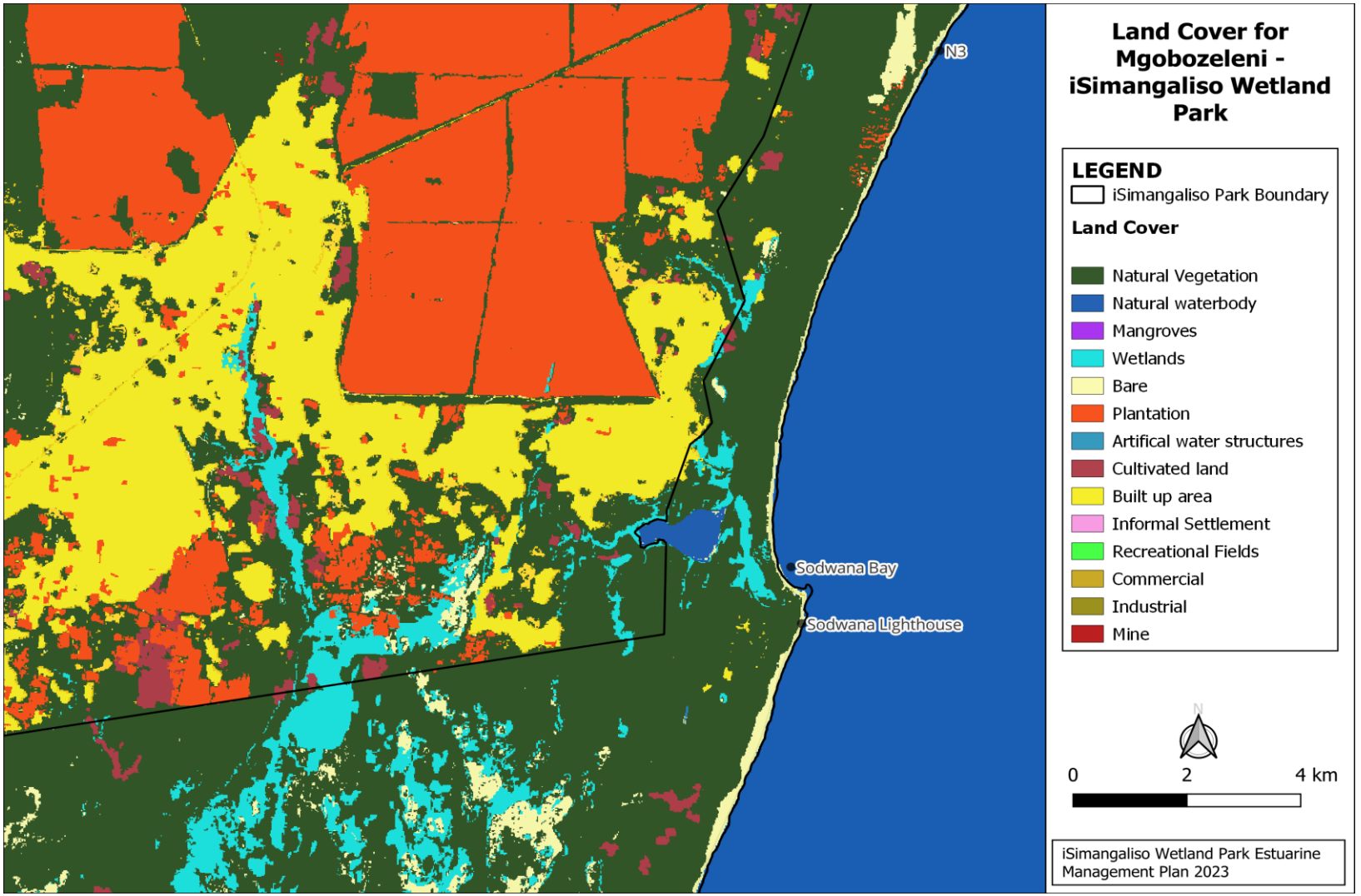


Figure 4: Land cover types surrounding the Mgobozeleni Estuary.

The Mgobozeleni is included in the list of South African estuaries as one of the rarer types of estuary, being classified with the estuary category of 'coastal lake' on the basis of its size and the relative extent of tidal influence (Whitfield & Baliwe, 2013), whereas van Niekerk (2023) refers to it as an 'estuarine lake'. However, Kelbe, et al (2016) regards the Mgobozeleni Estuary as a Temporarily Open/Closed Estuary (TOCE) rather than an estuarine lake system, as it has a cycle of open and closed phases. During closure, a sand berm develops, which may be overtopped during spring high tides, until it is forced open again, whether by swells, rainfall discharge or a combination of the two.

2.2 Abiotic Function

iSimangaliso falls within the humid tropical climatic zone of Africa (Köppen classification Cwa), with the warm Agulhas Current offshore having a moderating influence. Summers are hot and humid, whilst winters are mild, with intermittent cold spells associated with the passage of cold fronts. About 75% of the rainfall along the coastal margin occurs during the spring to autumn months of October to April. Mean annual rainfall for the Maputaland Coastal Plain is approximately 1 200 mm per annum (pa) along the coastal margin. Rainfall is an important parameter as it influences lake levels, groundwater levels, estuary mouth dynamics and vegetation growth. The coastal ecosystems in Zululand are driven to a large degree by multi-year wet-dry cycles. There is a great degree of interannual variability in rainfall, with dry and wet periods linked to El Nino-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) cycles. Winds blow predominantly coast parallel, from the north to north-north-east (NNE) and south to south-west, in approximately equal proportions. There are seasonal variations, with NNE winds more dominant during summer and south-west and north-west winds more prevalent during winter.

The warm Agulhas Current flows offshore of the coast, from north to south. Inshore of this is the considerable net northward, longshore transport of sediment, in response to predominant south-south-east (SSE) to east-south-east (ESE) swells, which exerts a major influence on intertidal habitats. However, prolonged north-easterly winds can impose a north-easterly to easterly swell direction, causing a reversal in the longshore drift and a phenomenon called beach rotation, manifested as a change in beach erosion and deposition patterns (Guastella & Smith, 2014). A synoptic scale (i.e. over a few days, associated with passing weather systems) variability in the swells and winds is superimposed on seasonal variability, which results in dynamic changes in sediment movement along the coast. Added to this is the effect of tides; the tidal range in the area

is of the order of 1.5 to 2.3 m.

The physio-chemical character of the system has not been well documented, with few references dating back 35 years, documenting salinity, temperature, PH and other abiotic parameters including pollutants. The lack of water quality data is clearly an information gap that needs to be considered for future long-term monitoring. However, the Water Research Commission project of 2016 (Bate, et al) provides updated information. The results of the estuary water analyses (2013-2015) indicates that there was no serious pollution in the estuary water, but that values for nitrogen and phosphate were likely at times to be slightly elevated above a desirable ecological level. Water temperatures range from 27 to 24^{o}C in summer and 19 to 24^{o}C in winter (Bate, et al., 2016).

Stratification of the water is a common occurrence within the estuary. Seawater may penetrate up to 700m within the estuary, however because mixing does not occur, the dense saltwater sinks leaving a layer of freshwater above. As a result, saltwater seldom reaches the roots of the floodplain swamps. Recent salinity information indicated that the lower and middle reaches of the system are characterized by brackish water (>5), up to the bridge. Freshwater conditions prevailed after the bridge and within the lake. Hypoxic conditions were noted just before and after the bridge (DWS, 2022).

2.3 Groundwater

The groundwater aquifer of the Maputaland coastal plain is classified as a coastal aquifer and is considered the largest primary aquifer in South Africa (Meyer et al., 2001). The base of the primary aquifer is formed by the silt- and clay-rich sediments of the Cretaceous period rocks. This terrestrial aquifer is under threat due to the risk posed by seawater intrusion, either by over-exploitation or sea level rise (Ferguson and Gleeson, 2012). There is a declining gradient in groundwater resources, and the depth thereof, from east to west, as determined by the rainfall and underlying geology. Mean annual run-off varies between 200-500 mm pa in the southern coastal strip, 100-200 mm pa in the northern coastal area and 20-50 mm pa in the western portion (Bailey & Pitman, 2015). Average groundwater resource potential shows that the eastern portion of the Maputaland Coastal Plain has 25 000 – 50 000 m^3 /km^2 pa and the western portion 6 000 – 15 000 m^3 /km^2 pa. Aquifer recharge is > 100 mm pa in the east to 5 -10 mm pa in the west (Bailey and Pitman, 2015), or varying between 18% and 5% from coast to inland (Meyer et al., 2001). Average depth to groundwater varies from < 5 m along the coastline to approximately 40 m along the Lubombo range.

Generally, the hydraulic head of the coastal aquifer is seaward (Meyer et al., 2001).

The Mgobezeleni system is largely groundwater driven and has a diversity of important habitats with strong tropical influences, including swamp forest, mangrove, reeds and sedge swamp. The water balance and estuary hydrodynamics will be influenced by direct abstraction via boreholes and wells in the catchment, as well as plantations, which may result in a loss of connectivity between the different parts of the estuary.

2.4 Water Quality and Quantity

The Mgobozeleni Estuary is a clear water system with variable surface water area ranging from 0.2 to 1.3 ha. This is largely dependent on the state of the mouth. When the estuary mouth closes, water within the estuary channel rises, from catchment groundwater, and permeates into the surrounding floodplain. Elevation levels of 3.27 mRl have been recorded during such circumstances. Eventually, when the mouth breaches, a significant volume of water is released. During the April 2014 breaching event, water levels within the estuary dropped by 0.75m at the bridge, with a less significant drop of 0.05m further upstream. The average water depth within the estuary during fully open mouth states is less than 0.5m and 2m at its deeper sites (Taylor, 2016).

The estuary water is dark brown in colour, reflecting high tannins that leach from dead plant material. The main cause is humic acids and peat fragments not reflecting sunlight (Bate, et al., 2017). A significant problem existed in the 1970s in relation to levels of Dichloro-diphenyl-trichloroethane (DDT), and its derivatives, however not much historical information on pollutants or toxins is available. Recent studies relating to the harmful effect of DDT (and derivatives) conducted by Buah Kwofie, et al (2017 and 2018) in the iSimangaliso Park indicate that the continued use of DDT and other chemicals outside of the reserve remains a threat. Elevated residue concentrations of DDT in fish tissue samples indicated ecotoxicological risks to higher trophic level organisms and consequently potential health risks associated with fish consumption (Buah Kwofie, et al 2018).

2.5 Mouth dynamics

The mouth of the Mgobozeleni is dynamic and migrates northward with longshore drift. The sandbar, which controls the mouth position and state of the inlet is a north extending barrier. The protection of Jesser Point allows water outflows and tidal currents to maintain an open mouth state at lower flow conditions than other estuaries with comparable outflows. The mouth position varies and can be placed anywhere from Jesser Point in the south to an area 200 – 300 m north of Jesser Point.

There appears to be a barrier as to how far south the outlet can go. This probably is the result of sand-covered bedrock. The Mgobozeleni mouth goes through various phases from mouth closure to breaching. From the 25th July 2013 to 11th December 2014, the estuary breached 23 times. The estuary mouth is currently open.

Estuary position is controlled by swell direction, a more southerly swell causes an anticlockwise rip-current cell in the lee of Jesser Point which pushes the estuary to the south (Guastella and Smith, 2014). A more easterly swell is more likely to cause a northward flowing estuary. During mouth closure, a sand berm develops, which may be overtopped during spring high tides, until it is forced open again, whether by swells, rainfall discharge or a combination of the two (Figure 6). A long history of artificial breaching is documented in the literature and this is considered to affect the Estuarine Health Index and the physical state of the estuary. Breaching is the term for the opening of an estuary mouth and is a natural response to rainfall and sea conditions. The dynamics of the estuary mouth (see Figure 5) need further investigation – there is an information gap that needs to be addressed; something that could be addressed through use of webcam imagery.

Figure 5: Temporal positions of the Mgobezeleni estuary/ outlet between 2006 and 2022; basemap is 3 June 2022.

This is simply an expression of positional variation over time (see Table 1) using available Google Earth imagery.

Table 1: Sodwana Bay imagery timelines

DATE	COLOUR	COMMENT	MOUTH STATE	SEASON
22/1/2006	Red	Extends North	Closed	Summer
31/5/2011	Blue	Central	Open	Autumn
25/12/2014	L. Green	Central	Closed	Summer
26/3/2016	Yellow	South	Open	Autumn
16/4/2017	Black	South	Closed	Autumn
22/4/2020	Orange	Central	Closed	Autumn
3/6/2022	Turquoise	South	Open	Summer

From Figure 5 it can be seen that the estuary is generally located in the South-Central area, in which location it is more likely to be open. Data in Table 1 is insufficient to link to seasonal variation owing to insufficient statistical data/imagery.

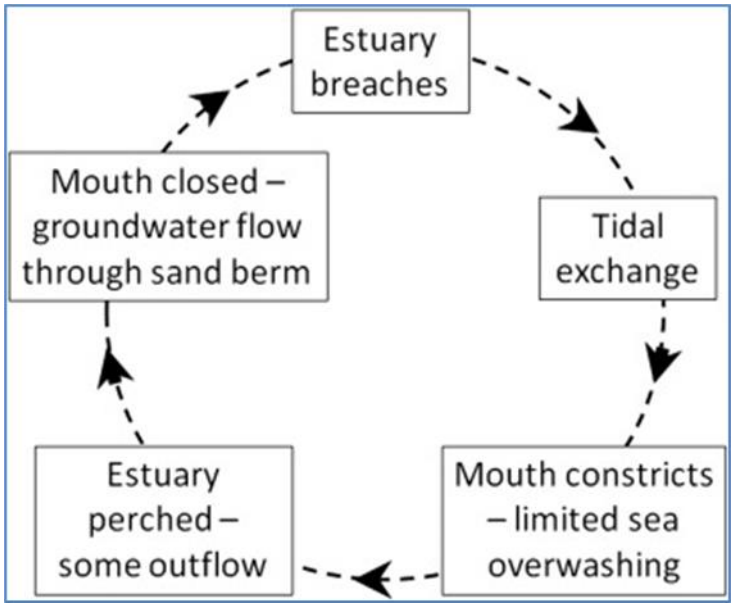


Figure 6: Typical schematic of the breaching and closure of Mgobozeleni estuary mouth (from Bate, et al., 2016).

2.6 Biotic Function

Earlier surveys recorded various species of decapod crustaceans, crabs and molluscs within the estuary. These invertebrates species are largely absent from the system today with the exception of *Varuna litterata* and *Chiromantes eulimene.* (Peer et al., 2018). The invasive gastropod *Tarebia granifera* has, however, been recorded in population densities well over 1000 ind. m^{-2} within the

estuary (Miranda et al., 2011). A recent survey of the estuary noted that the sediment largely consisted of particulate organic matter (POM) which in combination with the low dissolved oxygen measured in the system, would not support a very diverse invertebrate community (DWS, 2022).

The Mgobozeleni Estuary, although smaller than its neighbouring systems, is an important nursery habitat for estuarine dependent marine animals. The present-day fish composition reflects a system of high diversity with 24 marine, eight estuarine, six freshwater, and one diadromous species. In contrast the upstream lagoon is dominated by freshwater species and three estuarine and diadromous species(Whitfield et al., 2017). An updated survey in 2022 recorded 18 fish species in total along with the invasive species *Micropterus punctulatus,* which has not been recorded in the system before. The importance of the small connection between the sea and the lagoon is obvious with the number of diadromous and marine species in the system, of which both would be lost if the mouth had to close for extended periods. Although some previous studies have overlooked the importance of the Mgobozeleni, recent studies confirm that the system is a fully functional estuarine lake (DWS, 2022). Historically, a small population of hippo were also resident in the upper estuary but have not been recorded since the mid-1970s.

The estuary has important plant communities which support a diverse bird population of up to 98 species. The lower estuary is surrounded on both sides by dune forest, although extensive rows of Causerina trees have been planted on the south bank to stabilize the sand. Mangroves (only the black mangrove, *Bruguiera gymnorrhiza)* in combination with the mangrove fern, *Acrostichum aureum* occurred just above the bridge and were considered to be some of the largest specimens of this species in South Africa. Inundation, as a result of bridge construction in the early and late 1970s, resulted in the death of many of these mangroves. Dead trunks of the black mangrove interspersed between the swamp forest and amongst mangrove ferns can still be seen (DWS, 2022). Currently a few 18m tall mangroves can be found within the estuary along with saplings at low densities. The recovery of this mangrove community is promising considering that viable seedlings have been found in recent years (Peer et al., 2018). The surviving mangroves therefore need to be protected particularly from harvesting and human disturbances. A recent survey observed evidence of bark harvesting of the black mangrove above the road bridge (Figure 7).

Figure 7: Bark harvesting of the black Mangrove (Photo: J.Adams, 3 October 2022; Adapted from DWS, 2022).

The most obvious vegetation type observed within the system is *Phragmites* reed beds, *Hibiscus* and *Ficus* trees. The vegetation within the Mgobozeleni Estuary has therefore shifted from a mangrove dominant system to a sedge swamp and swamp forest, with more recent increases noted in the latter vegetation type (Taylor, 2016). Reed encroachment upstream of the existing bridge is becoming problematic and needs to be addressed. Furthermore, slash and burn activities have resulted in the loss of swamp forest area which has now been replaced with *Phragmites*, Bull Rush (Typha capensis) and mangrove ferns (Figure 8). The general vegetation biomes surrounding the Mgobozeleni Estuary can be seen in Figure 9 below.

Figure 8: Evidence of swamp forest removal (Photo: N Van Schoor, 24 November 2022)

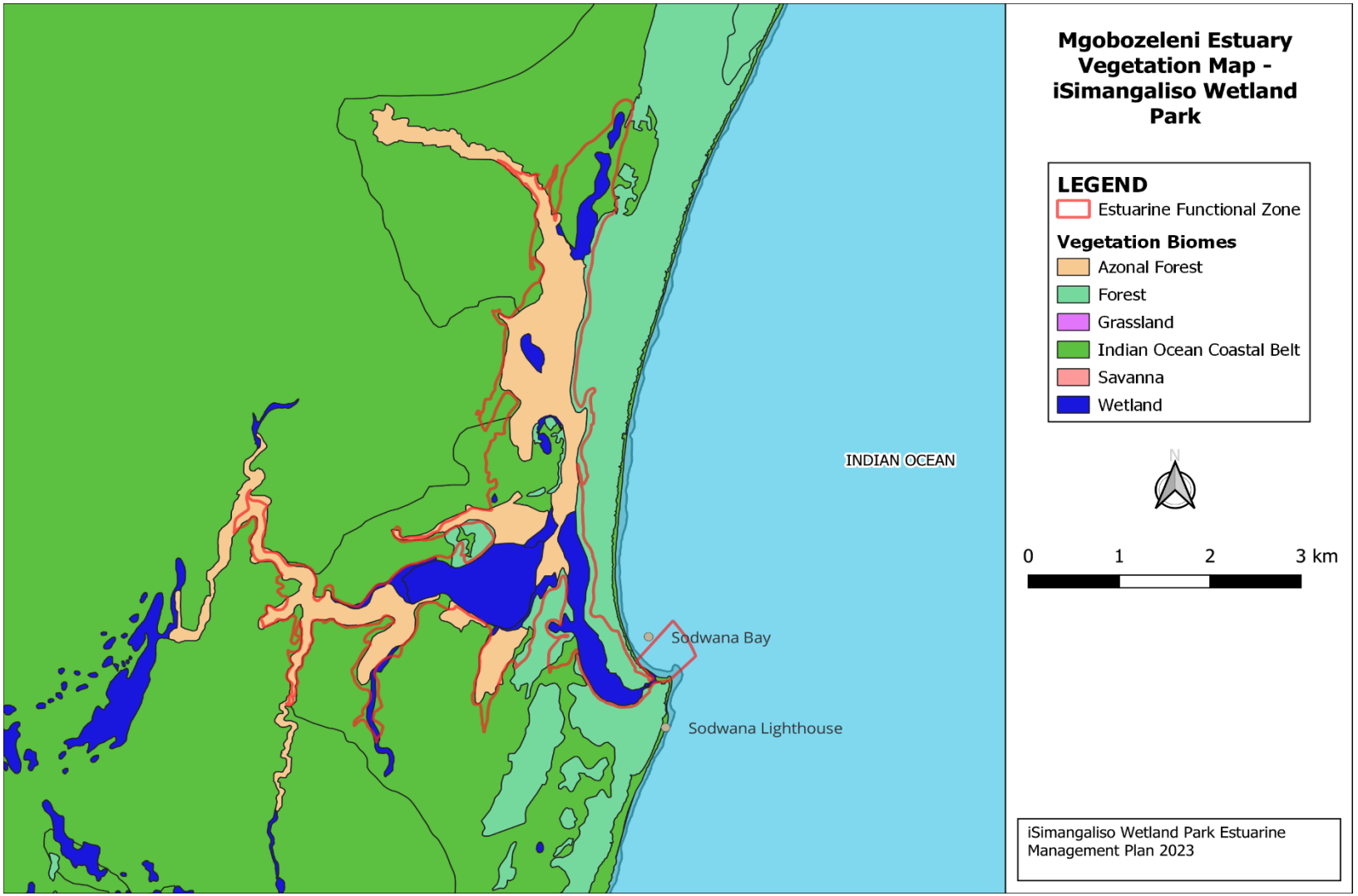


Figure 9: Vegetation biomes surrounding the Mgobozeleni Estuary

2.7 Present Ecological state

Estuarine health has been defined as a systems ability to maintain structure, functioning and resilience against stress (Van Niekerk et al., 2013). The health status of an estuary is determined using the Estuary Health Index (EHI). The EHI is a standardised metric for use in estuary management and the determination of ecological water requirements. To determine overall health, the estuary is evaluated by estimating the estuary conditions, both physical and biological characteristics, for the Reference Condition and then scoring the present conditions relative to this estimated Reference Condition. The score derived from this assessment is the Present Ecological State (PES) score and falls into one of six categories (A-F) detailed in the table 2.

Table 2: The Present ecological state categories and description according to the Estuary Health Index Score.

Estuary Health Index Score	**Present Ecological State**	**Description**
100 - 91	A	Unmodified, natural
76 – 90	B	Largely natural with few modifications
61 – 75	C	Moderately modified
41 – 60	D	Largely modified
21 – 40	E	Highly degraded
0 – 20	F	Extremely degraded

The Mgobozeleni Estuary was described in the National Biodiversity Assessment (van Niekerk & Turpie, 2012) as being in good condition generally with artificial breaching influencing estuarine health. At that time, the estimates of estuary health suggested a Present Ecological Status **category 'B',** being "*largely natural with few modifications*" (van Niekerk & Turpie, 2012). The more recent National Biodiversity Assessment report depicted that the estuary has remained within a PES **category "B"** (Van Niekerk et al., 2019).

A Recommended Ecological Category has been generated for all estuaries in the country and for the Mgobozeleni system this has been determined to be a '**Category B'** given that the estuary is:

i. Located within a proclaimed protected area and World Heritage Site; within the St Lucia Ramsar Site (Figure 10).

ii. Listed as a national priority for estuary conservation (Van Niekerk et al.,2019).

iii. In relatively good condition considering the current status state of the collective estuarine resource in KwaZulu-Natal and South Africa (Van Niekerk et al., 2019; Whitfield & Baliwe,2013).

iv. The only estuary between the larger St Lucia Lake System to the south and Kosi Bay to the north (i.e. along a stretch of *ca.* 170 km of coastline) (see the delineation of the estuarine functional zone).

v. Known to support a number of rare and threatened species, being situated within a transition zone between the tropics and subtropics (iSimangaliso Wetland Park Authority, 2011).

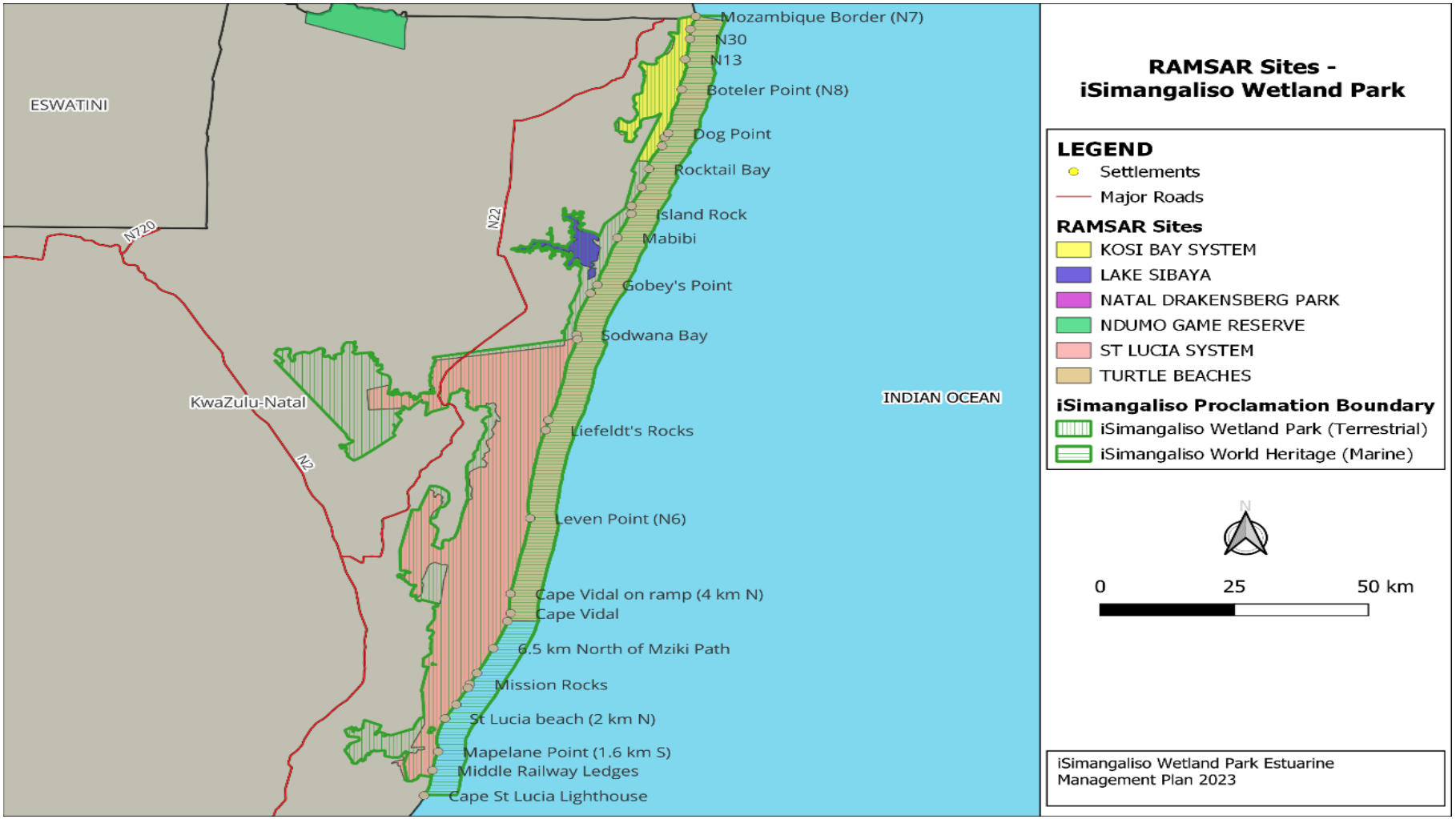


Figure 10:Locality of the Mgobozeleni Estuary in respect to the RAMSAR sites and iSimangaliso boundary.

2.8 Goods and Services provided by the estuary

The Sodwana Bay area has long been known as a popular fishing and diving destination. The boat launch site for these activities is situated at Jesser Point which is also the point at which the Mgobozeleni estuary mouth connects to the sea. The conditions are often more favorable for launching at the mouth depicting the essential recreational service which the estuary supplies to its visitors. The estuary is also used for swimming by tourists to Sodwana Bay. The Mgobozeleni plays a minor role in providing additional regulating services which are represented across all estuaries such as biochemical cycling, primary productivity, climate regulation, and organic matter mineralisation (de Groot et al., 2002). Critical estuarine habitats such as mangroves, salt marshes, and swamp forests sequester large amounts of carbon and contribute to local and global temperature regulation, subsequently combating the magnitude of climate change (Duarte et al., 2013; McPherson et al., 2016; Rovai et al., 2021). The Mgobozeleni Estuary functions as a most important recruitment facility for marine fishes and the marine environment, being the only recruitment estuary along a 180 km stretch of coastline (Bate, et al., 2016).

2.9 Threats, impacts or potential impacts

Estuaries and the adjacent marine environments are subjected to accumulated anthropogenic impacts both directly and indirectly from their catchments and are often the focus of both consumptive and non- consumptive resource use. Given the role that estuaries play in the broader coastal environment, and their sensitivity to human impacts (DEAT, 2000), a focused and coordinated approach to sustainable use of these ecosystems becomes essential to the continued delivery of ecosystem values, goods and services.

The main threats and issues that may affect the ecological health and integrity of the Mgobozeleni Estuary are:

i. Artificial breaching and mouth manipulation.
ii. Direct surface water abstraction and indirect abstraction of the major groundwater feeds affecting the freshwater volumes reaching the estuary (activities such as Eucalyptus spp. plantations affecting ground water recharge required to maintain the water balance of the system). Changes in water volumes through the system may result in a loss of connectivity between the different parts of the estuary and is very likely influencing the mouth status. Therefore, it is important to ensure that the environmental (ecological)

reserve is determined and adequate flow is maintained to preserve water quantity/volume or flow.

iii. Water quality. Recent studies suggest water quality in the estuary may be deteriorating but no data are available.

iv. Alien species. Several alien plant species occur around the system and associated with the water body. *Casuarina equisetifolia* alters dune dynamics with the potential to influence estuary mouth dynamics. Casuarinas were removed from the vicinity of the mouth but seed bank reestablishment needs to be controlled. Animal alien invasive species also occur such as the snail, *Tarebia granifera*.

v. Climate change – rainfall, sea level rise and temperature changes.

vi. The encroachment of reeds upstream of the existing bridge.

vii. Development pressures from upstream.

viii. Community dwellings occur in areas surrounding the lakes and the Shazibe. As such, swamp forest has more recently been impacted by slash and burn activities for informal agriculture practices.

ix. Mouth migration

x. Dive charter infrastructure

Key impacting activities that affect the ability of the Mgobozeleni Estuary to continue to deliver ecosystem goods and services are described below.

2.9.1 Artificial Breaching and Mouth Manipulation

Breaching is the term for the opening of an estuary mouth and is a natural response to rainfall and sea conditions. It is an important natural and highly seasonal process in the life-cycle of an estuary as it establishes the connection of an estuary with the sea. This allows for the immigration and emigration of fish and invertebrates, tidal exchanges, flushing and the re-establishment of salinity gradients along the estuary, which is one of the drivers of estuarine diversity and productivity.

Artificial breaching is the active removal of the sandbar from an estuary by human manipulation. This is usually done in response to rising water levels that rise behind the sand barrier once the estuary is cut off from the sea. A variety of fish species and invertebrates have life histories geared to the natural cycles of opening and closing, and along with many plants and birds are dependent on these natural cycles. Once estuaries close, habitat, nutrients and food availability increase

dramatically thereby providing ideal conditions for growth and survival.

Artificial breaching in KwaZulu-Natal is most often carried out during winter or when rainfall is low. Unseasonal flushing of these systems reduces the nursery function for many fish and invertebrates by the removal of food resources and the premature flushing of juvenile fish and prawns out into a hostile marine environment while they are still too young to cope.

Thus, artificial breaching disrupts the natural cycle and, therefore, has a negative effect on the plants and animals within estuaries, (which in one study showed a twentyfold decrease in biomass). Artificial breaching is a convenient, but disruptive, means of altering the natural processes of an estuary. This is often done for the benefit of a few individuals but at the expense of the ecological health and services that these important systems provide and, in this way, has a ripple effect through many other lives. It is recognised and has been shown in the literature to be a highly damaging activity for estuaries.

Prior to 2004, the Mgobozeleni Estuary was subject to high levels of artificial breaching. Artificial breaching is usually done in order to protect beach access at this popular tourist node and in response to concerns that the northward position of the mouth would lead to the erosion of the coastal dunes and loss of dune forest (Begg, 1978). More recently, the reasons for artificial breaching have been ecological in order to protect a small stand of mangrove saplings that have been reported to have established near the mouth (Taylor, 2016). Artificial breaching is known to interfere with water and sediment budgets as well as salinity regimes and as such is considered to be a significant impacting activity on the ecological health and integrity of an estuary. Artificial breaching should only be considered only for ecological and socio-economic exceptional circumstances reasons . These ecological or social reasons must be more clearly and legally defined. If breaching is to occur ecological and socio-economically, monitoring must take place before and after the breach. The breach level should be informed by quantitative , recorded measurements and the specifications for when and how the mouth should be breach clearly stated.

2.9.2 Water Quality

It has been reported that the water quality of the Mgobozeleni Estuary has declined markedly as a result of contaminated groundwater inputs. The source of this contamination has been identified as pit latrines in local communities. Pit latrines are effective in controlling diseases but ultimately discharge sewage nutrients into the groundwater (Bate et al., 2016.). Cyanophytes, have been

shown to make up 88% of phytoplankton within the Mgobozeleni (Bate et al., 2019). This raises concern for the potential health risk to communities who may utilize this water for domestic, agricultural or recreational purposes. Further population increases within the municipality will only exacerbate these water quality issues threatening the health of both people and the ecosystem. The current levels of nutrients (nitrogen and phosphorus) and microorganisms would need to be monitored to confirm this finding and implement corrective measures. Currently no information is available on the flushing and retention times of these nutrients within the lake and estuary.

2.9.3 Alien Invasive Species

Casuarina equisetifolia was historically planted on the south bank of the lower reaches to stabilize sand movement (Begg, 1978). This stabilization acts against the normal sediment movement patterns of the highly dynamic estuary and beaches altering dune dynamics, and once stands of the tree have established, they tend to accelerate dune and beach erosion (Digiamberardino, 1986). In addition to influencing dune morphology, *C. equisetifolia* alters dune and beach vegetation structure and species composition (Avis,1995; Kraus et al., 2003) decreasing biological diversity and compromising beach integrity (Awale & Phillott, 2014).

This tree has since been identified as an invasive alien species (Conservation of Agricultural Resources Act No. 43 of 1983; National Environmental Management: Biodiversity Act No.10 of 2004; Invasive Species South Africa 2014) particularly in the province of KwaZulu-Natal. These trees will be removed as a component of the current upgrade and restoration project to this tourism node.

The Mgobozeleni system is known to have populations of the invasive alien freshwater snail *Tarebia granifera* (Appleton *et al.,* 2009; Miranda *et al.,* 2011). This parthenogenetic snail has proved to be a very successful invader of estuaries and lake systems on the KwaZulu-Natal north coast, although the significance of possible ecological impacts on these brackish-water habitats remains unknown (Miranda *et al.,* 2011).

Increases in nutrient level inputs to the system are likely to promote the growth of additional alien invasive species. In particular, invasive water plants such as *Pistia*, *Eichhornia* and *Azolla* thrive on excessive nutrient levels.

2.9.4 Tourism and Recreation

The Sodwana Bay camp is a highly popular tourism node within the iSimangaliso Wetland Park, with high numbers of visitors accessing and using the beaches, which also provide access to popular recreational fisheries and globally renowned SCUBA diving opportunities (Figure 11). During peak seasons, the lower reaches of the estuary have been subject to impacts that vary from swimming to pollution by solid waste from holiday makers and contamination by fuel oils from boats (Bruton, 1976b). The artificial breaching is linked in part to tourism activities and drives mouth manipulation. The estuary mouth often needs to be traversed by two vehicles and boats, depending on the estuary mouth position in relation to optimal launch position. Extensive use of the mouth bar by vehicle beach traffic affects the estuarine ecology. The 2018 National Biodiversity Assessment reported a high fishing pressure on this estuary at 4.6 tons annually (Van Niekerk et al., 2019).

Figure 11: Panoramic view of Mgobozeleni estuary mouth and tourism related activities

2.9.5 Development Pressures

Human activities adjacent to estuaries can individually or in combination potentially generate significant effects on their health and integrity. Developments on the western boundary of the Mgobozeleni Estuarine Functional Zone (EFZ) and in the region of the mouth have the potential to degrade the estuary's health unless these activities are monitored for impacts on key processes. Any settlement developments should be assessed against run-off impacts as part of the implementation of iSimangaliso's Zone of Influence (Buffer) Zone Policy once revised and adopted. The impacts of plantation establishment have been documented and any future commercial plantation licenses needs to be evaluated against the water requirements of the estuary.

2.9.6 Effects of Climate Change on Estuaries

Estuaries are situated where rivers meet the sea and are therefore sensitive to changes occurring both in the ocean and on land (National Geographic Society, 2022). This makes them particularly vulnerable to the impacts of climate change. Rising sea levels can inundate shallow coastal areas with seawater, disrupting the balance between fresh and salty water (National Geographic Society, 2022). Floods, storms, and other extreme weather events can change the amount of water flowing into an estuary from upstream, leading to more polluted runoff, erosion, and sedimentation (Wetz and Yoskowitz, 2013).

Climate change is predicted to alter precipitation patterns, which affect the quality, rate, magnitude and timing of freshwater delivery to estuaries, and will potentially exacerbate existing human modifications of these flows (James et al., 2013). This is likely to result in changes to fish communities, as river flow has been found to have a major impact on the structure and functioning of fish communities in South African estuaries (James et al., 2013). Estuaries are the meeting place of freshwater from rivers and saltwater from the sea and, as such, are dynamic environments characterized by large fluctuations in environmental conditions (Elliott 2002).

Changes in environmental conditions within an estuary may be fairly predictable, or they may be caused by short- and/or long-term unpredictable climatic fluctuations, all of which have large effects on the abundance and distribution of estuarine fish species (Flint 1985, Kupschus & Tremain 2001, Desmond et al, 2002). Estuarine-associated fish species are known to be sensitive to reductions in the volume of freshwater runoff and this may reduce the abundance of these species, which will also have fisheries implications. Reduction in freshwater flow will also reduce the quantity of nutrients

entering estuaries, with a resultant impoverishment of the biota. Increases in extreme precipitation events projected for the east coast may result in increased freshwater flow and elevated delivery of sediment to estuaries as a result of runoff from land and river and stream channel erosion, which may significantly alter estuarine fish communities through the clogging of their gills and smothering of the benthos, and create indirect impacts through elevated turbidity (e.g., prey detection and predator avoidance).

Sea level rise, wave energy and storm disturbance are some of the significant predicted consequences of climate change which accelerate sea level rise and an increase the frequency of high-intensity coastal storms and high-water events. Several climate models project an accelerated rate of sea level rise over the coming decades (Solomon et al. 2007). An assessment of sea level rise in South Africa, using available tide gauge data for the last 50 yrs., shows a 1.87 mm yrs. −1 rise on the west coast, a 1.48 mm yrs. −1 rise on the south coast and a 2.74 mm yr−1 rise on the east coast (Mather et al., 2009). Isostatic settling of the crust caused by the additional weight of water over areas with a wide continental shelf, such as the Agulhas Bank, will locally accentuate sea level rise, possibly by as much as 25% (Reddering & Rust 1990). It is anticipated that the effects of sea level rise will be exacerbated by predicted increases in the frequency of severe storms and high tides impacting the coastal platform at a higher mean sea level (Bindschadler 2006). The South African coastline is intermittently affected by extreme swells associated with tropical cyclones and cut-off low pressure systems (Mather & Stretch 2012). Extreme weather events are predicted to increase in frequency and intensity in the 21st century and appear to be on the increase globally (Solomon et al., 2007, Engelbrecht et al. 2009, 2011).

An increase in the frequency of extreme weather events, together with sea level rise, may alter the hydrogeomorphology of estuaries and result in a loss of essential estuarine habitat (such as mangroves and salt marsh), which will ultimately affect estuarine fish communities and will have implications for fisheries targeting estuary-associated species (Elliott 2002, Clark 2006). Childs et al. (2008) found that during their estuarine dependent phase, *Pomadasys commersonnii*, a species targeted by recreational anglers in both the estuarine and coastal environment, require specific habitat. Similarly, Mann & Pradervand (2007) found that for several estuary-associated fish species there was a close relationship between adult abundance in the marine environment and the availability of estuarine nursery areas. Of all climate-induced changes, sea level rise is seen as the greatest threat to mangrove and salt marsh habitats.

The concept of vulnerability has become increasingly important in climate change research (Intergovernmental Panel on Climate Change, 2022). Within coastal environments, estuaries are particularly vulnerable and have been the focus of several international and/or regional climate change vulnerability assessment (Day et al., 2008; Day et al., 2011; Gillanders et al., 2011; Robins et al., 2016). Modification of land climate, oceanic and coastal circulation mechanisms, sea level rises, increasing sea storminess, and ocean acidification are the main climate change stressors on estuaries (Day et al., 2008; Day et al., 2011; Gillanders et al., 2011; Robins et al., 2016; Newton et al., 2014).

The Intergovernmental Panel on Climate Change (IPCC) predicts an increase in frequency and intensity of extreme weather events in the 21st century associated with climate change (IPCC, 2007). Such modifications are anticipated to significantly affect coastal ecosystems, possibly increasing coastal sediment movement and storm erosion. (Theron et al., 2012). This can both amplify or moderate shifts in biological responses including processes such as primary production (structure/habitat-farming plants and eutrophication), contraction or expansion of species ranges, changes in recruitment patters and nursery function, shifts in community composition and general behavior responses (van Niekerk et al., 2022) Therefore, the effect of climate change stressors on estuarine processes, variables and associated biotic responses is complex.

2.9.7 Human Impacts on Estuaries

Estuaries are transitional areas between the land and the sea, and between freshwater and saltwater environments, thus can be seriously impacted by any number of human, or anthropogenic activities (Levin et al., 2011). The greatest threat to estuaries is their large-scale conversion by draining, filling, damming, or dredging (Kennish, 2002). These activities result in the immediate destruction and loss of estuarian habitats. Poor water quality affects most estuarine organisms, including commercially important fish and shellfish. Another less widely discussed human-caused disturbance is the introduction of non-active or invasive species into estuarine environments (Deepa and Sivakami, 2022). The impact from human activities on marine ecosystems is determined by the intensity, duration, and characteristic, both in time and space, of the pressure that the activity is causing and the specific ecosystem component's sensitivity to the pressure (Dailians et al., 2018).

People find it satisfying to live in or visit estuaries; swimming, boating, hunting, or fishing in an environment that is sometimes like the ocean and sometimes like the river (Turner et al., 2006). However, people's interaction with estuaries does have an impact to the system of estuaries. Due to human activities, changes occur to river flow, tides, and the plants and animals that live in

estuaries (Culberson, 2021). Pollution accumulates, and huge quantities of water are captured and pumped elsewhere for drinking, agriculture, industry, and other uses.

2.9.8 Reed Encroachment

A mangrove community upstream of the existing causeway bridge was lost during the 1970s as a result of the bridge severely restricting water movement. Reconstruction of the bridge to restore the connectivity and mangrove community was not successful. Since then, reed encroachment upstream of the existing bridge has become problematic and needs to be addressed (Figure 12).

Figure 12: Reed encroachment upstream of the Mgobozeleni bridge.

2.9.9 Reduction in groundwater inputs

Groundwater is a major source of water input to the Mgobozeleni Lake. Catchment activities which use groundwater either directly (through abstraction) or indirectly (plantations which use large volumes of groundwater), threaten this fundamental water supply. The increases in subsistence farming within the wetlands is becoming a concern, particularly with “commercial style” mono-farming (E.g., Banana farming). The area which is selected for the farming is drained. This lowers the water table and dries up the peat which influences the groundwater flows to the lake and the estuary (Bate et al., 2016). Changes in flow can further alter the breaching frequency of the estuary

which has even further ecological consequences. The number of gardens which should be permitted to operate within these wetland areas should be monitored to ensure the overall ecological health of the system is maintained.

2.10 Socio-economic Context

2.10.1 Demographics

The Mbazwana area has a total population of 4 312 people (Census, 2011). The gender distribution in Mbazwana is 51% females and 49% males (Census, 2011). They are divided into Mbazwana A & B, with Mbazwana B housing most of the population. The most dominant population group is black Africans (98,9%) and whites are the least (0,3%) (Census, 2011). The area has 1119 households in total, with 45,8% headed by females (Stats SA, 2011). The dominant spoken language in Mbazwana is IsiZulu, spoken by 93,8% of the population (Census, 2011). Only 10,4% of the Mbazwana population has received higher education, and 11,7% have no schooling experience (Census, 2011).

2.10.2 Economic Profile

The majority of the population in Mbazwana (20,5%) earn between R9 601-R19 600 (Census, 2011). The main economic sectors are agriculture, mining, manufacturing, and services. The economic base of KwaMhlabuyalingana Local Municipality depends largely on tertiary services, with community services accounting for about 70% of the municipality's GDP (KwaMhlabuyalingana IDP, 2022). Despite the local economy's diversity, just 13% of the labor force is employed in the municipal area, raising concerns about unemployment. Unemployment rate is currently estimated at 22% while 65% of the total labor force is not economically active (Stats SA, 2011). The unemployment rate has decreased over the years; however, it is still high, and this shows that there is a great need for the municipality to look into economic opportunities which lead to sustainable job creation. There is a relatively high dependence on social grants in the municipality, with majority of the population surviving on around R500 per month (KwaMhlabuyalingana IDP, 2022). Poultry production is the most dominant agricultural activity with 14 421 households practicing it (Stats SA, 2011). There is a high number (9812) of household heads that make no income from agricultural activities. The highest number of household heads that get an income from agricultural activities is 7 682, and they earn between R4 801-R38 400 (Stats SA, 2011). Agriculture in the municipality is based on commercial agriculture and consumption agriculture, which is directed towards meeting consumption needs of the population (KwaMhlabuyalingana IDP, 2022). It is evident that the full potential of the agricultural sector has not been fully realized in the municipality as the areas of existing agricultural activities is small in comparison to the areas that have agricultural potential.

2.11 Opportunities and Constraints

Sodwana Bay and the associated Mgobozeleni Estuary is an important tourist destination attracting thousands each year for fishing, diving, and camping. The tourism industry therefore offers vital employment opportunities to the local community which is sustained by the continued conservation of the area. Currently various temporary wooden structures, mark tents, a coffee shop and storage facilities for boats can be found along the shore. Opportunities on this front may exist for the development of a tourism node in which facilities such as a restaurant, dive school, information centre and craft market are erected within a portion of the dunes which already receives boat and vehicle traffic.

The current health status of the estuary (category B) may however be better maintained by ensuring minimal permanent development within the area. Non-permanent structures such as mark tents could perhaps serve as craft markets which would attract additional tourists without the more permanent impacts which come with development. One constraint to any potential tourism increases in this area would be access and infrastructure. Although a parking area is already present near the estuary mouth, the existing bridge is small and may not be able to accommodate larger traffic increases. Additionally, there is no formal path to the beach which may result in damage to the estuary vegetation.

Any management or development actions would have to take cognizance of the delineated estuary boundary, which includes the lakes and channel forms, being intrinsic components of the Mgobozeleni system, and a buffer zone. The basis of any possible artificial breaching policy would also have to be seriously considered in the light of information regarding historical closure patterns.

2.12 Major Information Gaps

The greatest information gap which is apparent for this system is the lack of recently collected data, although fairly recent surveys on the flora and mangrove invertebrates have been conducted by Taylor (2016) and Peer et al (2018). The physio-chemical character of the system has not been well documented with only a few references dating back 35 years, documenting salinity, temperature, PH and other abiotic parameters including pollutants. Likewise, the same trend exists for fish, birds, reptiles and mammal species within the system. Long term data collection is significant in identifying trends which can then be used to inform management decisions. The

dynamics of the estuary mouth need further investigation – there is an information gap that needs to be addressed. The groundwater resources of the catchment are particularly important for the Mgobozeleni System and should be thoroughly monitored. Of particular significance is the effects of the surrounding plantations on the groundwater resources and groundwater quality from sewage contamination.

3. Geographical boundaries of the estuary

As per the Department of Environmental Affairs "Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol" (DEA, 2015: "estuaries - as defined by the spatial delineation of the estuarine functional zone – are 'sensitive areas' where previously the 'geographical boundaries' of an estuary was assumed to be the 'open water body', the EFZ encapsulates additional areas that support physical and biological processes and habitats necessary for that estuarine function and health (Van Niekerk and Turpie, 2012). The geographic boundary of the estuary is defined by the 5 m amsl topographical contour. The coastal management line may also be a useful guide when defining the terrestrial extent of the estuary area. More recent approaches have included mapping to the historical extent of the estuary which includes movement of an estuary mouth, and areas surrounding estuarine habitats which have the potential to the eroded by flooding events (Van Niekerk et al., 2019). It is important to define the boundaries of the estuary and by virtue of this the extent of the plan. This step defines and maps the geographic boundaries of the estuary as follows:

- **Downstream boundary.** The estuary mouth, which may include the surf zone, seaward extent of the flood tide delta and/or transitional waters. This extension can be determined on salinity observations, and variations observed in historical aerial photographs or satellite imagery.
- **Upstream boundary.** The extent of tidal influence, i.e. the point up to where tidal variation in water levels can still be detected or the extent of saline intrusion or the extent of back-flooding during the closed mouth state, whichever is furthest upstream.
- **Lateral boundaries.** The lateral boundaries include all areas below the high tide mark, all estuarine vegetation (including mangroves, swamp forest, reeds/sedges and supratidal salt marsh), and any floodplain areas below the upstream boundary as determined by the 1:100 flood line. Where these boundaries have not been defined by scientific methods, they can be defined at a desktop level using the 5 m topographical contour as indicative of 5 m above Mean Sea Level (MSL) along each bank. It should be noted that the littoral active zones adjacent to an estuary can stretch beyond the 5 m contour and should be incorporated in the estuarine functional zone in specific cases where scientific work determines these are an integral part of the estuary function.

The EFZ is a highly sensitive ecological area which should be adequately managed. Consequently, any development which occurs within the EFZ is captured as habitat degradation and an overall decline in the estuarine condition.

The EFZ of the Mgobozeleni Estuary is approximately 803 ha and is inclusive of Lake Shazibe directly north of Lake Mgobozeleni. The geographic boundary of the Mgobozeleni Estuary is defined by the 5 m amsl topographical contour. The coastal management line may also be a useful guide when defining the terrestrial extent of the estuary area. The 1 km development buffer provides an indication of the area in which listed activities are regulated relative to the high water mark in accordance with the EIA Regulations, and the extent of the coastal protection zone for rural areas as defined by the ICMA. These zones are designed to more formally regulate certain activities that may cause degradation of the estuary. The 1:100-year flood line is also an important guideline for land-use and town planning, in that it indicates areas of high risk where development should not be allowed. The location of the 1:100 year flood line needs to be determined so that future planning can take this into account. It will also provide an indication of existing and future activities that are at risk. The estuary boundary is depicted graphically using the 5 m amsl topographical contour in Figure 13.

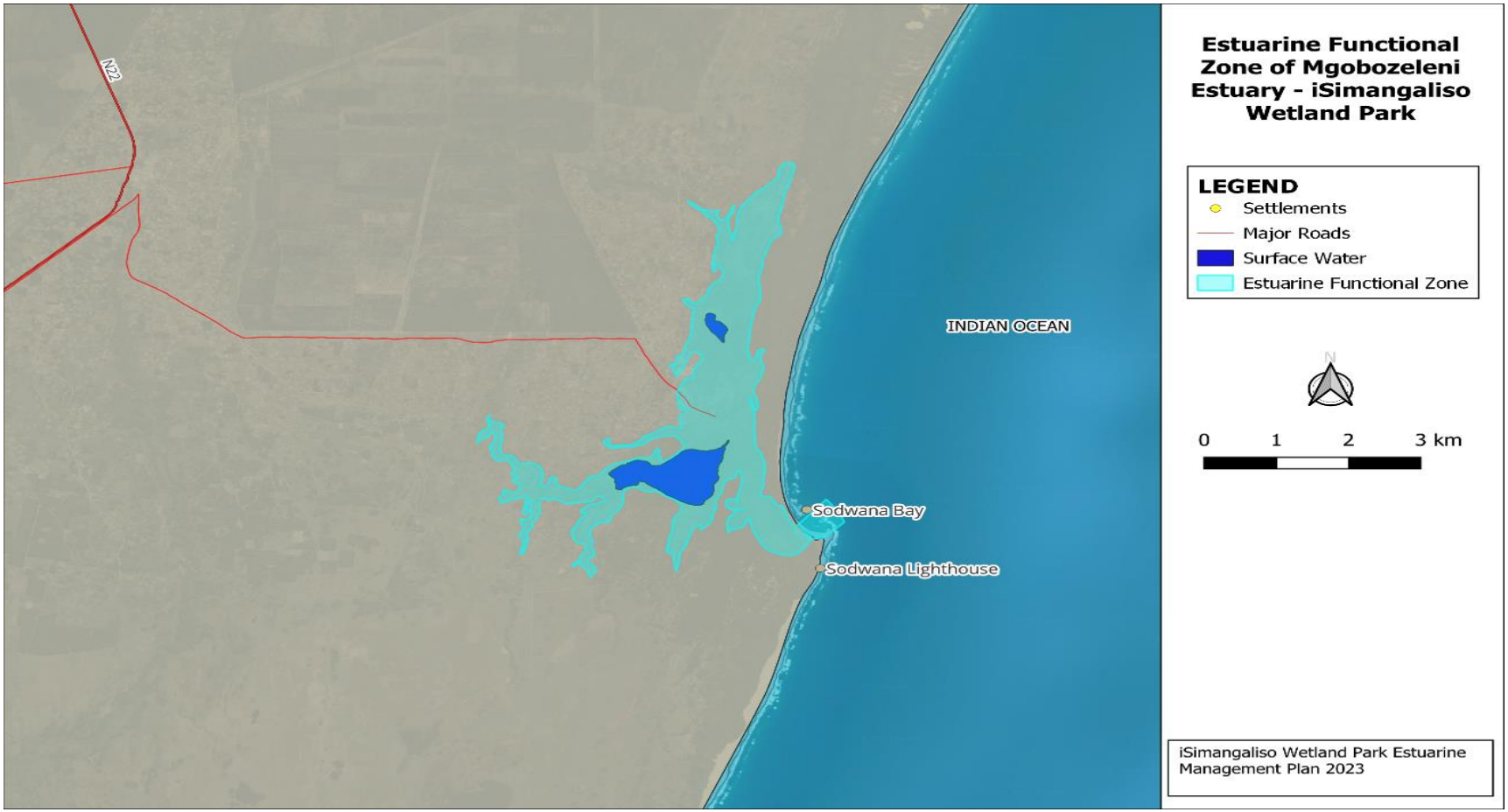


Figure 13: Estuarine Functional Zone of the Mgobozeleni Estuary.

4. Local vision and objectives

The Estuarine National Protocol provides the national strategic vision for all estuarine management in South Africa, which states that:

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

In order for estuarine management to be effective, local visions should be created and tailored towards the needs of individual estuaries. The vision, mission and management goals for the iSimangaliso Wetland Park are set out in the World Heritage Convention Act. These apply to the estuaries that fall within the park and are outlined in Chapter 4 of the 2022-2031 ISimangaliso IMP.

The vision for the Mgobozeleni Estuary is to ensure efficient management that will result in the desired state for the estuary, which is Category B (Largely natural with few modifications). The objective is to conserve, protect and maintain the Mgobozeleni estuarine system's biodiversity, eco-system health, sense of place and ecological processes, and minimise internal and external negative impacts on the system. This can be achieved by ensuring effective management objectives of the estuary which speaks to the conservation and monitoring of the estuary, water quality and quantity of the estuary in a desired state, and monitoring of land use within and around the estuary are adhered to. While research is carried out to ensure proper management of the estuary, socio-economic activities are to be closely monitored and communication is to be carried out efficiently with ongoing monitoring and improved multi-stakeholder liaison. There is also opportunity for collaboration and co-production of various knowledge so that varied inputs can be included in policy decision making and all may benefit equitably from the ecosystem services of this system.

5. Management objectives and key actions

The management goals of the Integrated Management Plan (IMP) contributed to the development of the specific key management objectives for Mgobozeleni Estuary. Below are the five major management objectives in the focus areas for iSimangaliso.

1. **Management Objective 1- Conservation:** To protect, conserve, enhance and present the estuary's ecological processes; superlative natural phenomena and scenic beauty; and biodiversity and threatened species. To avoid any further degradation of the floodplain and encourage users to rather utilise the existing disturbed areas or implement agricultural activities that are tolerant to waterlogging to avoid drainage of the wetlands.

2. **Management Objective 2- Socio-economy**: To promote, manage, oversee, market, and facilitate optimal tourism and related development in the park. To promote the empowerment and development of historically disadvantaged communities in and adjacent to the park. To ensure that all estuary users and the local community are well informed, self-compliant and supportive of estuary initiatives.

3. **Management Objective 3- Management:** To ensure that iSimangaliso operations are properly funded and cost-effectively managed while maintaining an appropriate system of internal control and reporting of accounting, management, and statutory information

4. **Management objective 4- Heritage:** To protect the cultural, historical and archaeological values of the estuary. To ensure that development in and around the estuary is guided by the cultural values and sense of place of the surrounding environment

5.**Management Objective 5- Research:** To promote awareness, education and training that relate to the importance, value, and management of estuaries.

The above Management Objectives are developed in line with the National Estuarine Management Strategic Objectives that are defined by the National Estuarine Management Protocol 2021. This is done to ensure that the management of the iSimangaliso Estuaries is in line with national legislation. The national objectives speak to estuary conservation, community empowerment, efficient estuary management and education. Upholding these objectives will result in getting the estuary to a desired state. This will be achieved through undertaking the actions stipulated in the table below. Each objective has specific actions that need to be carried out in order to ensure efficient management of the estuary and ensure that it gets to the desired state.

Management categories are developed based on issues that affect estuaries. These categories assist in converting management objectives into actions as they speak to important aspects in and around the estuary. The following categories were developed as a baseline for management actions:

1.Water Quantity and quality

- The description of the condition of an estuary is driven by two key drivers, water quality and quantity. Ecological Water Requirements (EWR), also referred to as Ecological Flow Requirements, quantifies the water regime (quality, quantity and timing) required to ensure the adequate functioning and future persistence of estuaries (Adams et al., 2016). It is therefore essential to determine a 'Reserve', which is the water quality and quantity required for the protection of basic human needs and estuary systems. The 'Ecological Reserve' is the quality and quantity of water required to maintain a desired level of structure and function, or quality, of an estuary.

2. Recreational activities

- Recreational opportunities are important benefits provided by the ecosystem services of estuaries. Quantifying recreational use provides information about which sites are used most heavily, and the activities for which they are used. This information can support a better allocation of resources and improved spatial planning for environmental management, facilities siting, and safety purposes (Dwight et al. 2007; Pendleton 2008; Morgan 2016).

3. Living resource management

- Due to increasing demands on estuarine living resources (fish, invertebrates and plants), the development of an environmentally and socially acceptable strategy to ensure long-term sustainability is essential (Hay et al., 2005). The sustainable utilisation of estuaries and their resources centres on improved law enforcement, compliance with regulations, and dedicated research and monitoring efforts through the development and implementation of an effective management system.

4. Land use and development

- Land use planning in South Africa is becoming more strategic and forward thinking with its increasing inclusion in new legislation such as the National Environmental Management ACT (NEMA) and the Land Use Management Act (Hay et al, 2005). The economic value of estuaries is affected by land use in their catchment areas, as well as in the coastal zone. For example, certain land uses use more water than others, lead to more soil erosion, or yield more polluted freshwater

inflow. These affect the functioning of estuaries by altering the quantity and quality of freshwater inflows into estuaries, therefore it is essential to consider land use estuary management.

5. Funding and Education awareness

- Currently knowledge on the management of estuaries is fragmented, difficult to locate and share, and therefore not effectively used. There is a need to develop a culture for the sharing of knowledge. The goal of the education objective in estuaries is to improve the use of knowledge by estuary users (including indigenous knowledge) and managers. Funds that are raised from estuary activities should be used for estuary management in the same region.

A range of management actions have been categorised into the 5 sectors below (Table 3). These actions incorporate the key iSimangaliso management objectives and the national objectives, and will work towards getting the estuary to the desired state of Category B.

Table 3: Management Categories and Actions

Category	Action	Priority	Initiated	Responsible Entity
1. Water quantity and quality	1.1 : Determine the ecological water requirements (EWR) of the estuary, focusing on both surface and groundwater resources	High	Yes	Department of Water and Sanitation
	1.2 Develop and implement a water resource utilisation plan for surface and groundwater resources	High	No	Department of Water and Sanitation & iSimangaliso Authority
	1.3 Design and implement a water quality monitoring programme for the estuary	High	Yes	iSimangaliso Authority
	1.4 Eradicate/control invasive alien plant species from estuary to increase flow	High	Yes	iSimangaliso Authority
	1.5 Conserve and restore wetlands in the estuary	High	Yes	iSimangaliso Authority
	1.6 Investigate the link between sewage spills, nutrient dynamics, and algal blooms/prawn kills/diaretic shellfish poising (oyster die-off)	Medium	No	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority
	1.7 Oversee the implementation of the Conservation Operational Plan and revise annually	Medium	Yes	iSimangaliso Authority
	1.8 Future setbacks/flood line determinations must include sea level rise (+0.5to 2m) and projected increase in flood magnitudes	High	yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority
2. Recreational Activities	2.1 Manage and monitor consumptive and non-consumptive recreational and community based natural resource use of the estuarine resources	High	Yes	iSimangaliso Authority and Ezemvelo KZN WIldlife
	2.2 Maintain compliance and monitoring of fishing activities.	High	Yes	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority and Ezemvelo KZN Wildlife
	2.3 Improve compliance and monitoring of recreational activities.	High	Yes	iSimangaliso Authority and Ezemvelo KZN Wildlife

	2.4 Sustainable tourism to facilitate responsible economic growth and the optimal utilisation of ecosystem services.	High	Yes	iSimangaliso Authority
3. Living Resource management	3.1 Monitor illegal gill netting (verifying the extent of problem) and maintain compliance in this regard	High	Yes	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority and Ezemvelo KZN Wildlife
	3.2 Investigate occurrence and sensitivity to pressures of estuarine invertebrates (in both open and closed bait collection areas) and update bait collection strategies and plan accordingly.	High	No	iSimangaliso Authority and Ezemvelo KZN Wildlife
	3.3 Promote alternatives to consumptive exploitation. For example, catch and release fisheries and eco-tourism or alternative livelihood options such as mariculture ventures and job creation for subsistence users.	High	No	iSimangaliso Authority and Ezemvelo KZN Wildlife (with partnership from WildOceans)
4. Land use and Development	4.1 Develop appropriate setback lines for development that considers major floods and sea level rise	High	No	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority and Ezemvelo KZN Wildlife
	4.2 Implement agricultural best practice specifically to reduce nutrient enriched return flow and sediment erosion from surrounding farms and catchment	High	No	iSimangaliso Authority and Ezemvelo KZN Wildlife (with partnership from WildOceans)
	4.3 Develop and implement best practice guidelines for riparian protection (addressing reed removal, grazing, and burning	High	no	iSimangaliso Authority and Ezemvelo KZN Wildlife (with partnership from WildOceans)

	4.4 Improve access (e.g. walkways and board walks).	Medium	Not a priority at this stage	
	4.5 Apply zonation, through consultation with all Interested and Affected Parties (IAPs), of estuaries for recreational and subsistence fishing activities and non-consumptive activities to reduce user conflict	High	Yes	iSimangaliso Authority and Ezemvelo KZN Wildlife
	4.6 Identify potential Estuarine Protected Areas (EPA) for the conservation of over-exploited linefish species (e.g. dusky kob and white steenbras). The area must include the mouth and adjacent marine environment.	High	no	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, Oceanographic Research Institute, South African National Biodiversity Institute
	4.7 Identify and mitigate against impacts resulting from industrial and mining activities, and urban development	High	Yes	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, Department of Mineral Resources, KZN Department of Economic Development, Tourism and Environmental Affairs
	4.8 Ensure that no permanent structures are built within 100m of the estuary.	High	no	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, Department of Mineral Resources, KZN Department of Economic Development, Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities

5. Funding and Education Awareness	5.1 Dissemination of information through electronic media (e.g. website), popular press and scientific publications	Medium	Yes	iSimangaliso Authority
	5.2 Authorise and process research from external research institutions to conduct research in the St Lucia Estuary in accordance with the research policy	Medium	Yes	iSimangaliso Authority and Ezemvelo KZN Wildlife
	5.3 Social monitoring indicators should be developed which consider the needs of coastal land users within the area. Indicators could include employment, social grants, income, skills levels, resource harvesting, health, and well-being.	High	no	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, Department of Mineral Resources, KZN Department of Economic Development, Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities, Department of Agriculture, Land Reform and Rural Development
	5.4 Promote estuarine awareness and instil a feeling of social responsibility towards estuaries through advertising and marketing, and education of managers, user groups and the public.	High	no	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, KZN Department of Economic Development, Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities,
	5.5 Prioritize and increase funding for research and enforcement.	High	yes	iSimangaliso Authority

	5.6 Funds raised from estuary activities to be used for estuary management in the same region.	High	yes	iSimangaliso Authority
	5.7 Education and raising awareness about the importance of estuarine ecosystem protection and conserving and the subsequent benefits to the community in terms of local socio-economic gain.	High	yes	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife, KZN Department of Economic Development, Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities,
	5.8 Research should also address issues of livelihood and means to develop projects which assist in the upliftment of the community.	High	No	Department of Water and Sanitation, Ezemvelo KZN Wildlife, iSimangaliso Authority, Department of Agriculture Land Reform and Rural Development, Local and District Municipalities
	5.9 Local and Indigenous knowledge to be adopted into structuring EstMP hence a thorough public participation is essential when updating EstMP in order to capture the communities' ecological and socio-	High	No	iSimangaliso Authority, Department of Science and Technology

6. Zonation of estuary activities

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)" (DEA, 2015)

Zonation entails a negotiation process between stakeholders and management authorities to spatially depict the desired state of an estuary. These estuarine zonation plans should be incorporated into the Spatial Development Framework of local or district municipalities to guide sustainable development and use.

The zonation of the Mgobozeleni Estuary follows the same system as the zonation for the Park as defined by the IMP (Chapter 5). The iSimangaliso estuaries are multiple use areas. Zonation helps to manage and protect both the sensitive areas and species within these systems as well as separate potentially conflicting activities. Increasing development and utilization result in the resource deteriorating, which usually lead to conflicts between stakeholders (users) of that particular estuary.

Within the general provisions of the Controlled (Terrestrial) and Controlled (Marine) Zonation which apply to the Mgobozeleni Estuary, one existing boat launch site is operational. The extent of this area is from Jesser Point to the Mgobozeleni mouth with a demarcated area of 200m between each point. The usage limits are as follows:

i. 100 vehicles for launching per day including concession operators.
ii. 10 recreational vehicles at any one time for use as service vehicles for the diving and fishing charters.

Another important component of the estuary zonation is the distribution of subsistence farmers. As addressed in Section 2, mono-farming within the Mgobozeleni wetland area is increasing. As such this poses a threat to the habitat, and water supplies as the farmed area is drained. According to The Conservation of Agricultural Resources Act (Act No 43 of 1983), subsistence farmers require a permit, which means that the vast majority of farmers are likely cultivating illegally. Considering the reality that a significant proportion of South Africans rely on subsistence

farming, this legislation needs to be updated. For example, guidelines on the wise use of wetlands can be developed, specific areas allocated for wetland use with others remaining restricted, and best practice methodologies stated. Specifically, for the Mgobozeleni, the number of farmers allowed within the EFZ should be closely monitored and specific areas for farming demarcated.

Zonation of the Mgobozeleni Estuary is illustrated in Figure 14 and the zones are described in the following tables. The inclusion of the sanctuary zonation has been omitted and is now incorporated into the terrestrial and marine zones of wilderness, restricted or controlled. This will be further open to comment during the public participation process.

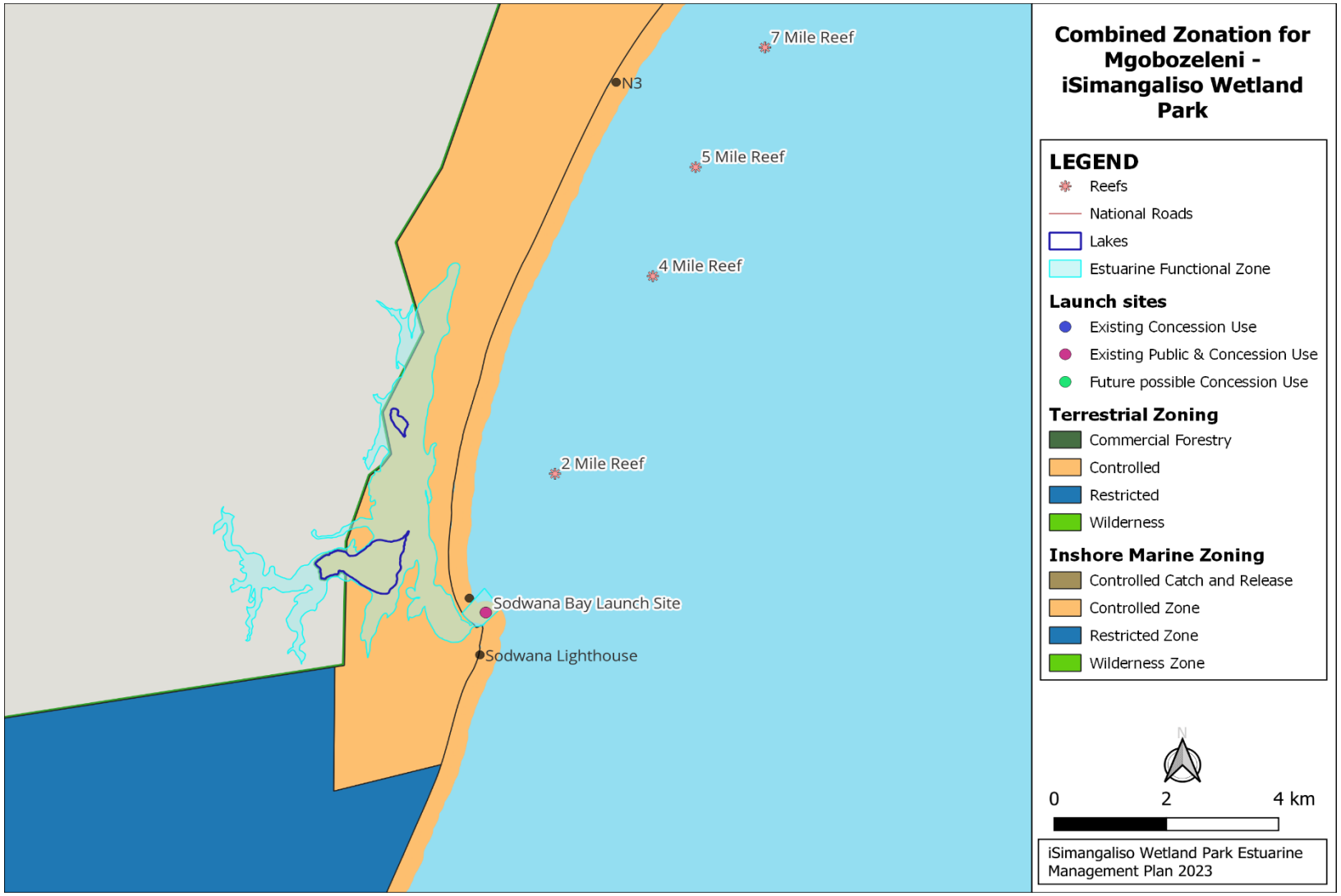


Figure 14: Combined zonation for Mgobozeleni

Controlled (Terrestrial)

MODIFIED NATURAL ENVIRONMENT. Noticeably less pristine than a Restricted Zone and, thus, normally less sensitive to the development of visitor facilities.

Inherent Attributes/ Characteristics	An area in which the landscape and ecological processes may have been noticeably transformed by past or present development (e.g. human settlement, silviculture, agriculture, alien plant invasion and soil erosion) but in which restoration is possible to: i. A natural setting that appears largely unmodified. ii. A system in which the ecological processes function naturally in many if not all respects. iii. A situation in which, as a result of achieving the above, the area could be regarded as partly modified and, hence, could be upgraded to a Restricted Zone. Proactive and responsive interventions may be required indefinitely for the maintenance of the above.
Focal Purpose of Zone	i. The restoration and maintenance of natural landscapes and ecological processes. ii. Provide nature-based recreational experiences for the full spectrum of potential user groups and market segments.
Permissible Uses & Activities NOTE 1	i. Hiking. ii. Horse riding. iii. Cycling. iv. Motorised boats (concession and self-drive) v. Non-motorised water craft. vi. 2x4 and 4x4 driving (concession and self-drive). vii. Freshwater diving (coastal freshwater lakes). viii. Swimming (in secured areas in coastal freshwater lakes). ix. Motorised and non-motorised special interest/educational trails, tours and activities under special permit only. x. Overnighting in all types of Park Development Nodes and houseboats. xi. Lake ferry shuttle service. xii. Controlled traditional subsistence resource harvesting and use. xiii. Human settlement in Special Residential Nodes in the Coastal Forest Reserve section of the xiv. Park and as defined in Local Area Plans, with limited non-commercial food gardens (for xv. subsistence purposes and using low technology). xvi. Scientific research and monitoring.
Non-Permissible Uses & Activities	i. Quad bikes and motor cycles except for management purposes. ii. Personal watercraft and private sail boats (freshwater lakes). iii. Invertebrate harvesting (freshwater lakes). iv. Recreational and commercial fishing (freshwater lakes). v. Mining, silviculture, hunting, commercial agriculture, and aquaculture. vi. Human settlement, except for Special Residential Nodes and management staff and tourist accommodation facilities, as described above under 'permissible uses and activities. vii. Supply of water to consumers outside the Park excluding existing and emergency use. viii. Recreational and leisure activities that are not associated with an outdoor nature-based experience. ix. Fireworks

Use Intensity/ Frequency NOTE2	Full range of controlled use – very low to high intensities and frequencies but appropriate to the World Heritage status and context. Distinguished from previous zones by entry/access control mainly through the issue of permits (tickets) at entry gates, as opposed to advance application for individual or concession permits. Also distinguished by the potential to allow a significant level of self-drive game viewing experiences, as opposed to the need to confine activities to guided experiences (as in the previous three zones).
Development Nodes	All Development Nodes are permitted, including Medium and High Intensity Tourism Overnight Nodes, Tourism Day Visitor Nodes, Park Management Nodes and Special Residential Nodes.
Development Restrictions	Despite falling within a Controlled Zone, development must be sensitive, maintain a 'sense of place' and be in keeping with the Park's World Heritage values and status. Development must also adhere to all other environmental specifications and guidelines, including avoidance of sensitive sites. Outside of the Medium and High Intensity Development Nodes, the following development is permitted: i. Small, low impact management facilities, bush lodges, hides, permanent campsites, viewpoints, canopy walkways, picnic sites and interpretation display. ii. Accommodation facilities to use low intensity lighting. iii. Comprehensive but environmentally harmonious informative/directional signage. iv. Upgraded management and tourist roads (i.e. gravel and hard top). v. Regional supply of utility services but overhead/above ground infrastructure in exceptional cases only (e.g. occurs historically, provides an essential service and is too costly to relocate, bury or substitute with alternative technology).

Controlled (Terrestrial)

NOTE 1: All permissible activities are subject to parameters set by legislation and the Permissible Activities Framework (including respective permits and permit conditions)

NOTE 2: Actual density levels, activities and group sizes are specified in the development node and activities framework of the IMP.

Controlled (Marine)

MODIFIED NATURAL ENVIRONMENT. Noticeably less pristine than a Restricted Zone and, thus, normally less sensitive to the development of visitor facilities. Similar in principle to a Terrestrial Controlled Zone. A Controlled Zone means an area within the MPA where limited fishing or any other activity in terms of section 48A (1) of the Act may take place if authorised in terms of these regulations as contemplated in terms of section 48A (2) of the Act or if authorised in terms of regulation 4(7).

Inherent Attributes/ Characteristics	A marine area where the seascape, ecosystems and habitats, and ecological processes may have been noticeably transformed by past or present developments (piers, buoys) or human activities (fishing, estuary mouth manipulation) within the area or in the terrestrial area immediately adjacent to it, but with significant interventions over time it could be restored to: i A natural setting that appears to the general public as largely unmodified. ii A system in which the ecological processes function naturally. iii A situation in which, as a combination of achieving the above, the area could be regarded as partly modified and, hence, could be upgraded to a Restricted Zone. Proactive and responsive management interventions may be required indefinitely for the maintenance of the above.
Focal Purpose of Zone	i Where applicable, the restoration and maintenance of natural landscapes and ecological processes. ii Provide an affordable, comfortable, informative, safe, enjoyable and sustainable outdoor recreational experience in a relatively-unspoilt marine environment.
Permissible Uses & Activities NOTE 1	*Inshore:* i Walking on beaches and rocks and fossicking. ii Swimming, snorkelling, surfing, surf-skiing, kite and wind surfing and kayaking. iii Horse riding. iv Cycling. v Concession, research and monitoring, and management beach driving only. vi Recreational and subsistence rock and surf angling. Fishing after sunset and before sunrise by special permit only. vii Sharks and rays may be caught from the shore, but must be returned unharmed to the water from where they were caught. viii Boat launching (self and concession) at recognised boat-launching sites. ix Special interest/educational activities within parameters of other permissible and non-permissible uses and activities. x Controlled subsistence invertebrate harvesting of intertidal organisms and rock and surf linefishing in designated areas. xii Research and monitoring with a scientific permit. *Estuarine Lakes:* i Walking on estuary margins and fossicking. ii Boat launching (self and concession) at recognised boat-launching sites. iii Use of motorised vessels (self and concession). iv Recreational and small-scale shore and boat-based angling (sunrise to sunset only).

	v Kayaking and canoeing vi Special interest/educational activities within parameters of other permissible and non-permissible uses and activities. vii Controlled and permitted small scale invertebrate harvesting in designated areas. viii Research and monitoring with a scientific permit.
Non-Permissible Uses & Activities	*Inshore.* i. Vehicles on the beach except for boat launching purposes at recognised launch sites, and concession beach driving and authorised management and research and monitoring vehicles. ii. Launching from non-recognised sites except under special permit. iii. Harvesting of intertidal organisms other than small scale invertebrate harvesting or under special permit. iv. Collection of marine aquarium fish, invertebrates and plants except for educational or scientific purposes and under special permit. v. Collection of broodstock for undertaking aquaculture, except with a permit from the management authority. vi. Collection of organic (drift wood, shells) and inorganic (e.g. rocks, sand) materials except for educational or scientific purposes and under special permit. vii. Commercial fishing. viii. Fishing between sunset and sunrise, unless by special permission. ix. No person may participate in or arrange any fishing competition without a permit from the managing authority x. No person may litter or leave any waste including fishing gear, hooks, bait packaging and fishing line within the MPA. xi. No person or vessel may be in possession of or have on board SCUBA diving gear and a speargun. xii. Fireworks Estuarine Lakes: i. Vehicles on the beach barrier except for boat launching purposes at recognised launch sites, concession beach driving and authorised management and research and monitoring. ii. Launching from non-recognised sites (except under special permit). iii. Personal watercraft., windsurfing, kiteboarding (crocodiles, hippos) iv. Harvesting of intertidal organisms other than subsistence small scale invertebrate harvesting or under special permit. v. Collection of marine aquarium fish, invertebrates and plants except for educational or scientific purposes and under special permit. vi. Collection of broodstock for undertaking aquaculture, except with a permit from the vii. Collection of organic (drift wood, shells, etc) and inorganic (e.g. rocks and sand) materials except for educational or scientific purposes and under special permit. viii. Commercial fishing. ix. No person may litter or leave any waste including fishing gear, hooks, bait packaging and fishing line wihtin the MPA x. Fireworks

Use Intensity/ Frequency	Regulated and controlled use of moderate intensity and relatively high frequency, with entry/access restricted to and controlled at entrance gates or other demarcated points of entry.
Development Nodes	Only Tourism Day Visitor Nodes and Park Management Nodes permitted.
Development Restrictions	Only very low key, unobtrusive and low impact development permitted from base of dunes to the low water mark. No development of any type or form permitted from the low water mark to the outer limit of the park boundary regardless of circumstances or needs. Development from base-of-dune to dune-crest and inland must conform to restrictions laid down for the adjacent Development Node or Terrestrial Zone which, in most instances, will be a Terrestrial Controlled Zone.

Controlled (Marine)

NOTE 1: All permissible activities are subject to parameters set by legislation and the Permissible Activities Framework (including respective permits and permit conditions)

6.1 Appropriate buffers to the estuary boundary

ISimangaliso has delineated a buffer zone to protect the park from external threats. This is in keeping with international best practices and Acts such as the World Heritage Conservation Act and the Protect Areas Act. The delineation of the Buffer Zone was undertaken in accordance with the provisions of iSimangaliso's approved Buffer Zone (Zone of Influence) policy and the South African Department of Environment, Forestry and Fisheries Policy and Strategy on Buffer Zones. iSimangaliso is currently undergoing the review of this buffer zone policy. The buffer zone and associated delineation for the World Heritage Site is depicted in Figure 15 below. It is critical that the revision of this buffer zone considers external threats to the functioning of the Mgobozeleni Estuary. In order to do this, the zone would need to be extended to include additional catchment area.

The current iSimangaliso Park Buffer (or zone of influence) extends significantly past the EFZ of the estuary. As such the proposed additional buffer for this management zone is not markable different. The Mgobozeleni System is not fed by any major rivers but rather by groundwater seepage and streams. The correct management of these groundwater resources are therefore vitally important. Of particular concern would be the concentrated commercial plantations directly north of the system as well as the growing settlements.

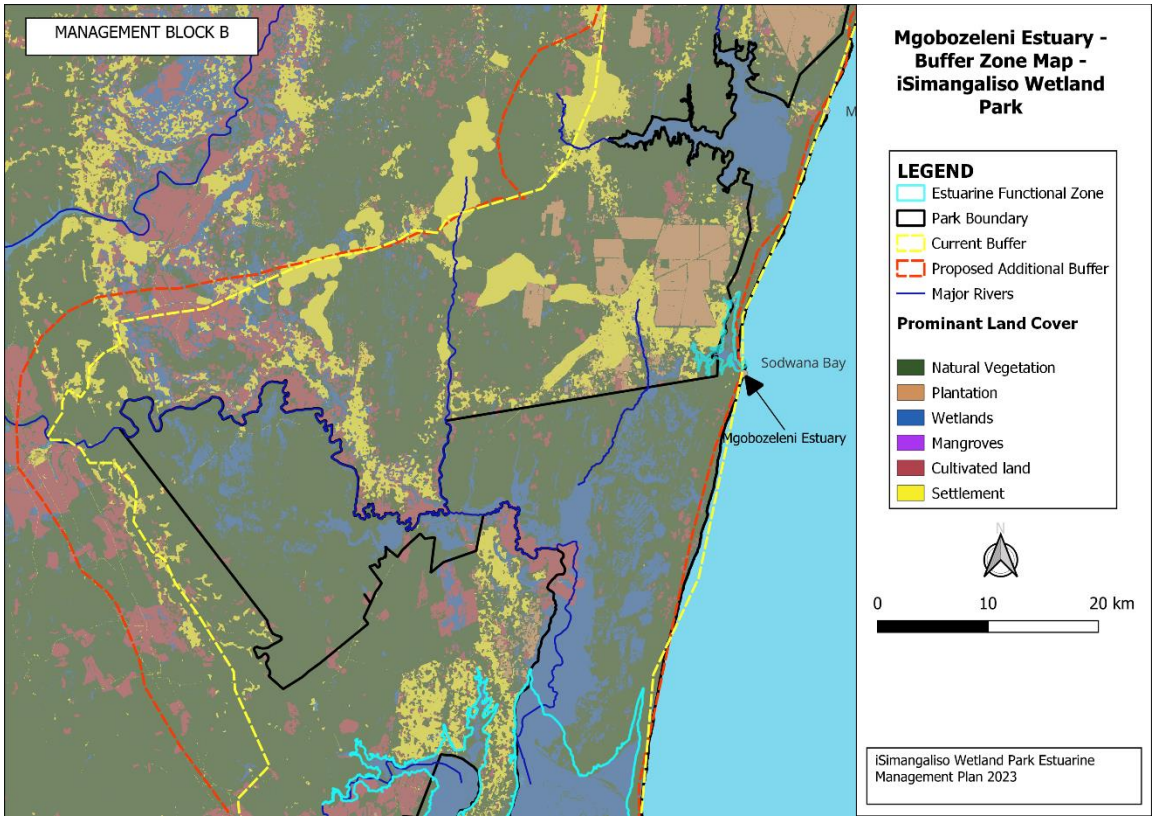


Figure 15: The current and proposed buffer zone for the Mgobozeleni System.

7. Recommended Management Priorities

The following are key action plans that needs to be prioritised within the Mgobozeleni estuary in order to ensure ecological and socio-economic benefit of the estuary: The below management priorities need to be carried out effectively in order to achieve the above-mentioned key management objectives. The recommended management priorities are not limited to the following actions:

- Monitoring of the water quality of the estuary regularly to identify the impacts associated with it.
- Review the current monitoring programme, identify areas needing strengthening, including selected physio-chemical variables, indicators that reveal presence of contaminants, status of estuarine plants and animals
- Monitor Gill netting fishing method and implement prohibitions on the method
- Fishing to be monitored and only allowed in permitted areas as per the zonation areas of the estuary activities
- Create estuary buffer zone through the implemented EFZ

- Develop an EMPr and Emergency Response Plan (ERP) for the Mgobozeleni estuary,
- Local and Indigenous knowledge to be adopted into structuring EstMP hence a thorough public participation is essential when updating EstMP in order to capture the communities' ecological and socio-economic perception of the estuarine systems considering it's part of their local livelihood
- Implement a no permanent structure Park rule within 100m of the estuary.
- Education and raising awareness about the importance of estuarine ecosystem protection and conserving and the subsequent benefits to the community in terms of local socio-economic gain
- Support DWS' initiatives to manage catchment water use
- Monitor Mangrove dieback
- Monitor Sedimentation and Reed encroachment of the system as the accumulation of this contributes to the narrowing of the estuary channels and smothering of other vegetation types
- Monitor the Loss of swamp forest area
- Monitor Upstream anthropogenic activities such as agriculture and mining

8. Integrated monitoring plan

Good data needs to be available to assess long-term changes in the hydrological, hydrodynamic and ecological health and functioning of the Mgobozeleni estuarine system. A review of the monitoring plan for the Mgobozeleni estuarine system will be undertaken as part of this EstMP. The monitoring plan that is finally put in place should be made as practical as possible and with essential indicators selected, taking into account availability of human and financial resources. It should aim at collecting appropriate and reliable quantitative data, which are essential for the implementation of management actions and review of the responses of the system.

The table below defines a comprehensive monitoring plan for the Mgobozeleni system and is a good starting point for the review. Given that the current resource constraints are likely to persist during the lifetime of this EstMP, it is unlikely that all indicators will be included. However, the indicators should cover the following:

- Biological. Diversity and Abundance and Areal

Coverage.

- Exploitation of Living Resources: Invertebrates and Fish.
- Water Quantity and Quality.

Table 4: Monitoring Plan

Focal Areas and Indicators	Monitoring Objective	Frequency	Location	Collection/Analytical Method
Water Quality: Essential physical parameters (salinity, temperature, dissolved oxygen, conductivity, depth, pH and turbidity/suspended solids) Inorganic nutrients (phosphates, nitrates, ammonium etc) Toxic substances (heavy metals, hydrocarbons, pesticides, herbicides, etc) Coliform bacteria (*Escherichia coli* and total coliforms) Macroalgae (cyanobacteria, chlorophytes, dinoflagellates, diatoms)	To determine changes in water quality in response to management actions	Monthly	A minimum of ten fixed sample sites Sample at the mouth, before the bridge, after the bridge, within the channel leading to the lake, and within the Mgobozeleni Lake.	According to laboratory specifications and/or as stipulated in the Methods for the Determination of the Ecological Water Reserve for Estuaries (DWA, 2010)
Water Quantity: Water flow into the estuary Depth of the estuary	To detect decreases in volume of water reaching the estuary to inform management actions. To assess the sediment entering the system	Monthly	Water quantity measures from all water sources	Installation of suitable flow measurement stations Review of new WULAs and plantation permit applications
Mouth Condition and Bathymetry	To assess mouth behavior and long term changes in mouth dynamics To detect changes in depth and sedimentation rates	Daily Every 5 years	Mouth and sand barrier Whole system	Mouth condition by trained observers with GPS and photography Installation of water level recorders Bathymetric surveys

Focal Areas and Indicators	Monitoring Objective	Frequency	Location	Collection/Analytical Method
Biological: Diversity and Abundance and Areal coverage Phytoplankton/Microphytobenthos Macrophytes (reed swamp, other peripheral vegetation types, alien invasive) Microcrustaceans (prawns and crabs) Fish Birds Reptiles Mammals	To determine baseline and then on-going changes in biota in response to management actions	Quarterly for the 1st year for fauna Then twice a year once during summer and winter rainfall months Twice a year for macrophytes	Sample at the mouth, before the bridge, after the bridge, and within the Mgobozeleni Lake.	As stipulated in the Methods for the Determination of the Ecological Water Reserve for Estuaries (DWA, 2010) Fixed photo monitoring/aerial photography of macrophyte coverage
Exploitation of living resources: Macrocrustaceans, Fish, Reed and Thatch Grass Subsistence farming in wetlands Permits issued Levels of non-compliance	To assess the level of exploitation of living resources to inform management actions	Weekly	Through-out system for fish Reed swamp for Reeds and Thatch Grass harvesting Within swamp forests and other wetland areas for uncontrolled subsistence farming	Patrol survey of the number of permits issued and non-compliance

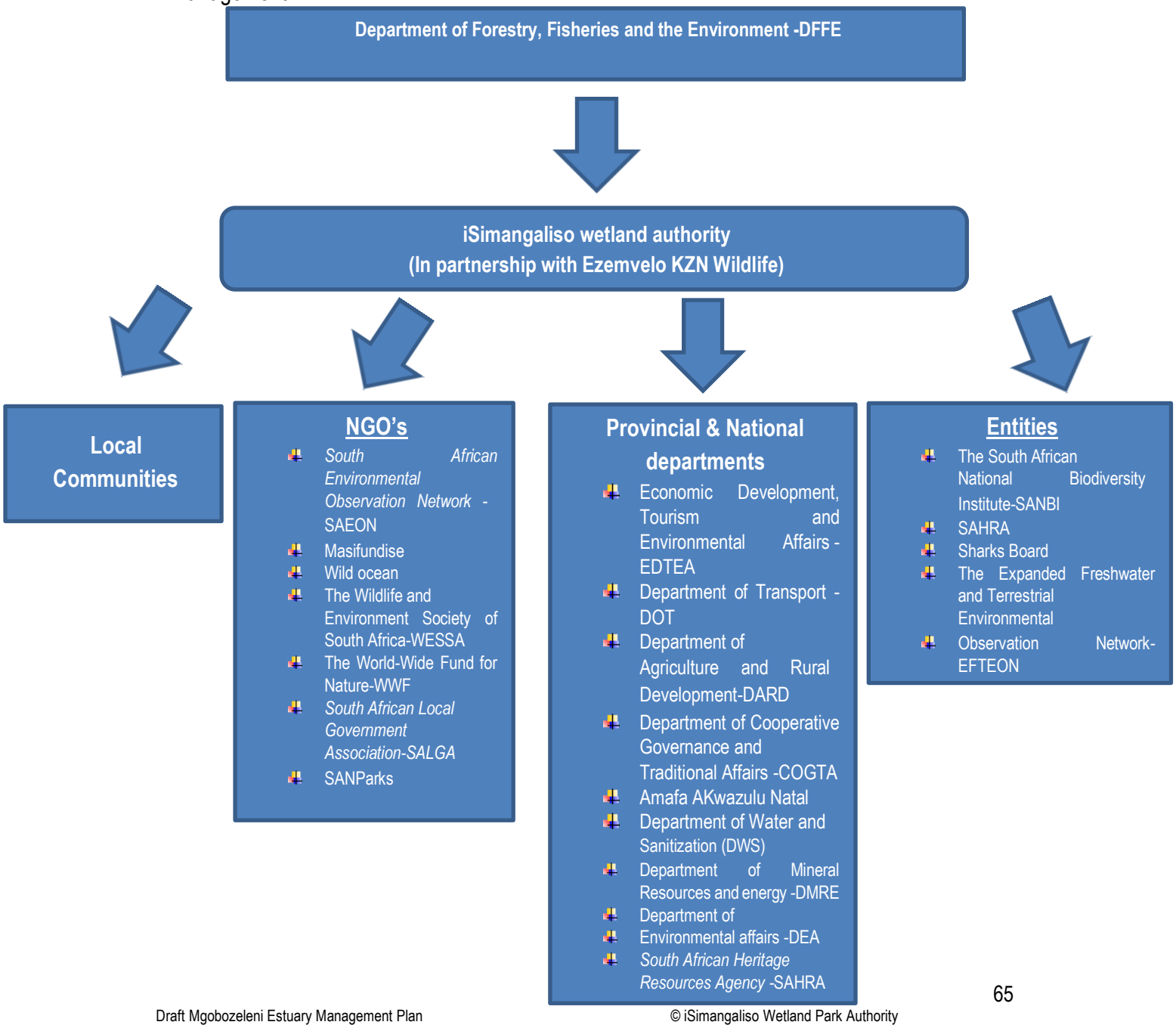
Socio economic aspects and indigenous knowledge approach	To determine if the indigenous knowledge and socio-economic aspect have been considered on the management and implementation phase of the EstMP	Every 5 years	This information needs to be reflecting in all future EstMP updates process as part of the review of the EstMP	Such evidence needs to be made transparent through a comment and response report constructed dung the public participation

9. Institutional capability and arrangements

It is critical that this EstMP is regarded as a strategic plan that can guide the detailing of management actions and identification of implementing agents to offer a schedule or phased planning approach that incorporates capacity building and implementation at the local level over a five-year period. It is crucial that champions/project leaders/teams are identified who will be responsible for the formulation of detailed project plans and the implementation thereof.

9.1 Key Role Players

The below figure illustrates the key role players that should be included in the EstMP management.



9.2 Responsible Management Authority

iSimangaliso wetland authority are responsible for the co-ordination of the implementation of the Mgobozeleni River EstMP. The majority of the implementation actions identified in this EstMP are the responsibility of iSimangaliso Wetland Park Authority, Ezemvelo KZN wildlife and DFFE as the authority for the protected area, supported by mandated government, NGOs agencies where indicated. These stakeholders will be responsible for the formulation of detailed project plans and the implementation thereof. Progress towards achieving the objectives set out in this EstMP should be reviewed on every annually basis by iSiiSmangaliso wetland authority and communicated to stakeholders as well as to Ezemvelo KZN wildlife and DFFE via an annual report. This EstMP will need to be revisited and updated after five years to reflect goals that have been achieved and to accommodate changing priorities. Provincial, national department including the entities, NGOs and local communities are considered as stakeholders that are to be considered during the planning, management ongoing monitoring of EstMPs. In order to multi-stakeholder liaisons will assist in collaboration and co-production of knowledge so that varied inputs can be included in policy decision making and all may benefit equitably from the ecosystem services of the Estuarine system.

9.3 Project plans for implementation

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

9.3.1 Recommendations

In order to ensure iSimangaliso Wetland Park reaches the desired ecological state(category B - Largely natural with few modifications) of the Mgobozeleni estuarine, the EFZ and zonation of the estuary boundaries need to be adhered to. The following actions that need to be considered during the planning, management/objective setting and implementation phase of the EstMP :

- Design and implement a water quality monitoring programme for the estuary
- Eradicate/control invasive alien plant species from estuary to increase flow
- Conserve and restore wetlands in the estuary
- Oversee the implementation of the Conservation Operational Plan and revise annually
- Review and refine the zonation of the Mgobozeleni estuarine system in order to better protect sensitive habitats and species, particularly estuarine dependent biota

- Apply zonation, through consultation with all Interested and Affected Parties (IAPs), of estuaries for recreational and subsistence fishing activities and non-consumptive activities to reduce user conflict
- Identify potential Estuarine Protected Areas (EPA) for the conservation of over-exploited line fish species (e.g. dusky Kob and white steenbras). The area must include the mouth and adjacent marine environment.
- Identify and mitigate against impacts resulting from industrial and mining activities, and urban development
- Ensure that no permanent structures are built within 100m of the estuary.
- Monitor illegal gill netting (verifying the extent of problem) and maintain compliance in this regard
- Investigate occurrence and sensitivity to pressures of estuarine invertebrates (in both open and closed bait collection areas) and update bait collection strategies and plan accordingly.
- Improved multi-stakeholder liaison as there is opportunity for collaboration and co-production of knowledge so that varied inputs can be included in policy decision making and all may benefit equitably from the ecosystem services of this system
- There is a need to develop a culture for the sharing of knowledge. The goal of the education objective in estuaries is to improve the use of knowledge by estuary users (including indigenous knowledge) and managers.
- Socio-economic activities are to be closely monitored and communication is carried out efficiently with communities in and around the estuary and conservation is carried out proficiently

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11. APPENDICES

11.1 Park Authority and Environmental Assessment Practitioner (EAP)

Table 5: Contact details of iSimangaliso Wetland Park Authority:

Contact Person	**Siboniso Mbhense**
Address	**Private Bag X05** **St Lucia** **3936**
Telephone	**035 5901633**
Email	**siboniso@isimangaliso.com**

11.2. Role and Competence of the Project team

It is the responsibility of the project team to perform all work relating to the iSimangaliso Wetland Park in an objective, appropriate and responsible manner.

Table 6: Name and contact details of the lead EAP for the project:

Business name of EAP:	**ICEBO ENVIRO PROJECTS**		
Physical address:	**SUITE 2B, NO: 8 OLD MAIN ROAD, HILLCREST, 3650**		
Postal address:	**P.O. BOX 29156, HILLCREST**		
Postal code:	**3650**	**Cell:**	**079 307 3282**
Telephone:	**0317654129**	**Fax:**	**086 549 8430**
E-mail:	**shangen@iceboenviro.co.za**		

11.3. Names and expertise of representatives involved in the preparation of the EstMP

Names and details of the expertise of each representative involved in the preparation of this EstMP:

Table 7: Expertise of representatives of the project team

Role	Name	Responsibilities	Experience at environmental assessments (yrs.)
Project Principal and Senior Environmentalist	**Monica Shange**	Monitoring project progress as per set timeframes. Project quality control and progress monitoring. Client and project team liaison. Draft all EstMPs and reviews all EstMP reports and applicable legislations. Principle presenter for public participation process – stakeholder engagement of the EstMPs	17 Years' experience as a qualified and registered environmentalist and registered natural scientist with EAPASA and SACNASP
Senior ecological specialist	**Andrew Husted**	Assist in drafting of report relating to aquatic advise, review reports, GIS / Spatial mapping of EstMPs	12 years' experience as an environmental specialist
Aquatic Ecologist & Spatial Mapper	**Nikita Van Schoor**	Assist with GIS mapping of EstMPs and estuary background information	3 years' experience as an aquatic ecologist
Coastal and Estuarine/riverine specialist	**Dr Alan Mitchell Smith**	Assist with coastal and estuarine of EstMPs	27 years as coastal and estuarine specialist
Meteorologist, air quality specialist, oceanographer, coastal expert and climate change specialist	**Lisa Anne-Marrie Guastella**	Meteorologist, air quality specialist, oceanographer, GIS Mapping, coastal expert and climate change specialist	41 years as Meteorologist, air quality specialist, oceanographer, GIS Mapping, coastal expert and climate change specialist
Project Assistant	**Noluvuyo Masango**	Assistance with project where required Facilitator for public participation process – stakeholder engagement of the EstMPs	2 years as a Project assistant
Environmental Consultant	**Nombuso parkies**	Assists with drafting of EstMP reports Assist Facilitator for public participation process – stakeholder engagement of the EstMPs	3 years' experience as an environmental consultant

