DRAFT ESTUARY MANAGEMENT PLAN (EstMP) FOR ST LUCIA ESTUARY WITHIN ISIMANGALISO WETLAND PARK

COMPILED IN TERMS OF THE NATIONAL ESTUARINE MANAGEMENT PROTOCOL (2021) & THE NATIONAL ENVIRONMENTAL MANAGEMENT: INTEGRATED 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) 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, to be reviewed 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 best available 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 Lake St Lucia estuary as described in the Situation Assessment Report (MER, 2016). The most recent EstMP was developed by iSimangaliso in 2016 and this is a version reviewed and updated by Icebo Enviro Projects. The iSimangaliso Wetland Park has three major estuary 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 iSimangaliso Wetland Park World Heritage Site. The Lake St Lucia Estuary is situated on the Mozambique coastal plain in the uMkhanyakude District Municipality. It is one of the rarer types being classified as an estuarine lake on the basis of its size and other physical features including the relative extent of tidal influence (Whitfield & Baliwe,

2013). The Lake St Lucia Estuary begins approximately 200 km north of Durban and stretches for a further 90 km parallel to the coastline. The upper estuary, comprised of a lake component, consisting of South Lake, North Lake and False Bay, lies to the north of a channel, generally referred to as the Narrows, which is approximately 20 km long and links the system to the sea when the mouth is open. The lake is roughly H-shaped with a maximum length of approximately 40 km and a maximum width of approximately 20 km. The area of the Lakes and Narrows will vary with water depth but a generally accepted figure is 620 ha being the extent of the Estuarine Functional Zone. For the purposes of this EstMP, the geographical boundaries of the Lake St Lucia Estuary are defined by the 5 m topographical contour and the area within this boundary is known as the Estuarine Functional Zone (EFZ).

The estuary falls within the sub-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 catchments. The mouth of the Lake St Lucia is dynamic and migrates northward with longshore drift. Historically, mouth dynamics in terms of closure and position between Maphelane in the south and the St Lucia high ground to the north were driven by the interaction between flow levels in the uMfolozi River and wave induced marine sediment movements. A long history of river diversion (uMfolozi River) and artificial breaching has occurred and this has influenced strongly the physical state of the estuary. The policy of diverting the uMfolozi River to sea which was initiated in 1952 was changed by the iSimangaliso Authority sixty years later in 2011/2012. An active relinking of the uMfolozi River with the St Lucia Estuary occurred in July 2012 and this began the process of restoring estuarine function. The uMfolozi River migrates naturally northwards to link with the estuary. Previously artificial breaching would pull the river back southwards by diverting it to sea in the vicinity of Maphelane. To ensure continued restoration, diversion of the uMfolozi River and artificial breaching of the estuary will be carried out in the future only in accordance with approved breaching guidelines which has to consider ecological as well as socio-economic indicators, in line with the recommendations of the 2022 Panel of Experts Report on the St Lucia Estuary Mouth. The active facilitation of the re-joining of the uMfolozi River with the St Lucia system has been implemented by the removal of the dredge spoil that has been deposited in the vicinity of the estuary mouth in combination with the complete cessation of mouth interference, save for situations where the ecological and socio-economic factors compel such action of artificial breaching be undertaken.

The most biologically significant water quality parameters in the Lakes, Narrows and the uMfolozi-Msunduzi complex under present conditions are salinity, turbidity and, to a lesser degree, temperature. All these parameters undergo large temporal and spatial fluctuations in response to rainfall and other environmental factors. These fluctuations move the estuary through many different states e.g., from freshwater through to very saline and it is this that drives the diversity of the biological components of the Estuary. The Lake St Lucia estuarine system is the most important nursery ground for juvenile marine fish and prawns along the sub-tropical east coast. It is also the most important estuary in terms of the numbers and diversity of water birds, which it supports. The estuary is a very important staging area with more than 50% of all water birds in KwaZulu-Natal feeding, roosting and nesting in this estuary. Importantly, it is the breeding area for several birds, which are rare or have limited distributions in South Africa. This has contributed to it being proclaimed a protected area, a Ramsar Wetland of International Importance and then finally a World Heritage Site.

Summary and recommendations as per the report Compiled by the Independent Panel of Experts as appointed by the Honourable Minister, Ms Barbara Creecy, Department of Forestry and Fisheries and Environment (DFFE) 1 Oct 2021 – 31 March 2022

The findings of the panel outline the impact of the breach, stakeholder perceptions, and the alignment of the breach to authoritative reports. It states that the breach did not contravene the recommendations in the Maintenance Management Plan, however it does go against the Global Environmental Facility (GEF) report recommendations (The DFFE Independent Panel Report, 2022). The breach did not appear to have a significant ecological impact and it was found that the circumstances necessitating a breach were largely undefined. The findings from the panel report further highlight a gap in the socio-economic context regarding management plans and modelling of management scenarios. Although hydrological and ecological data provide useful insight into the environmental reality of managing estuarine systems, social actors are important ecosystem components and to exclude social or economic realities from management plans will only further exacerbate conflict between management and related stakeholders (The DFFE Independent Panel Report, 2022). Lastly, the panel provides key recommendations for the ongoing monitoring and management of the system along with potential directions for future investigation. The panel concludes that the increased attention around the St Lucia system heralds optimism for its ecological well-being and for the subsequent well-being of all interested and affected stakeholders. With careful planning, ongoing monitoring and improved multi-

stakeholder liaison, 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 (The DFFE Independent Panel Report, 2022).

This EstMP contains nine chapters as stipulated in the Guidelines for the Development and Implementation of Estuarine Management (2015).

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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
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
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**
GEF	Global Environmental Facility
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.
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 characterised 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
IDP	Integrated development plan
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.
IPCC	Intergovernmental Panel on Climate Change
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.
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, 2003 (Act No 57 of 2003) (NEMPAA) (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
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.
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	Public Finance Management Act
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 licence 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 Licence Application under the National Water Act No. 36 of 1998

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 St Lucia 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 and updated 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 St Lucia Estuary System 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 in the Department of Forestry, Fisheries, and the Environment (DFFE) and is mandated to implement the policies and principles of the World Heritage Convention, the Act and the National Environmental Management: Protected Areas Act, 2003 (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 NEMPAA. 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 Lake St Lucia estuarine system is the largest estuary in the country and is situated on the Mozambique coastal plain in the north of the province of KwaZulu-Natal. The estuary is a dominant feature of the iSimangaliso Wetland Park and from a biodiversity point of view is one of the country's most significant estuaries. It also plays an important socio-economic role in the region (Clark *et. al*., 2015) and, in terms of ecosystem services, has high tourism value. The estuary incorporates a large lake-like water body running parallel with the coastline in the north, with compartments known as North Lake, South Lake and False Bay (Figure 1). South of the lakes is a 20 km channel, referred to as the Narrows, which provides a physical and biological link between the lakes and the sea, allowing both water exchange and animal migration. The southern end of the Narrows links with the largest catchment to feed St Lucia, viz. the uMfolozi River, which complements the Lakes and Narrows as a source of freshwater and a driving force in terms of mouth dynamics. The estuary is fed by five large tertiary catchments (Figure 2) , W21, W22, W23 (uMfolozi), W31 (uMkhuze) with the remaining three rivers (Hluhluwe, Nyalazi and Mzinene) in W32. It is served by five large tributary rivers, four of which enter the lakes, viz. the uMkhuze and uMzinene rivers in the north. Hluhluwe and Nyalazi Rivers enter False Bay from the south; and the uMfolozi river, links with the system in the south at the lower end of the Narrows.

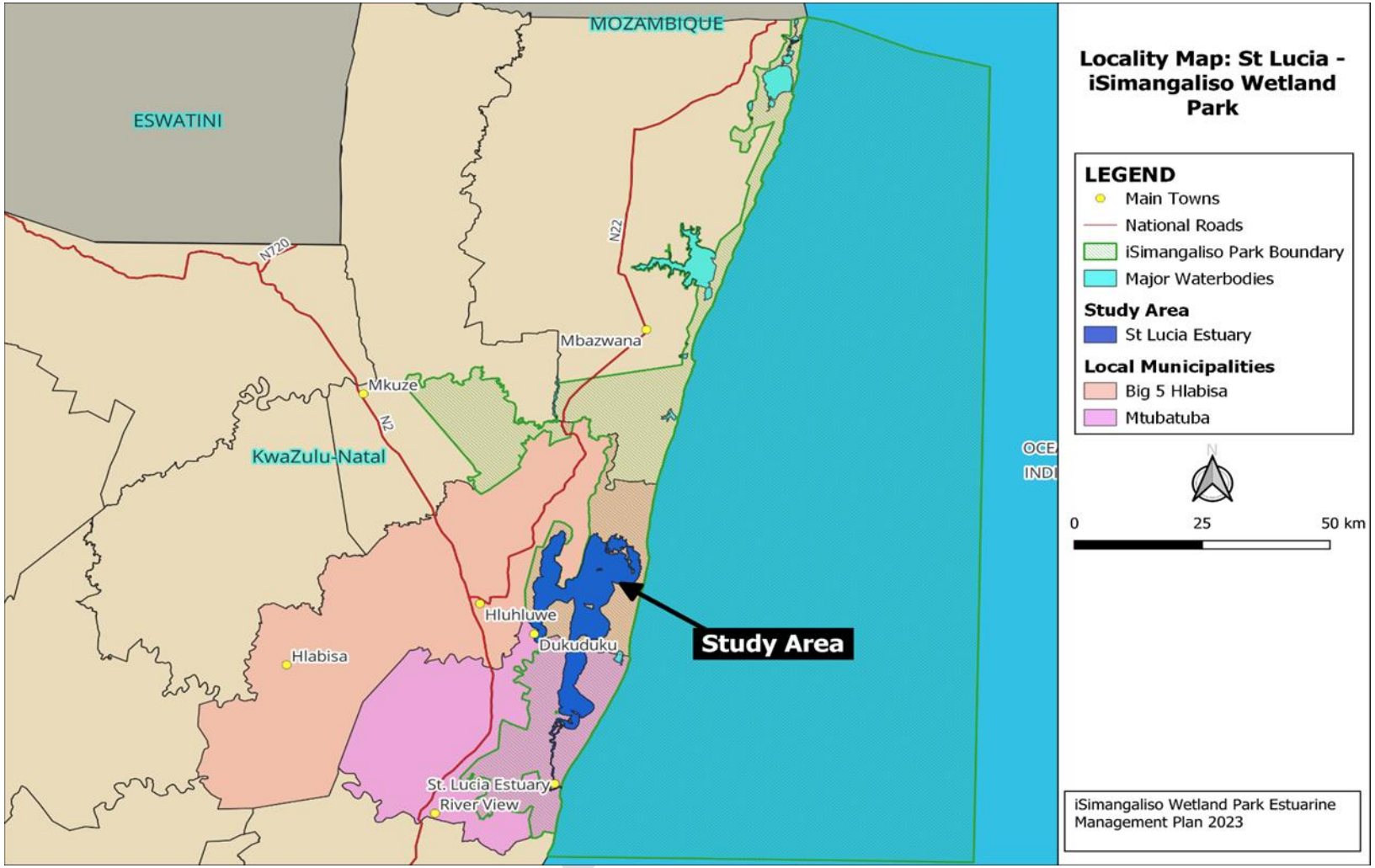

Figure 1: Locality map of the St Lucia Estuary within the iSimangaliso Wetland Park

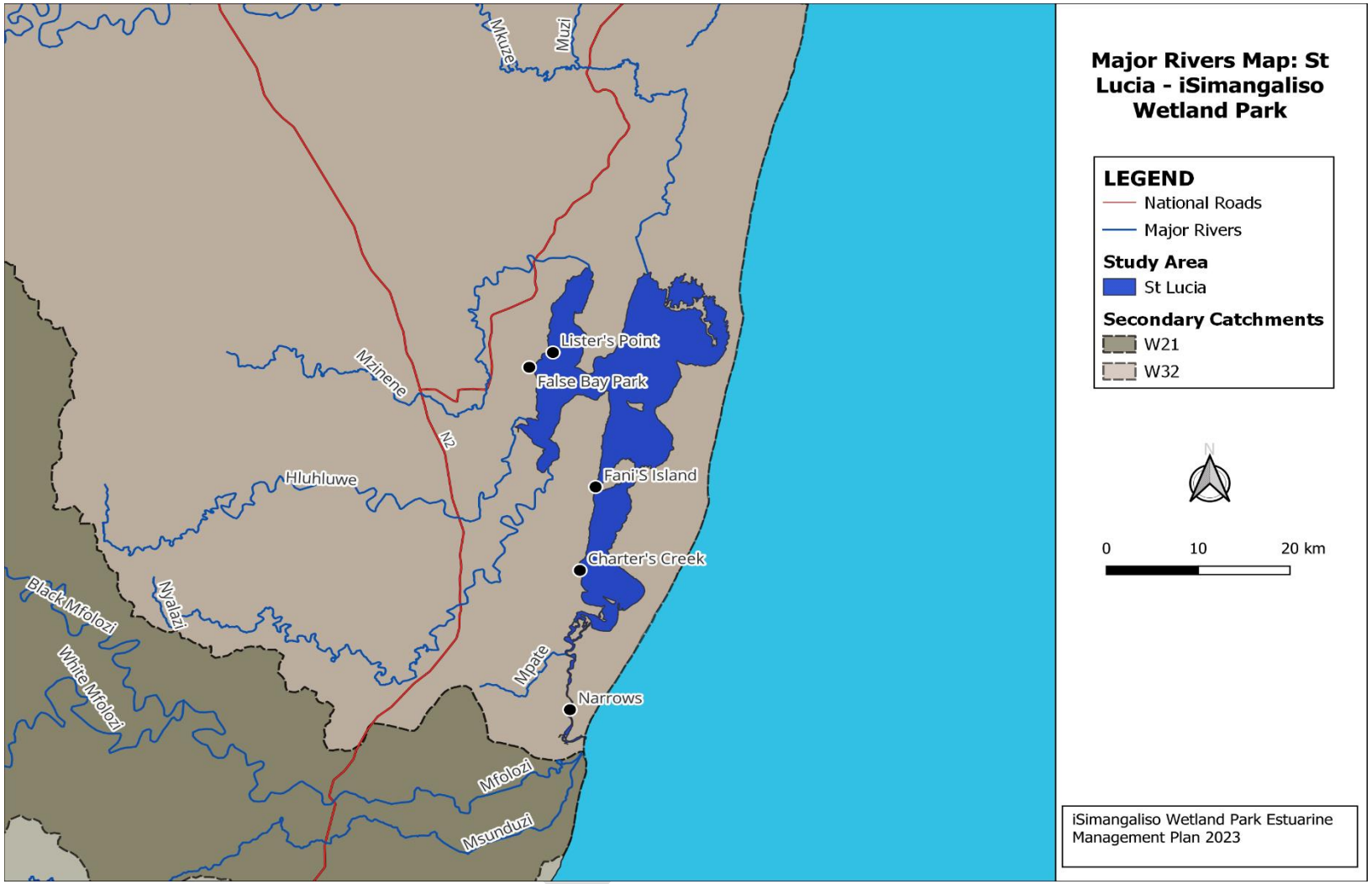

Figure 2: Map Showing Major Rivers that Feed into St Lucia Estuary

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. EstMP's must be consistent with the relevant Coastal Management Programmes, while further guidance is provided by the DFFE's "Guidelines for the development and implementation of EstMP's".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 (IDP) 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. The previous EstMP for the St Lucia 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. 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), objective setting phase and the development of the implementation phase. An adaptive management approach should be adopted during the latter phase with detailed reviews being conducted at five-yearly intervals (Figure 3).

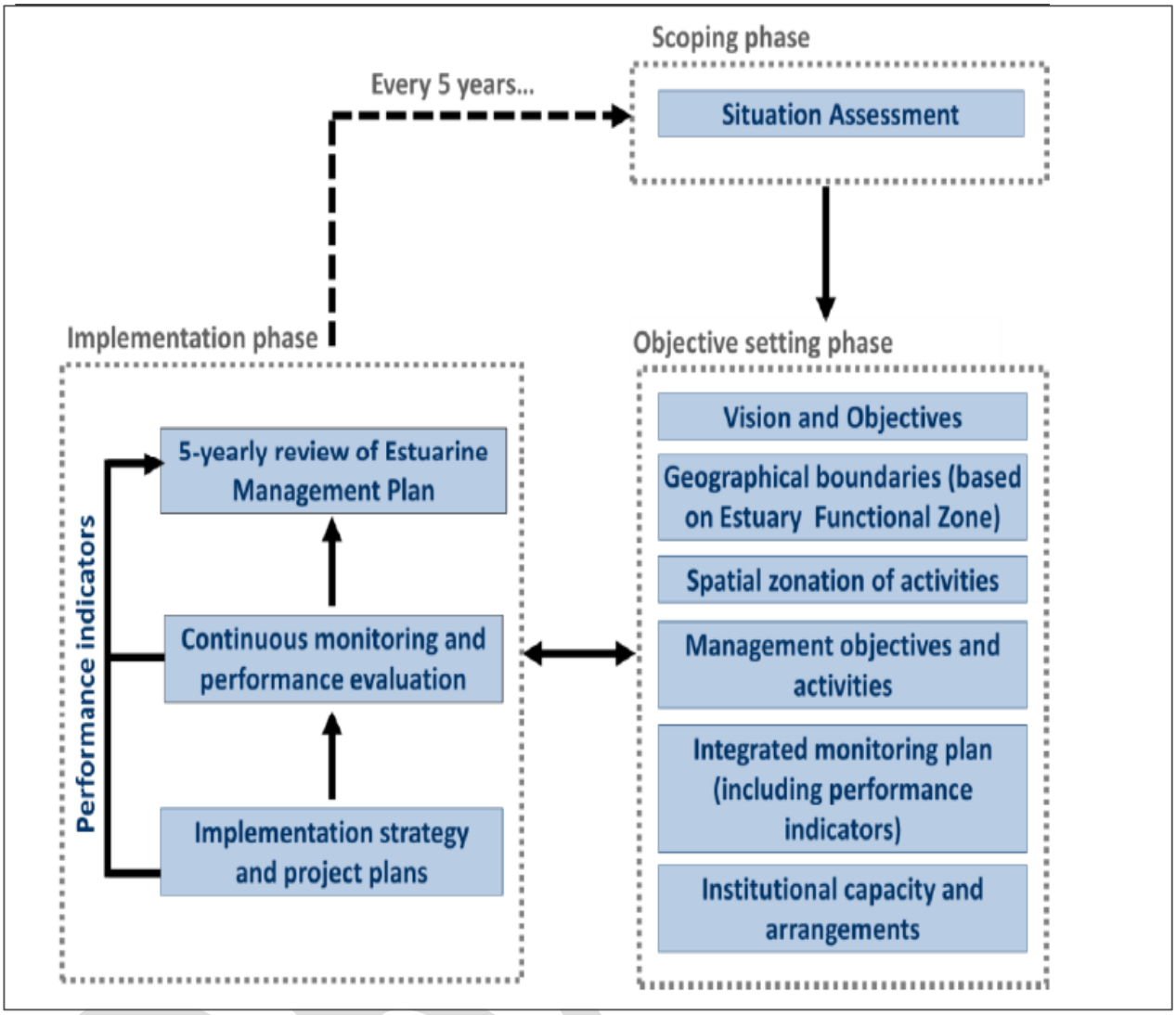

Figure 3: A framework for integrated estuary management in South Africa (DEA, 2015).

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 Notice 3 under the Marine Living Resources Act, 1998 (Act 18 of 1998), which provides specific protection to the marine environment. This was later repealed and the iSimangaliso Marine Protected Area declared on 23rd of May 2019 in terms of the National Environmental Management: Protected Areas Act.

ISimangaliso Wetland Park integrated management plan

The iSimangaliso Wetland Park terrestrial component 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. At the time of publication of this draft EstMP the 2022 iteration of the iSimangaliso Draft IMP had not yet been approved by the Ministry of the DFFE but

will be mentioned in this report.

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 St Lucia Estuary and any other activity that influences the system within the iSimangaliso Wetland Park.

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 St Lucia 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, partners and government agencies the content of the reviewed and updated Estuary Management Plan (EstMP) for the St Lucia Estuary, compiled as part of the requirements of the National Estuarine Management Protocol (NEMP), 2021. The objective is to review and update the previous St Lucia Estuary Management Plan (2016) and 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 revised Estuary Management Plans 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"). The purpose of EstMPs, in the spirit of the ICMA is to provide the mechanism that will enable coordination and alignment of management activities across sectors, underpinned by a shared vision – that is integrative estuarine management. (DEA, 2015). It is understood that the overall objective is to identify and streamline estuarine activities and improve the health status of the system; and ensure integration of the roles and responsibilities of various state organs and/or municipalities where applicable.

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:
    - which organs of state will need to be consulted given the type of zonation that is proposed; and
    - 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 St Lucia system to provide context for the management objectives and actions. 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.

2.1 Catchment Characteristics

The Lake St Lucia system is situated in the southern region of the iSimangaliso Wetland Park and is the southernmost estuarine coastal lake within the subtropical region (this would have been Lake Nhlabane estuary north of Richards Bay previously but major changes to this system have resulted in the lake no longer having a connection with the sea). The St Lucia estuarine system covers an area of up to 35 000 ha (depending on the water level), approximately 50% of South Africa's estuarine cover. This estuary type is one of the rarer types of estuaries, being classified in the category of 'coastal lake' on the basis of its size and the relative extent of tidal influence (Whitfield & Baliwe, 2013).

Unlike the other two iSimangaliso estuaries, Kosi Bay and Mgobezeleni, the Lake St Lucia system is primarily a surface water driven estuary with smaller groundwater inputs. From a water resource planning perspective, the estuary is fed by five large tertiary catchments, W21, W22, W23 (uMfolozi), W31 (uMkhuze) with the remaining three rivers (Hluhluwe, Nyalazi and Mzinene) in W32. It is served by five large tributary rivers, four of which enter the lakes, viz. the uMkhuze (catchment approximately 6 000 km²) and uMzinene (catchment approximately 800 km²) Rivers in the north, and the Hluhluwe (catchment approximately 1 000 km²) and Nyalazi (catchment approximately 7 000 km²) rivers entering False Bay from the south. These rivers are seasonal and flow mainly during the wet summer months. The fifth major river, the uMfolozi (catchment approximately 10 000 km²) River, links with the system in the south at the lower end of the Narrows and provides a dual function as a major source of freshwater and the driver of the estuary's mouth dynamics (Figure 8). Two smaller rivers also provide surface water to the system; the relatively small Mphate River enters the Narrows about 15 km from the sea on the Western Shores. Input into the lakes is also provided from the Nkazana Stream on the Eastern Shores just north of Catalina Bay. Further, the small kwaNdonyana pan discharges from the Western Shores into the Narrows about 7 km upstream from the mouth. Some local input (6-7%) also comes to the system in the form of groundwater derived from rainfall from the immediate areas surrounding the estuary and, in particular, the steep coastal dunes on the eastern margin. Sediments are deposited into the lake basins from these river systems and contribute to sediment accumulation. The dominant land uses for the catchment are nature reserves, commercial agriculture and plantations with other significant uses including rural settlements (Figure 4).

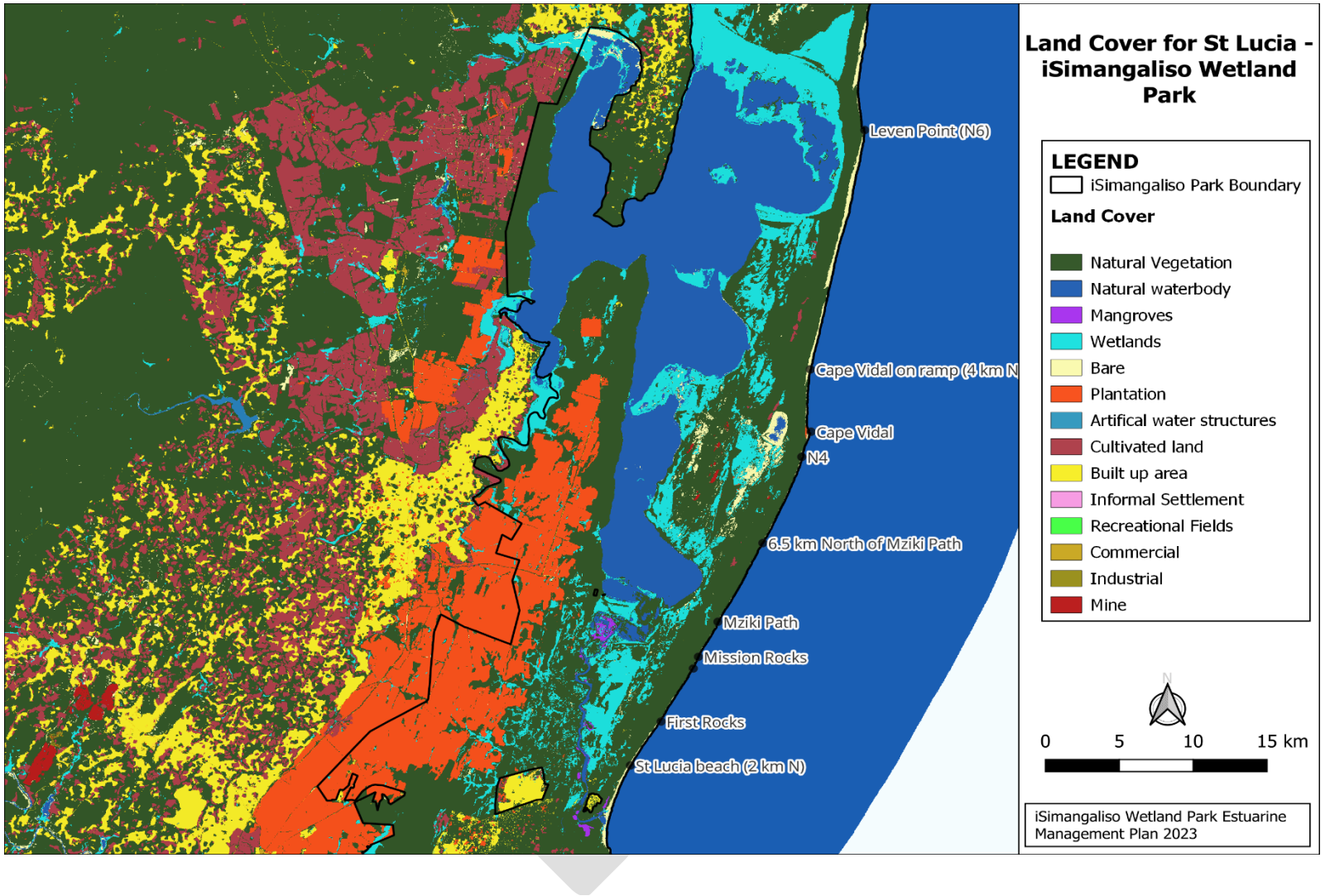

Figure 4: Land cover types surrounding the St Lucia Estuary.

2.2 Abiotic Function

The most biologically significant water quality parameters in the Lakes, Narrows and the uMfolozi-Msunduzi complex under present conditions are salinity, turbidity and, to a lesser degree, temperature. All these parameters undergo large temporal and spatial fluctuations in response to rainfall and other environmental factors. These fluctuations move the estuary through many different states e.g., from freshwater through to very saline. The fauna inhabiting St Lucia are either tolerant to a wide range in salinity or require a specific salinity level between freshwater (0 PSU) and seawater (35 PSU). It is this salinity fluctuation that drives the diversity of the biological components of the estuary. The St Lucia system is currently undergoing a shift from a freshwater state (0-4 PSU) to a brackish state (4-12 PSU), following the recent breaching and open mouth conditions. This is likely to support a more diverse range of organisms.

Figure 5 below illustrates the salinity measured during the past five years in the St Lucia Estuary. A distinct 'reverse' salinity pattern was evident before the breaching event in 2021, where the northern parts of the lake were more saline than the southern area. This higher salinity in the north was largely due to the residual salt in the system after the drought conditions a few years ago. However, following the artificial breaching event in 2021, the salinities within the northern lakes have dropped significantly conforming, although still slightly higher in some instances, to a more typical estuarine salinity gradient (Fox and Mfeka, 2023). During the 2021 artificial breach, salinity increased at the estuary mouth to 20 PSU. The lack of a higher salinity level was attributed to limited marine input and high rainfall following the breach (The DFFE Independent Panel Report, 2022). The short duration of this increased salinity, which was largely confined to the mouth region, had no impact on the removal of Phragmites reeds that can survive short periods of marine inundation. After the mouth breached again in mid-April 2022, seawater was able to flow into the St Lucia Bay and lower portions of the Narrows, albeit salinities only reached 12 PSU. The mouth currently remains open.

Turbidity is a measure of the clarity of the water. Generally, the more solids present within the water the less clarity. The high turbidity observed within the St Lucia System is largely a result of increased rainfall within the catchments. During the rainy season, rainfall is discharged into the estuary carrying excess sediments with it. These sediment loads are often exacerbated by catchment activities which increase erosion and therefore sedimentation processes. Turbidity

generally plays a vital role in estuaries providing protection for juvenile species from predators and providing chemical cues (Blaber and Blaber, 1980; Cyrus and Blaber, 1987; Tigan et al., 2020), however, excessive turbidity can also limit light penetration within the water column, smothering any submerged plant species as well as clogging the respiratory systems of invertebrates and fishes. Reduced turbidity within the St Lucia system in May 2021 is likely a result of reduced freshwater input, the open mouth state and low levels of sediment flushing (The DFFE Independent Panel Report, 2022). The continued input of sediments from the Mfolozi channel has been documented in Fox and Mfeka (2022b) with darker waters representative of sediment seeping. These sediment inputs have not been monitored to date.

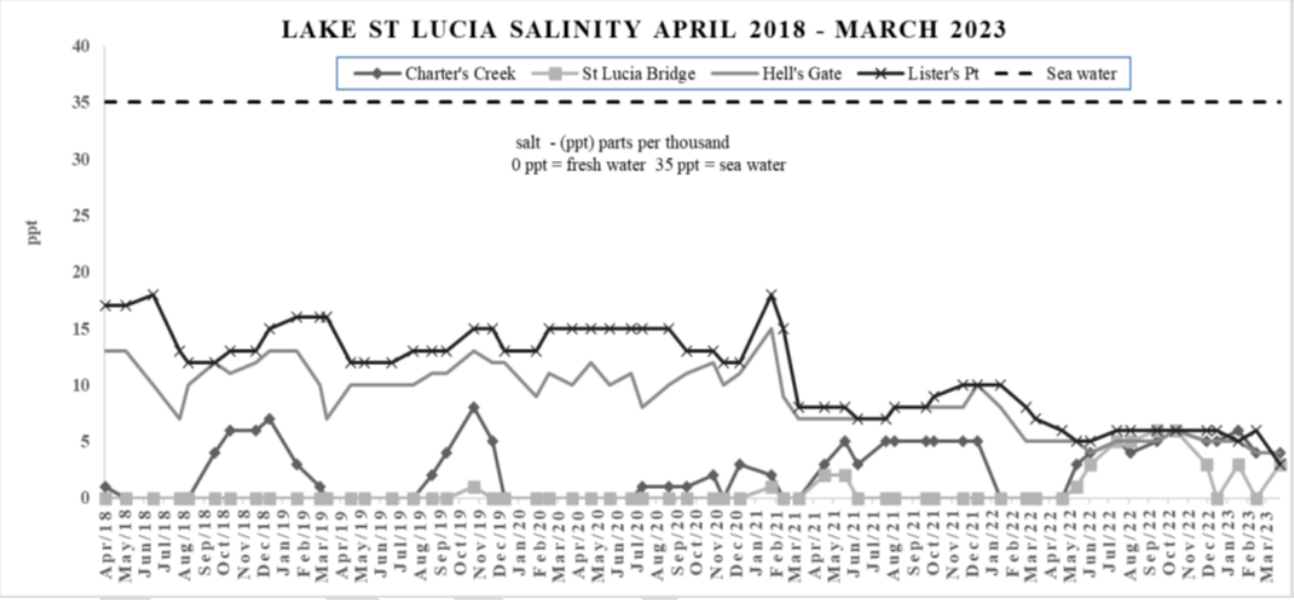

Figure 5: Track of salinity concentrations over the past five years for North Lake (Lister's Point & Hell's Gate), South Lake (Charter's Creek) and the Narrows (St Lucia Bridge). Adapted from Fox and Mfeka, 2023.

2.3 Groundwater

Groundwater on the Eastern and Western Shores contributes to the baseflow in rivers and is important in sustaining the ecological resilience and functioning of the lake (Perissinotto et al., 2013). 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 is between 200-500 mm pa in the southern coastal strip (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.

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 two primary porosity aquifers present on the Maputaland coastal plain, which influence the Park's aquatic habitats are:

- The shallow, unconfined aquifer or perched water table in areas of the park receiving rainfall in excess of 800 mm pa, and which is present due to the high permeability and infiltration of the KwaMbonambi sand cover of the coastal plain. Due to the high-water table (1 – 6 m) this aquifer is fairly extensively exploited.
- The deeper confined aquifer of the Uloa and Mkwelane Formations holds a significant amount of groundwater. The Uloa Formation is seen as a promising aquifer in the area but is not present everywhere on the Maputaland Coastal Plain. Little is known about how this aquifer is recharged and it is not greatly utilised.

There is a delicate balance between the ecosystems and the groundwater regime and care must be taken to avoid over- exploitation of the coastal aquifer, as this will negatively affect the ecosystems (Meyer et al., 2001; Grundling, et al., 2014). Regional pollution from agricultural practises (which introduce nutrients) and denser settlements with inadequate sewage disposal

pose a risk to aquifers. Wastewater and sewerage effluent from inappropriate systems can pollute the upper aquifer but is less of a risk to the deeper aquifers (Meyer et al., 2001).

Groundwater on the Eastern and Western Shores contributes to the baseflow in rivers and is important in sustaining the ecological resilience and functioning of the lake (Perissinotto et al). The seepage from the Nkazana stream that drains the Eastern Shores has not stopped flowing (even through the 2015/16 devasting drought) due to this groundwater seepage (Perissinotto et al). The level of groundwater is measured monthly, when possible, on the Eastern Shores in boreholes that have been in place for over twenty years (Fox & Mfeka, 2022a). These boreholes need to be refurbished as they do clog up. The water level is measured by means of an electronic sensor attached to the end of a long tape measure (on loan from SAEON).

Recent data (figure 6) shows that the groundwater level at this borehole rose significantly in February 2021 following rains experienced from Cyclone Eloise. A second increase was observed in April and May 2022 following the April flooding events in KZN. Groundwater levels continue to rise steadily since then. Other boreholes on the Eastern Shores showed similar trends. (Fox & Mfeka, 2023).

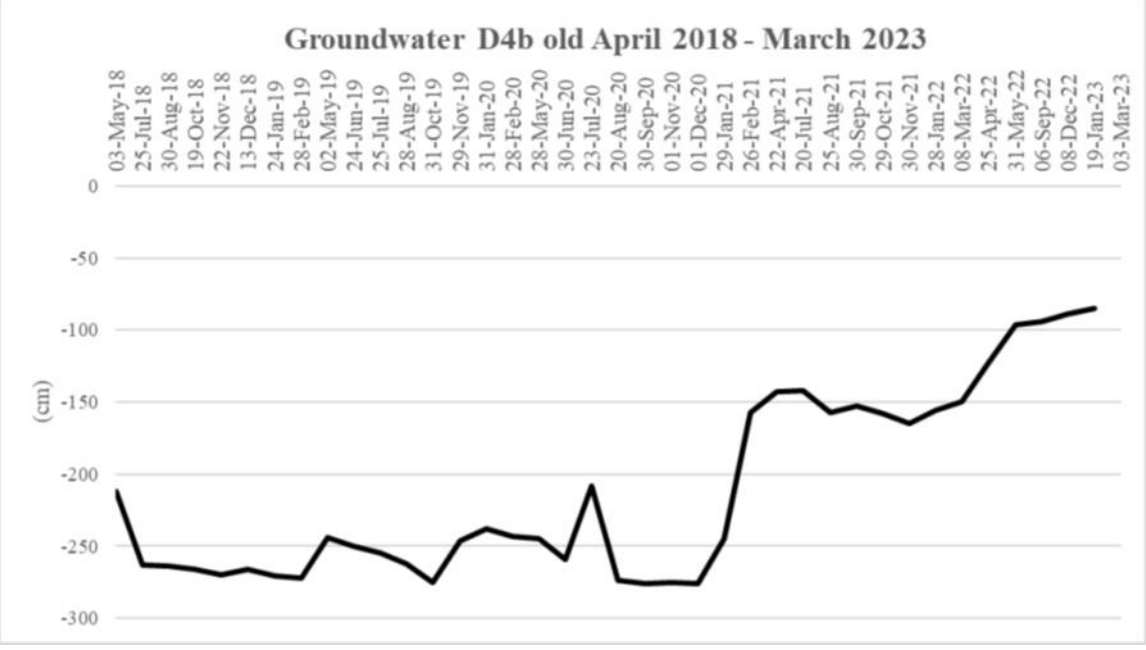

Figure 6: The depth of the groundwater table below the surface for well number D4b (old) (in centimetres) in the raised area of the Ezibomvini area of the Eastern Shores for the past 5 years (adapted from Fox & Mfeka, 2023).

2.4 Lake levels

Water level in St Lucia provides a measure of the volume of water contained in the Lake, as well as the area of surface water. These water levels are influenced by land use activities within the broader catchment. According to the EWR for St Lucia, the present mean annual runoff for the five feeder rivers is below that of the natural MAR (DWS, 2016). In order to improve the health status of the estuary, the MAR must be increased by 5.1m^3. It is therefore critical that licensed water users within the catchment consider the water requirements of St Lucia to ensure that ecological functioning is maintained. The shifting of the St Lucia System from a dry to wet state is dependent on this freshwater inflow as well as the state of the estuary mouth.

At present it is important to understand the effects that high water levels are having on vegetation in the periphery of St Lucia as well as the flooding of farms and the impacts on people and land-uses within the EFZ. Back flooding can be linked to a number of factors including sediment accumulation and vegetation blockage within the Mfolozi and Msunduzi channels. Increased rainfall associated with Cyclone Eloise in 2021, the closed mouth state and increased inflow from the feeder rivers resulted in significantly high lake levels (up to 1.8m). These levels continued in 2022 as a result of exceptional rainfall with lake levels remaining above 2m. In April 2022, St Lucia received the highest recorded rainfall since 1988 and the estuary breached. Lake levels steadily dropped following the breach, however, began to rise again in February 2023 following significant rain and flooding events (Fox and Mfeka, 2022b; Fox and Mfeka, 2023)(Figure 7). The consequences of this increased water level and back flooding include crop inundation, increases in mosquito infestation, diseases, the occurrence of crocodiles within the homesteads and increased crime from a lack of income (The DFFE Independent Panel Report, 2022). Currently back flooding within the floodplain sits at 5m which is a 2m rise from 2022.

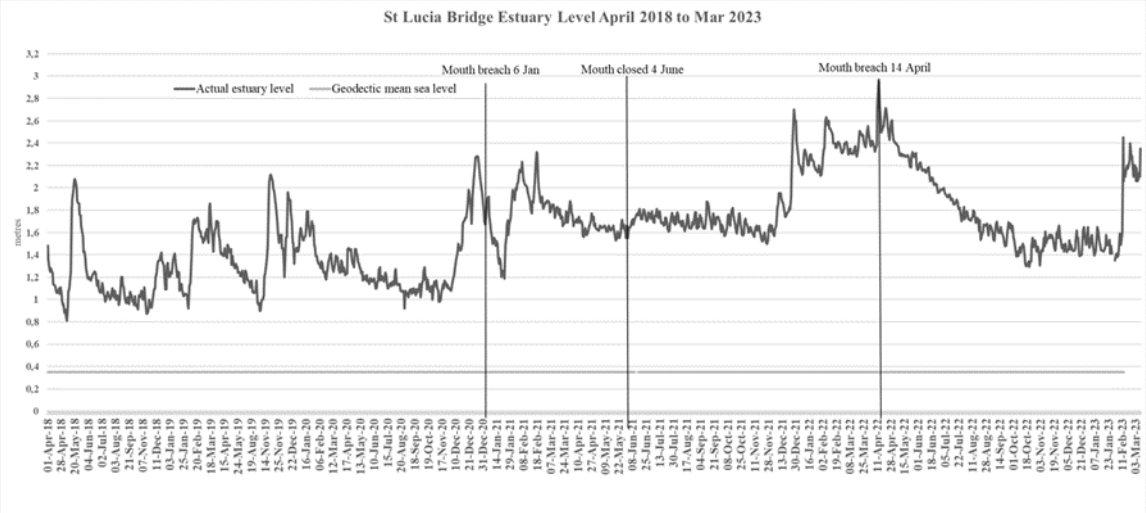

Figure 7: Water levels at the St Lucia Bridge (S28.369954, E32.409939) over the past five years. (The data is not calibrated to mean sea level). Adapted from Fox and Mfeka, 2023.

2.5 Mouth dynamics

The mouth of the Lake St Lucia is dynamic and migrates northward with longshore drift. Most recent data shows an approximate 300 m north ward migration (refer Figure. 8 and Table 1) Historically, mouth dynamics in terms of closure and position between Maphelane in the south and the St Lucia high ground to the north were driven by the interaction between flow levels in the uMfolozi River and wave induced marine sediment movements. A long history of river diversion (uMfolozi River) and artificial breaching has occurred and this has strongly influenced the physical state of the estuary. The policy of diverting the uMfolozi River to sea which was initiated in 1952 was changed by the iSimangaliso Authority sixty years later in 2011/2012. An active relinking of the uMfolozi River with the St Lucia Estuary occurred in July 2012 and this began the process of restoring estuarine function. The uMfolozi River migrates naturally northwards to link with the estuary. Previously artificial breaching would pull the river back southwards by diverting it to sea in the vicinity of Maphelane. The active facilitation of the re-joining of the uMfolozi River with the St Lucia system is currently being implemented by the removal of the dredge spoil that has been deposited in the vicinity of the estuary mouth in combination with the complete cessation of mouth interference. The uMfolozi transports large volumes of mud and, prior to the GEF rehabilitation project, used to enter the sea to the south of St Lucia town at Maphelane. Although artificially separated from Lake St Lucia since 1952 to prevent the inflow of suspended sediment into the main St Lucia system, the link between the uMfolozi River and Lake St Lucia was re-established under a new management approach in 2012 and Lake St Lucia and the uMfolozi River mouth have since been managed as one system.

The St Lucia/Umfolozi mouth was artificially breached in January 2021, following concerns about high rainfall, back flooding and siltation of the estuary. The mouth had been closed to the marine environment since 2014 and a large sand berm and establishment of sand dunes prevented a natural breach. Sediment modelling results have also confirmed that an extended closed mouth state leads to an extensive build-up of fine sediments within the Narrows (The DFFE Independent Panel Report, 2022). The main objectives for this breach, among others, were to restore the nursery function of the system and to flush out the accumulated silt load originating from the uMfolozi and its catchments (The DFFE Independent Panel Report, 2022). The breach was carried out by iSimangaliso Wetland Park Authority with the advice of a scientific and technical task team. This process was subsequently taken under review (The DFFE Independent Panel Report, 2022) by an Independent Panel of Experts appointed by the Minister. With regards to mouth breaching, it was advised that breaching should only occur under exceptional circumstances. These "exceptional circumstances" need to be more clearly defined, although an example would be if the berm height is greater than 3.5m MSL). Monitoring of both biophysical and socio-economic indicators should occur before and after artificial breaching. It was also advised that the terms of breaching should be more clearly defined such as the specifications for when and how to breach for each scenario (The DFFE Independent Panel Report, 2022).

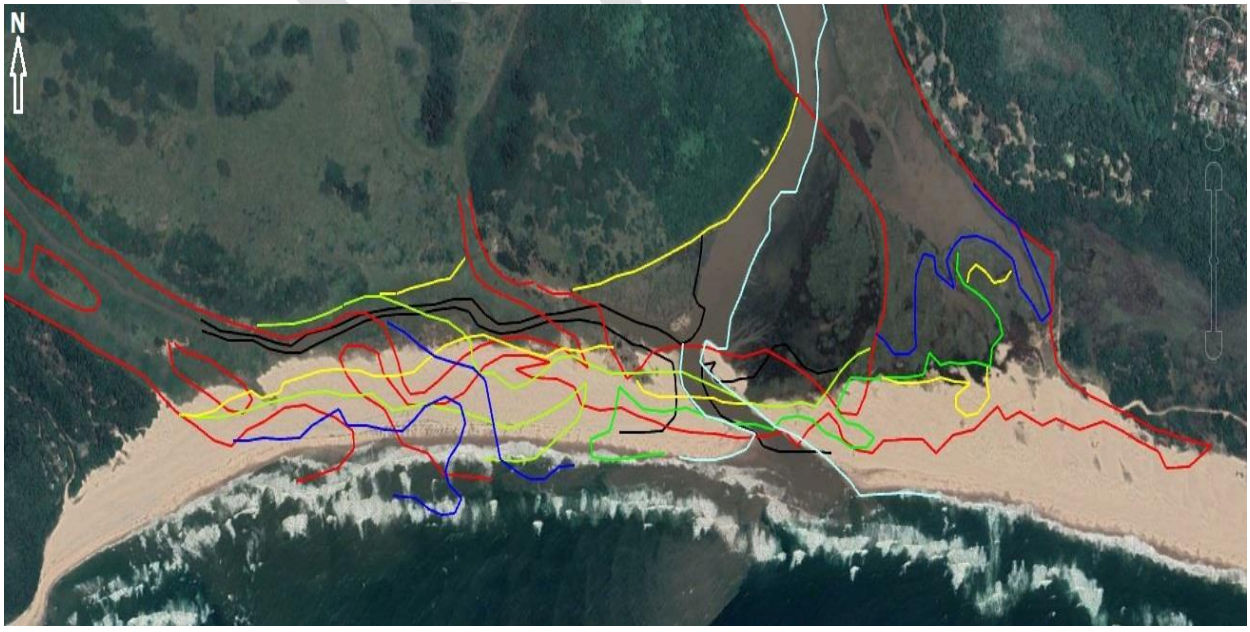

Figure 8: Mouth dynamics of St Lucia

Table 1: St Lucia Mouth Dynamics Timeline

DATE	COLOUR	OPEN	Estuary	Season
16/11/2002	Red	X south	Umfolozi	Spring
10/2/2010	Blue	X south	Umfolozi	Summer
27/7/2013	L.Green	X central	Umfolozi - St Lucia	Winter
21/5/2017	Yellow	Closed		Winter
4/3/2021	Black	X north	Umfolozi - St Lucia	Autumn
6/10/2022	Turquoise	X north	Umfolozi - St Lucia	Spring

2.6 Biotic Function

The St Lucia estuarine system is arguably one of the most important estuaries in South Africa accounting for more than half of the estuarine extent. It supports a diversity of plants, invertebrates, reptiles, birds and mammals The fluctuations in salinity, turbidity and temperature drive the diversity of the biological components of the estuary. Many invertebrate species have succumbed to the pressures facing the estuary and have declined or completely collapsed. The once extensive bed of Solen species has disappeared as a result of the estuary mouth closures and freshwater conditions (Van Niekerk et al., 2019). Likewise, the migratory crab *Veruna litterata* has long been unable to complete its migration into the estuary due to its closed mouth state. However, since the mouth breaching in 2022, post-larvae *V. litterata* have been observed along the edges of the estuary mouth and adult *V. litterata* within the Narrows (Fox and Mfeka, 2022b; Fox and Mfeka, 2023). Hundreds of freshwater prawns, *Macrobrachium equidens*, were also found stranded along the St Lucia beach suggesting its widespread population numbers within the estuary (Fox and Mfeka, 2022b). Phytoplankton community composition has shifted from predominantly marine based groups to freshwater and eutropic groups, a consequence of the silt laden inflow from the uMfolozi River and overall freshwater conditions (Van Niekerk et al., 2019).

The St Lucia estuary is an important nursery ground for juvenile marine fish, prawns and crabs. The fish species richness of the St Lucia Estuary has declined drastically over the years in response to mouth closures, increased freshening and hypersalinity. Earlier surveys recorded a total of 82 species of fish with commonly caught species being *P. commersonnii*, *A. hololepidotus*, *A. berda*, and *R sarba*. These species were largely of marine origin, making use of the estuarine system to various degrees (Begg, 1978). A more recent survey conducted in 2008 to 2011

revealed a decrease in the number of species from 51 in 2008 to 27 in 2011 (Schutte et al., 2020). During the estuaries prolonged closure period freshwater species such as the Tilapia (*Oreochromis mossambicus*), and the African sharptooth Catfish (*Clarias gariepinus*) dominated the system (Forbes et al., 2020). The recent artificial breaching of the estuary highlighted the positive impact on marine fish species recruitment with reports of Grunter, Perch and Bull sharks observed near the estuary mouth (The DFFE Independent Panel Report, 2022). These bull sharks were able to pup within the estuary, although ongoing monitoring within St Lucia has revealed four dead pups in the estuary (Fox and Mfeka, 2023). The cause of death is unknown, however excessive silt loads from the Mfolozi can be hypothesised. Additionally, hippos returned to the system post breaching, their absence likely a consequence of excessive siltation. The breaching however had detrimental consequences for the freshwater species with large numbers of the Southern Mouthbrooder (*Pseudocrenilabrus philander*), Tilarpia (*O. mossambicus*), Straight fin Barb (*Enteromius paludinosus*) and *C. gariepinus* washing up (The DFFE Independent Panel Report, 2022).

Lake St Lucia is also a highly important staging area with more than 50% of all water birds in KwaZulu-Natal feeding, roosting and nesting in this estuary. It is the breeding area for several birds, which are rare or have limited distributions in South Africa (iSimangaliso Wetland Park Authority, 2016). Waterfowl include flamingos, pelicans, and waders, along with breeding colonies of pelicans, yellow-billed storks, herons, Caspian terns, spoonbills, red-winged pratincoles, and the African fish eagle have been observed, many of which have been sited within the Northern Lake. After the 2021 and 2022 breaching events, the vast majority of recorded waterbirds were observed in the northern areas of the Lake (False Bay and near the uMkhuze river mouth). This was largely attributed to a reduction in shallow water areas including islands and mudflats which serve as feeding grounds for the birds (Fox and Mfeka, 2022b). Of particular interest is the return of the African Skimmer bird to St Lucia Estuary. The species was regularly spotted at the estuary mouth prior to 1943, however the species departed the area following dredging activities and the removal of the sand banks (Fox and Mfeka, 2023).

The St Lucia Estuary harbours the second highest mangrove area cover of all estuaries in South Africa. However, pressures such as relinking to the uMfolozi catchment, mouth closures, freshening and siltation has resulted in a loss in mangrove area from 331 ha to 288 ha since the 1960s (Adams and Rajkaran, 2021). Dead mangroves continue to be observed within the system.

Reed swamps occur along the edges of most of St Lucia although the greatest extent can be found in the Mkuze swamps in the extreme north of the estuary. Other previously recorded vegetation types include two species of submerged macrophystes (*Potamogeton pectinatus* and *Zostera capensis*), swamp forests (*Ficus, Barringtonia, Voacanga and Syzygium*, sedges (*Scirpus, Juncus*) and hydrophilous grasses (*Sporobolus* and *Paspalum*). Recent data has confirmed that *Zostera capensis* is now absent from the lake and will not return if freshwater conditions persist (Van Niekerk et al., 2019). The main terrestrial vegetation surrounding the estuarine area are of the savannah biome and coastal dune vegetation at the estuary mouth. Extensive forestry plantations in the form of pine and eucalyptus still occupy an extensive area inland of the system (Begg, 1978) (Figure 9).

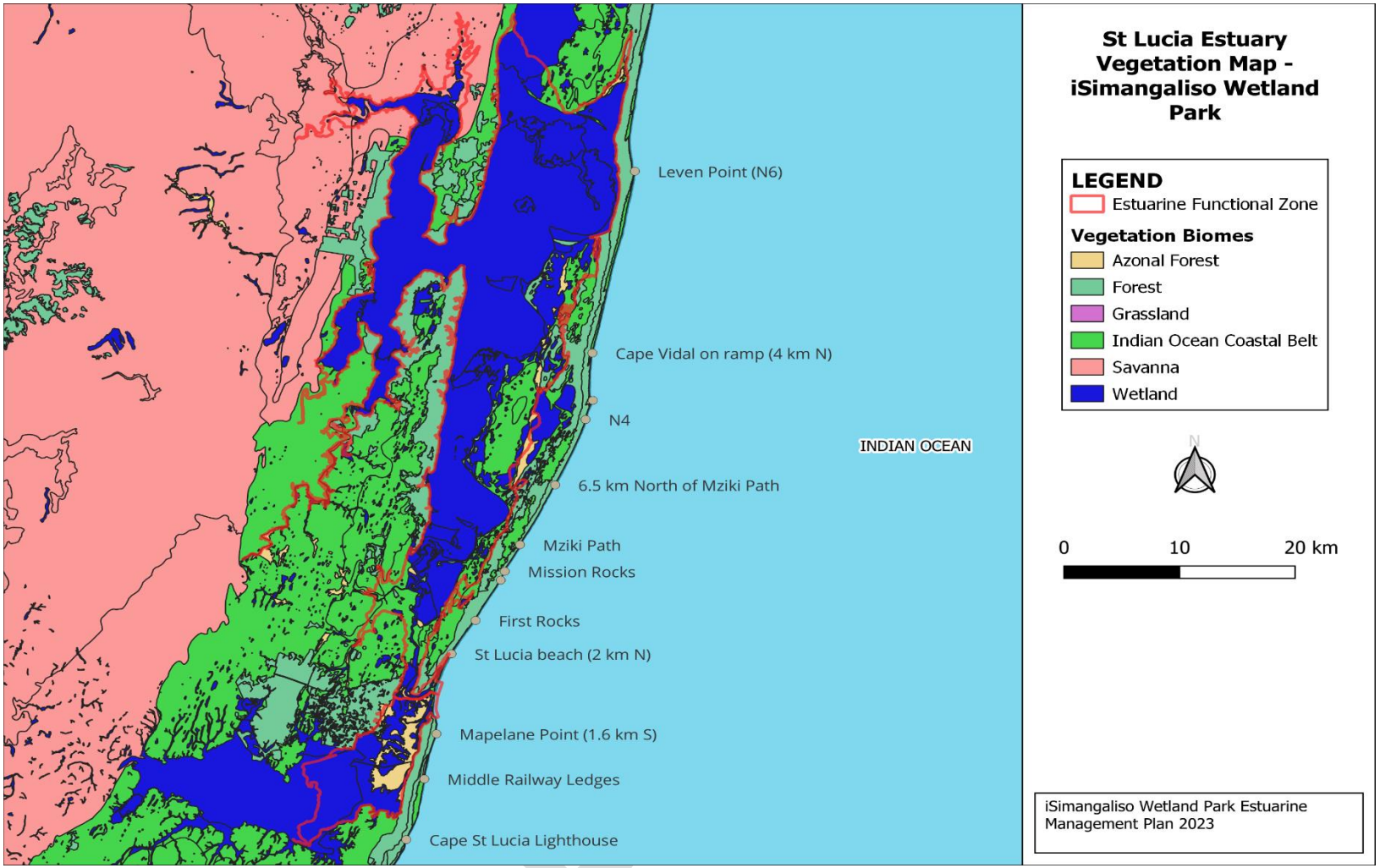

Figure 9: Vegetation biomes surrounding the St Lucia Estuary

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	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 St Lucia Estuary was described in the National Biodiversity Assessment (van Niekerk & Turpie, 2012) as being in poor condition generally but largely as a result of the historical separation of the uMfolozi River combined with prolonged drought conditions. At that time, the estimates of estuary health suggested a Present Ecological Status category of 'E', being "*highly degraded*" (van Niekerk & Turpie, 2012). Following the 2011 NBA, a more detailed re-evaluation of estuary health concluded that as a result of the relinkage of the uMfolozi River, the ecological health score changed to a 'C' category being "Moderately Modified" (Clark et al., 2014). Since then, a more recent evaluation has depicted further degradation of the St Lucia Estuary with its current ecological state being downgraded to a category "D" or Largely Modified (Van Niekerk et al., 2019).

A Recommended Ecological Category has been generated for all estuaries in the country and for

the St Lucia system this has been determined to be a 'Category B' given that the estuary is:

i. Located within a proclaimed protected area, Ramsar Site and World Heritage Site (Figure 10).
ii. Listed as a national priority for estuary conservation (Van Niekerk et al.,2019).
iii. Is an Important Bird and Biodiversity Area.
iv. By far the largest estuary in the country, comprising approximately 60% of the national estuarine area, 80% of the sub-tropical estuarine area and 90% of the protected estuarine area.
v. Recognised as one of the three most important nursery habitats for estuary-dependent marine fauna in the country.
vi. Known to support a number of rare and threatened species, being situated within a transition zone between the tropical and subtropical bioregions (iSimangaliso Wetland Park Authority, 2011).

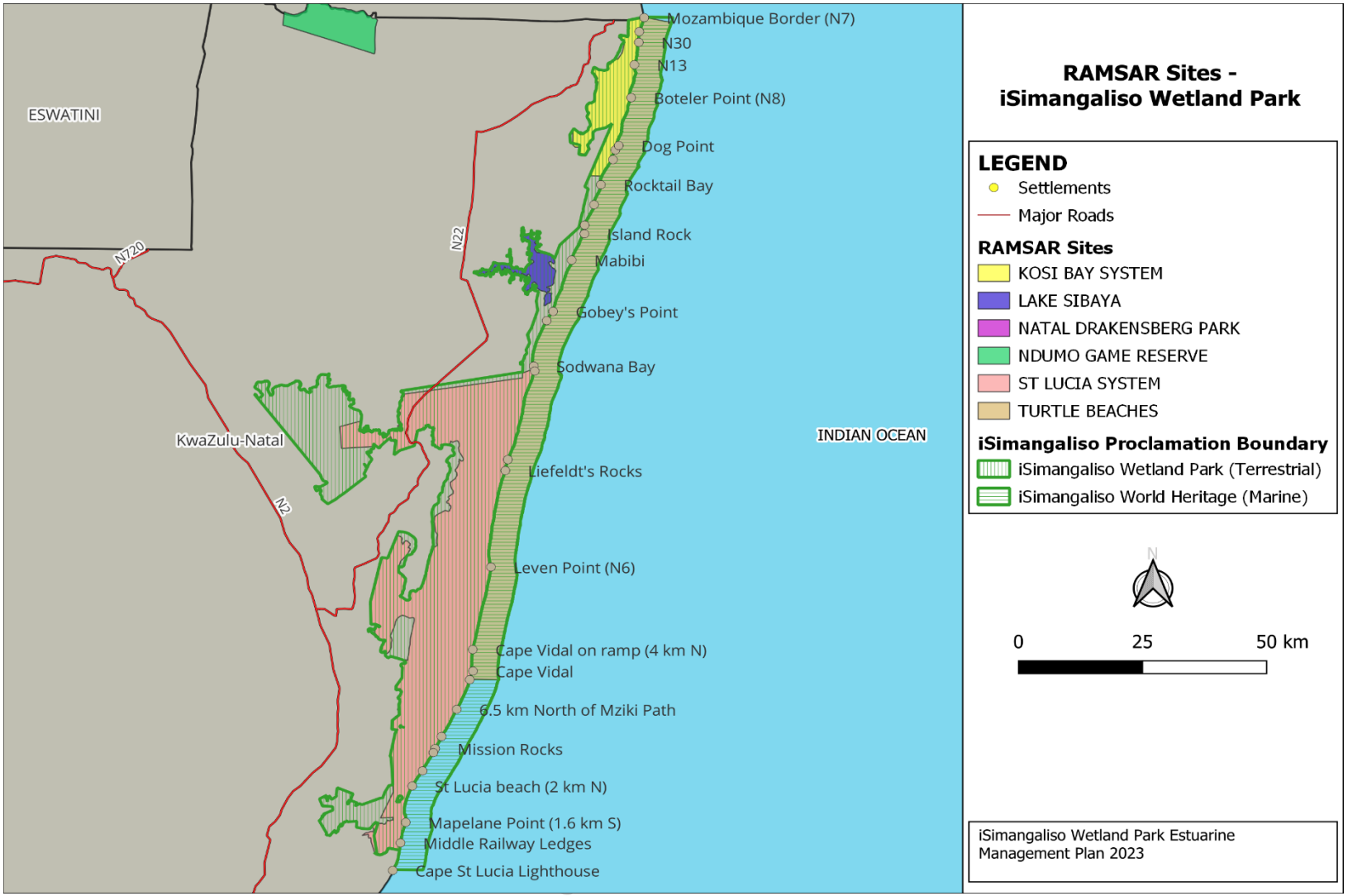

Figure 10: Locality of the St Lucia Estuary in respect to the RAMSAR sites and iSimangaliso boundary.

2.8 Goods and Services Provided by the Estuary

The role of the St Lucia estuary in providing ecosystem goods and services has developed into one which is largely tourism based, falling into the information services category. The number of accommodation establishments along with concession activities within the St Lucia Town has increased progressively over the years. Likewise, the type of tourists visiting this world heritage site has shifted from fishermen based to ecotourism based, with visitors more interested in the natural beauty and educational activities (Mtubatuba IDP, 2020). The town receives approximately 460 000 visitors annually with annual expenditure equating to R917 million (Forbes et al., 2020).

The St Lucia system makes up about 80% of the estuarine area in KwaZulu-Natal making it an important nursery habitat for estuarine and marine species. The presence of these estuarine and marine species has been the source of recreational fisher visitors in the past. However the systems dominant closed mouth state has reduced the system's ability to provide this service, and subsequently recreational fishing, although still present, has decreased (Cyrus et al., 2020).

The following are cultural services which the estuary provides:

i. St Lucia is rich in cultural heritage and has the potential for the development of archaeotourism.
ii. The system is rich in artefacts and other remains of Early Iron Age (250 – 1000 AD) and Late Iron Age (1000 – 1840 AD) settlements (Maggs, 1984). These settlements exploited the peat bog iron ore deposits that occur in the vicinity of Lake St Lucia and other wetlands.
iii. Chief Somkhele of the Mpukonyoni, supporting King Cetshwayo, fought against Zibhebhu kaMaphita, with the help of John Dunn in August 1883. Chief Somkhele lost the battle and fled to the swamps of Lake St Lucia (Dominy 1994).
iv. World War II remnants include the Catalina Jetty at Catalina Bay on Lake St Lucia, which was used as a base for the Royal Air Force (RAF) 262 Squadron between 1943 and 1944 (NCS 1995; Dominy, 1994), to supply air cover for allied shipping in the area. Currently the Catalina Jetty consists of several foundation structures, the jetty itself, and some concrete structures, which are currently under vegetation and not clearly visible.
v. The establishment of an active military site in a conservation area on the Nhlozi

Peninsula.

The estuary is also recognised for its “sense of place”. People of different backgrounds, locals, learners and conservationists have described their relationship with the estuary as spiritual, healing, calming and holding social value.

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 St Lucia Estuary are:

i. The limited water inflows from the uMfolozi River due to its partial separation from the estuary as a result of human manipulation to mitigate damage from upstream agricultural practices.
ii. Direct abstraction from tributary rivers and indirect abstraction of the groundwater feeds affecting the freshwater volumes reaching the estuary (activities such as *Eucalyptus* spp. plantations affecting ground water recharge). Changes in water volume have resulted in a loss of connectivity between the different parts of the Lakes and Narrows while the historical separation of the uMfolozi River has had a major impact on mouth status. Ensuring that the environmental (ecological) flow requirement is determined and adequate flow is maintained to preserve water quantity/volume or flow is a major priority. The flow requirement for the estuary as determined by the Department of Water and Sanitation was approved in 2017 (DWS, 2016). This report however should be updated to account for changes which have occurred within the last seven years.
iii. Water quality in tributary rivers.
iv. Alien species. Several alien plant species occur around the system. The tree *Casuarina equisetifolia* alters dune dynamics with the potential to influence estuary mouth

behaviours. Casuarinas were removed from the vicinity of the mouth but seed bank re-establishment needs to be controlled. iSimangaliso has implemented an alien plant removal programme to assist with the control of this species. Aquatic alien invasive animal species also occur such as the snail, *Tarebia granifera*.

v. Climate change – rainfall, sea level rise and temperature changes.
vi. Reed encroachment
vii. Mangrove dieback
viii. Sedimentation of the system
ix. Loss of swamp forest area
x. Upstream anthropogenic activities such as agriculture and mining

Key impacting activities that affect the ability of the St Lucia 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.

Historically, the uMfolozi River flowed into the Lake St Lucia system. The mouth of the system opened to the sea at any point on the approximately 3 km of sandy beach between the Maphelane dunes to the south and the higher ground to the north at St Lucia village. Patterns of mouth closure, breaching and migration were driven by the interactions of river flow, wave driven sand movement, wave direction, and mouth bank scour and erosion during tidal ebb and flow. Under natural conditions the system would have behaved like any other intermittently open system on the KwaZulu-Natal coast whereby mouth closure would have resulted in backflooding onto both the uMfolozi floodplain and the low-lying margins of the Lakes. However, in 1952 the uMfolozi River was partially separated from the system by artificially breaching the river in the south and conducting extensive dredging. Breaching was always carried out as far south as possible in order to maximise the separation of the systems.

The iSimangaliso Authority's strategy announced in 2011/2012 saw the uMfolozi River returning along its natural pathway into the system, thus, beginning the process of restoring estuarine function. This policy of minimum interference in the estuarine system to facilitate as much natural functioning as possible, limiting artificial breaching and then only for ecological reasons, meant to continue. However, the St Lucia/uMfolozi mouth was artificially breached in January 2021, following concerns about high rainfall, backflooding and siltation of the estuary. The mouth had been closed to the marine environment since 2014 and a large sand berm and establishment of sand dunes prevented a natural breach. The main objectives for this breach, among others, were to restore the nursery function of the system and to flush out the accumulated silt load originating from the uMfolozi and its catchments (The DFFE Independent Panel Report, 2022). The breach was carried out by iSimangaliso Wetland Park Authority with the advice of a scientific and technical task team. This process was subsequently taken under review (The DFFE Independent Panel Report, 2022) by an Independent Panel of Experts appointed by the Minister. The mouth closed again in June 2021 and built up an approximate 1.2 m high sand berm, but was naturally forced open again, at the same location, following the April 2022 floods and remains open at the time of writing. The mouth has now migrated some 300 m northwards since October 2022, most

likely following the impact of equinoctial tides, south-easterly swells and longshore drift. This mouth movement (Figure 11) is to be expected; the mouth has historically previously migrated north of the ski-boat ramp.

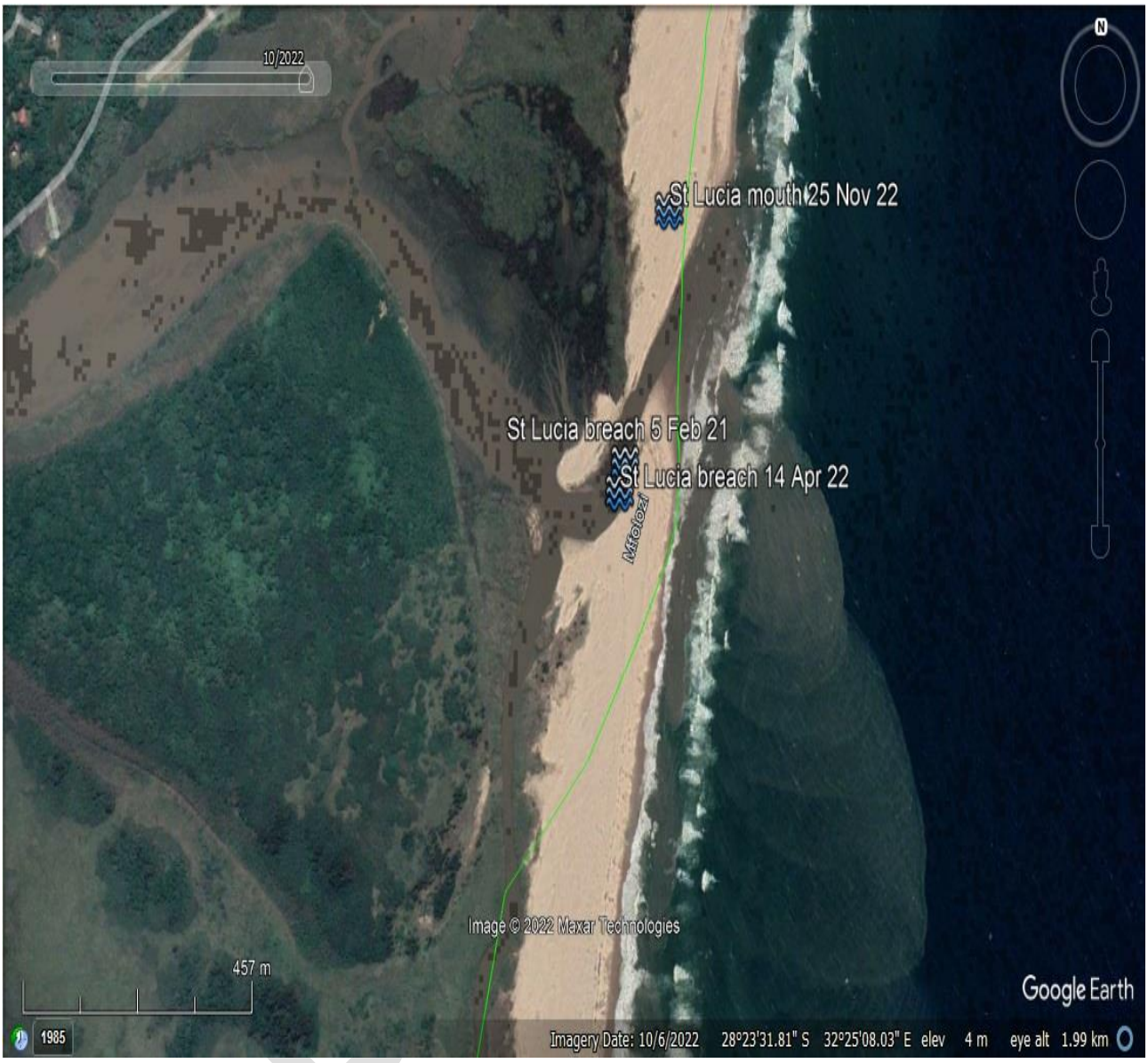

Figure 11: Movement of the St Lucia/Mfolozi mouth (imagery: Google Earth)

2.9.2 Water Quality

According to the Panel of Independent Experts Report, sediment was removed from the estuary after the artificial breaching event in 2021. As a result, turbidity initially increased in March 2021 followed by a sharp decrease in May 2021. However, because the system had been closed for a significant period of time before the breach, much of the accumulated soil had consolidated making it less susceptible to erosion. Additionally, the breach was unable to remove silt which had been

deposited from the Mfolozi Channel. Changes in sediment size and particularly increases in silt and mud deposition near the mouth have been documented post reconnection of St Lucia with the Mfolozi River in 2016-2017. The impacts of siltation have been documented in shifts in species composition of macrofauna and overall shallowing of the system (Jones et al., 2020). Evidence of continued silt deposition from the Mfolozi River is depicted in Figure 12 below. The darker water is associated with the reed beds and is 'older' water (pre-flood). It also represents water 'seeping' from the sediments along the respective banks and this water has low silt levels (hence the 'darker' coloration). The higher turbidity 'channel' water is more recent Mfolozi River flood water that still has high levels of suspended silt particles being carried through the system. (Pers com Prof Alan Whitfield) (Fox and Mfeka, 2022b). Silt levels have not been measured since August 2021 and should form part of the St Lucia monitoring programme. Although the reconnection has prevented desiccation of parts of the St Lucia as previously experienced, the filtering ability of the Mfolozi swamps has been compromised from land use activities resulting in sediment rich waters entering the St Lucia system.

There have previously been concerns about the water quality at the uMphathe River and the KwaNdonyana stream, which discharges into the western shores of the Narrows. The probable source is likely the Khula village situated upstream. Figure 14 depicts the Kwandonyana stream observed in November 2022. A distinct sewage odour was noted as well as colouration of the water. The observation highlights the extent that catchment activities can have on the water quality and state of the St Lucia system, calling for better management of water resources and provision of services within the uMkhanyakude District Municipality.

Figure 12: This photo shows the Mfolozi river water flowing out from the right-hand side while the St Lucia Lake water flows out from the left towards the sea 17th May 2022 (R Cawood). Adapted from Fox and Mfeka 2022b.

2.9.3 Invasive Species

Casuarina equisetifolia was historically planted on the south bank of the lower reaches of the Narrows to stabilize sand movement (Begg, 1978). This stabilization acts against the normal sediment movement patterns of the highly dynamic estuary and beaches, 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 (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. . Although an alien invasive plant removal programme is in place for St Lucia, small patches of C. *equisetifolia* continue to grow at the estuary mouth (Fox and Mfeka, 2023). *Tamarix ramosissima* has also been observed near the estuary mouth and along the bank of the Beach Channel, increasing dune stability and potentially inhibiting natural breaching (The DFFE Independent Panel Report, 2022). Other invasive plant species noted within the estuary include *Sebania bispinosa* at the estuary beach and the annual *Flaveria bidentis* at Hells Gate (Fox and Mfeka, 2023).

The Lake St Lucia 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 coast, although the significance of possible ecological impacts on these habitats remains unknown (Miranda et al., 2011). This invertebrate species has been recorded within the reeds and mangrove areas near the estuary mouth (The DFFE Independent Panel Report, 2022).

2.9.4 Tourism and Recreation

The St Lucia Town is a highly popular tourism node within the iSimangaliso Wetland Park, with high numbers of visitors accessing and using the beaches. Tourists are catered for by a variety of accommodation types, restaurants, and craft shops. Various activities are offered by concession holders, which enable tourists to take boat trips on the Narrows, go on a game drive on the Eastern and Western Shores, whale watching, deep-sea fishing or swim and snorkel at Cape Vidal. Guided night drives are available on the Eastern and Western Shores that provide opportunities to observe

nocturnal animals. The area is rich in birdlife and bird watching, which is catered for by knowledgeable local guides, and is a popular activity.

Tourism is the largest source of foreign exchange to St Lucia and has a substantial direct and indirect impact on economic activity. Tourism is St Lucia's main economic sector. The area of St Lucia was primarily known for its abundance of fish species that could be bagged both from the beach as well as venturing into the Indian Ocean. The growth in eco-tourism has also been accompanied by a growth in beach tourism. St Lucia is a small town with approximately 343 households (Census, 2011). All of which are involved directly or indirectly in the tourism sector. Hippos are the main attraction that promotes this fantastic place of wonder. The Indian Ocean offers the perfect setting for lazing about, fishing, snorkelling, and exploring its pristine beaches as far as the eye can see.

The rich resource endowment of iSimangaliso fits particularly well with domestic and foreign visitor preferences as determined by various surveys, including those conducted by SATour, the KwaZulu-Natal Tourism Authority and the iSimangaliso Wetland Park Authority (The DFFE Independent Panel Report, 2022). The DFFE Panel of Experts' Report (2022) states that when matched with the known interests of tourists to South Africa and KZN, the Park's natural and cultural assets strongly indicate the potential of iSimangaliso to become a worldclass tourism destination. Recent studies show that the international market now comprises approximately 42% of the tourist market for the Park and that the southern section of the Park alone contributes some 6.8% of KZN's tourism Gross Domestic Product (GDP) and 0.6% of SA's tourism GDP (Govender; 2013).

2.9.5 Development Pressures

The St Lucia Town tourism node is located immediately north of the mouth of the St Lucia Estuary with a secondary development node further north at Cape Vidal. The town has a remarkably high concentration of tourist accommodation and supporting infrastructure such as restaurants, supermarkets, craft shops and booking centres for tourism activities. This economic opportunity is accompanied with increased risk to the park as development encroaches on the park boundary. Delineation of the estuary, a setback line to ensure a buffer and zonation of the estuary to protect sensitive habitats and species will serve to mitigate the impact of development pressures. It is also vitally important that potential developers go through a formal authorisation with public consultation to prevent substandard environmental management.

2.9.6 Sedimentation and Reed Encroachment

The continued struggle with mouth management has resulted in secondary impacts to the system such as sedimentation and reed encroachment. Catchment development and natural habitat removal increases impervious surfaces which are not effective in sediment trapping. Sediments are therefore washed downstream and settle within the estuarine reaches. Sedimentation promotes the growth of reeds such as *Phragmites australis*, which naturally occur in estuaries. However, excessive sedimentation can result in the uncontrolled spread of these reeds which contributes to the narrowing of channels and smothering of other vegetation types. The extent of this encroachment has been recorded by Fox and Mfeka (2022b), in which reeds were observed significantly close to the estuary mouth, as far as Honeymoon bend (28°23'23.45"S; 32°24'23.54"E). Recent site visits have also confirmed the presence of reeds at the estuary mouth (Figure 16). Additionally, the lack of catchment rehabilitation freshwater inflows and mouth closures has increased flooding of the mangrove areas. In response to this inundation mangrove diebacks have been recorded (Adams and Rajkaran, 2021). The DFFE Independent Panel Report (2022) states that in the past, authorities responded to sedimentation by dredging (Taylor 2013). According to the report, dredging has since ceased and information from an overwhelming body of literature indicate the detrimental ecological impacts of this practice on water quality, nutrient resuspension, sediment chemical composition, light availability, terrain modification, and benthic fauna (Morton 1977, Johnston 1981, Nayar et al. 2007, Ohimain et al. 2010, Manap and Voulvoulis 2016, Fraser et al. 2017, Rehitha et al. 2017, Caballero et al. 2018, Okoyen et al. 2020, Borland et al. 2022 and references therein).

2.9.7 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.

Increased mouth closure, lower water levels and warmer temperatures are very likely to drive an increase in harmful algal blooms and concomitant lower oxygen levels (Niekerk et al., 2022). Droughts and floods play an important role in defining the state of the St Lucia system. Major floods are capable of shaping and changing the physical nature of the system i.e., the depth and sediment distribution, while droughts will influence salinity and lake levels (iSimangaliso Background Information Document, 2011)

2.9.8 Human Impact 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 do have an impact on 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.

Major impacts on Lake St Lucia have arisen through human intervention in the Mfolozi Catchment, which is the largest catchment in the St Lucia system. The most significant effects are the removal of swamp vegetation on the floodplain, the canalisation of the Mfolozi River and the separation of the Mfolozi and St Lucia systems (iSimangaliso Background Information Document, 2011). Agricultural development on the floodplain involves canalisation of the river and the removal of the wetland vegetation which slows flood waters and filters out sediment. Canalisation delays the overflow onto the floodplain from the main river channel which means that more sediment, are delivered to the mouth without the trapping effects of the floodplain (iSimangaliso Background

Information Document, 2011).

The surrounding regions in St Lucia have been modified so extensively over the last seven decades that long series of human interventions have sparked intense public and scientific debate on how best to manage the recovery and long-term health of this national treasure (Carnie, 2022).

The following images show the effects of the above-mentioned threats, impacts on St Lucia Estuary and feeding rivers.

Figure 13: Images showing sedimentation flow from the uMfolozi River at the St Lucia mouth

Figure 14: Contamination of the KwaNdonyana stream most likely from the local sewer within the Kula Village upstream. A distinct raw sewage smell was noted

Figure 15: Image showing high sedimentation of Omphathe Omkhulu River which feeds into the St Lucia Lake near the Narrows

Figure 16: Reed encroachment at the St Lucia bridge and estuary mouth

2.10 Socio-economic Context

2.10.1 Demographics

St Lucia has a population of 1104 (Census, 2011). The area has had an annual population change of 2,5% from the year 2001 to 2011. St Lucia has a population of 546 males and 559 females (Census, 2011). The dominant first language in the area is Afrikaans, with 219 people (Census, 2011). There are 343 households in St Lucia. Dukuduku has a population of 5329 (Census, 2011). The gender distribution in Dukuduku is 46.7% male and 53.3% female (Census, 2011). The dominant first language in the Dukuduku area is isiZulu which is spoke by 92.3% of the population

(Census, 2011). There are 878 households in the Dukuduku area. Maphelane has a population of 2485 (Census, 2011). The gender distribution in Maphelane is 44,6% male and 53.1% female (Census, 2011). The dominant first language in the Maphelane area is isiZulu which is spoke by 96.3 of the population (Census, 2011). There are 343 households in the Maphelane area.

2.10.2 Economic Profile

Tourism, agriculture, and manufacturing sustain the local economy. The manufacturing sector is dominated by the sugar mill at Mtubatuba which is strongly linked to the agricultural sector (Mtubatuba IDP, 2020). However, in their current form both agriculture and manufacturing do not offer opportunities for growth in St Lucia. Indeed, the future growth of agriculture is limited because most agricultural activities occur in a flood plain with small-scale farming activities occurring at the lowest parts of the flood plain. The economic system of St Lucia highlights that the local economy is dependent on the biophysical system within which it is embedded (Mtubatuba IDP, 2020). What has not been recognised enough is the inter-relationship between the ecology, economy, and social realities. Natural resources provide the focus for the eco-tourism industry (KZN Top Business, 2023). The majority of the population in St Lucia (18,5%) earn between R9 601-R19 600 (Census, 2011). The most dominant annual income category of agricultural household heads is R4 801-R38 400 for 8669 household (Stats SA, 2011) Approximately 32% of the Mtubatuba Municipality households are employed and 10% are unemployed (IDP, 2020). The rest of the population falls within discouraged work seekers, not economically active and those that are under the age of 15 years.

2.11 Opportunities and Constraints

During the 2022 panel investigation on the St Lucia breaching, it was noted that several issues exist around land use and ownership. If not resolved these issues will exacerbate the conflict which is already present between the local communities and the iSimangaliso Park Authorities. Zulu Craft Market selling crafts and fresh fruit produced in the area provides economic opportunities for the locals, similarly, boat cruises create job opportunities for the locals.

Figure 17: Boat Cruises at St Lucia

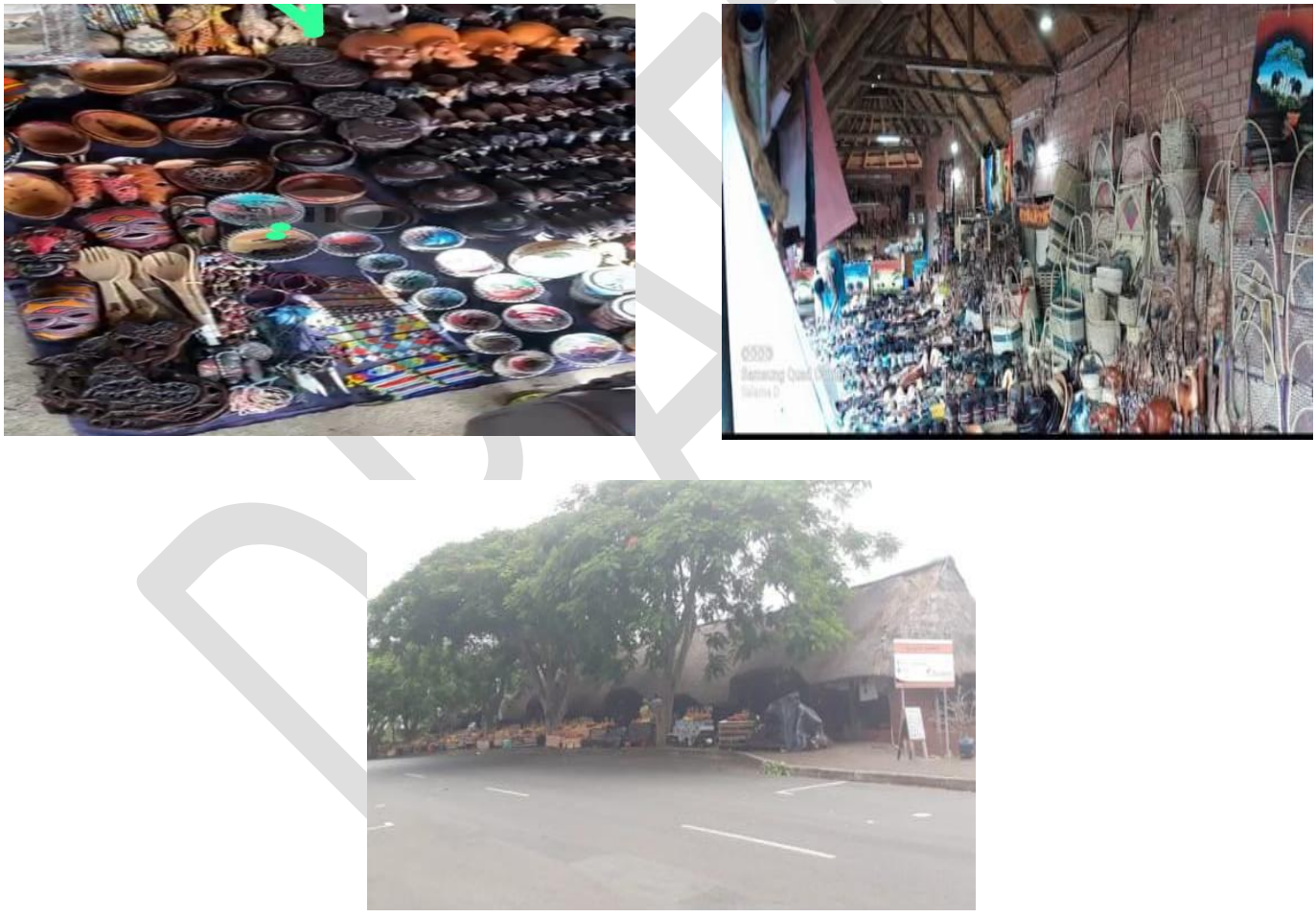

Figure 18: The above 3 images show the craft market opportunities created by the existing of St Lucia activities

2.12 Major Information Gaps

There is a lack of knowledge of the effects of altering freshwater flows to estuaries, and there is

also a high level of uncertainty associated with determining adequate and appropriate environmental flows for estuaries. The absence of available data on ecological processes has a large influence on the methods that could be adopted and likely outcomes of any given study, most of which rely on expert panels and qualitative risk-based assessments. Biophysical knowledge gaps limit the ability to assess ecological response to different scenarios. The ecological parameters of the St Lucia Estuary have been widely studied over the years and should continue to be monitored to best observe long term trends. However, monitoring of the socio-economic data within this area is lacking. Future monitoring should therefore include the collection of socio-economic information such as employment, well-being, etc. Research should also address issues of livelihood and means to develop projects which assist in the upliftment of the community.

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 be 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. Where no data are available to set the upper boundary, the +5 m topographical contour is used (bearing in mind that the tidal range in South Africa is microtidal [< 2 m] and sand bars at closed estuary mouths can sometimes build up as high as + 4.5 m AMSL).
- **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. All the associated wetlands, intertidal mud and sand flats, beaches and foreshore environments that are affected by riverine or tidal flood events must be included. 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 St Lucia Estuary is approximately 67 947 ha. This includes a variety of natural resources that are or have the potential to be harvested included grassland areas for grazing, woody and non-woody plant resources and animal resources of the marginal habitats and water areas of the estuary. 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 (including settlements in close proximity of EFZ) and future activities that are at risk.

The existing EFZ for the St Lucia Lake and estuary is provided in Figure 19

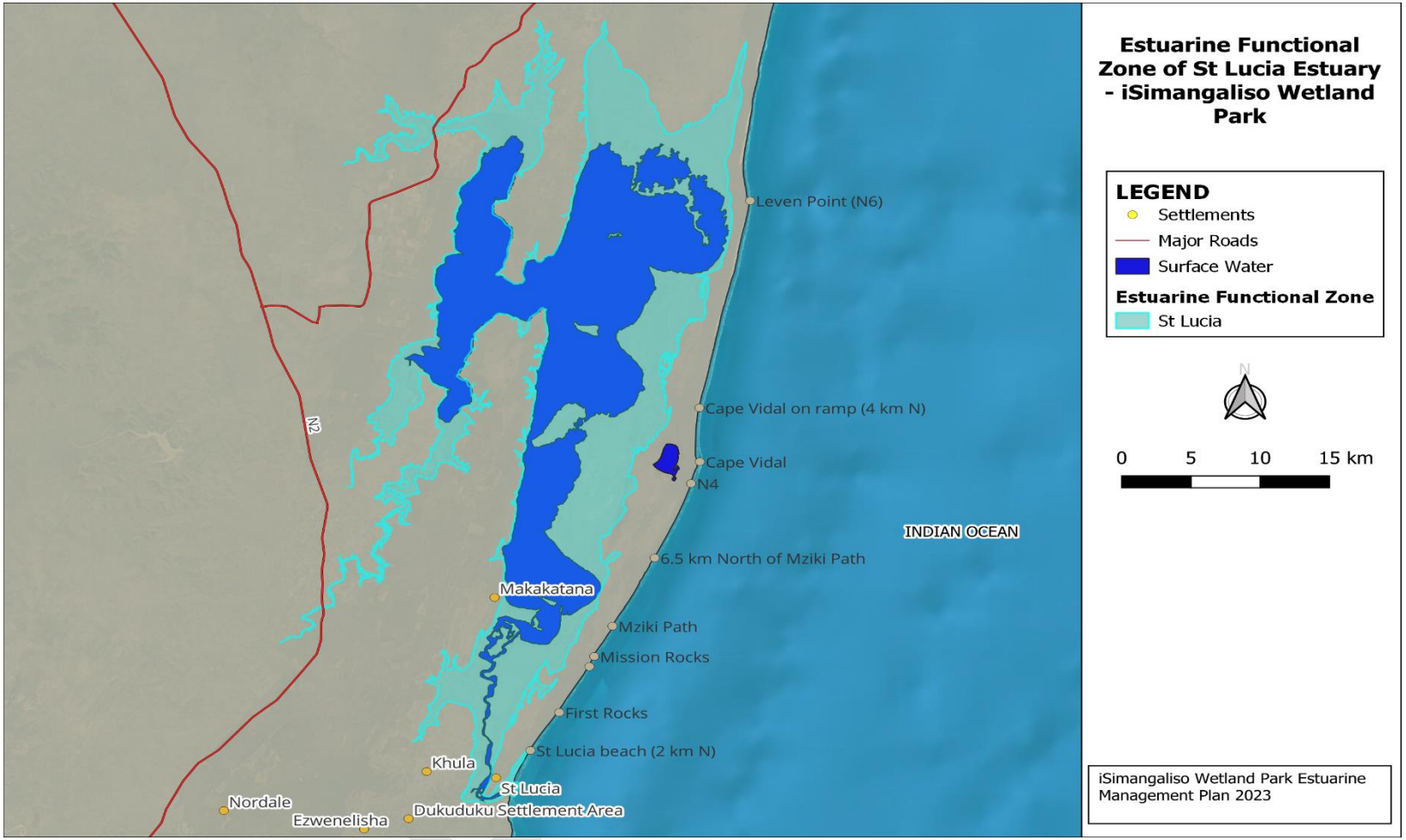

Figure 19: Estuarine Functional Zone of the St Lucia Estuary.

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 St Lucia 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 St Lucia 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 St Lucia 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 4- 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 the 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.

These Management Objectives are also derived from the DFFE Panel of experts' report (2022). According to the report, the issues surrounding the estuary mouth are highly technical in nature, and there appears to be no apparent effort to have these issues communicated in a non-technical manner to the community. This then speaks to the research objective which requires raising awareness and providing education around the management of the estuary. It is imperative that communities are considered and fully involved in management planning as this process has a direct impact on their livelihoods in the long term (The DFFE Independent Panel Report, 2022). The DFFE Independent Panel Report (2022) highlights a need to consider management and hydrology of the upper and lower catchments. Issues such as soil erosion, water abstraction, afforestation, and the use of agricultural herbicides all influence the ecosystem health of the St Lucia system and its biota (Buah-Kwofie and Humphries 2021, Humphries et al. 2021, Tyohemba et al. 2021, Tyohemba et al. 2020, Buah-Kwofie et al. 2018).

The panel is of the opinion that solutions to maintain economic activity and to restore functionality of the catchment and floodplain regions can be created. These will be more effective with a collaborative and data-informed approach which include adequate multi-stakeholder communication and efficient monitoring systems. This speaks to both the management and research objectives. The DFFE Independent Panel Report (2022) states that the current management plan for St Lucia is not designed to address issues of livelihood. This is an investigation that the panel feels should be conducted. The panel suggests that a structured Small Medium and Micro Enterprise (SMME) development masterplan should be developed and implemented accordingly. Such a document could detail projects to be capitalized on, private sector participation in community economic development, policy frameworks around participation goals and skills transfer, and ecologically aligned economic opportunities. This requires the development of actions under the socio-economic objective.

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 above (Table 3). These actions incorporate the key iSimangaliso management objectives, the national objectives and the panel of experts' recommendations, 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 Review the functioning of the uMfolozi-St Lucia reconnection, especially estuary mouth	High	Yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority
	1.9 Future setbacks/flood line determinations must include sea level rise (+0.5to 2m) and projected increase in flood magnitudes	High	no	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority
	1.10 Clearing of the Msunduze channel of vegetation and sediment to allow water to flow freely from the floodplain to the mouth reducing back-flooding	High	Yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority,

				Ezemvelo KZN Wildlife, Department of Water and Sanitation
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	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority, Ezemvelo KZN Wildlife
	2.2 Maintain compliance and monitoring of fishing activities.	High	Yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority, Ezemvelo KZN Wildlife
	2.3 Improve compliance and monitoring of recreational activities.	High	Yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority, Ezemvelo KZN Wildlife
	2.4 Sustainable tourism to facilitate responsible economic growth and the optimal utilisation of ecosystem services.	High	Yes	Department of Forestry, Fisheries and the Environment & iSimangaliso Authority, Ezemvelo KZN Wildlife, Kwazulu Tourism
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, Ezemvelo
	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	yes	iSimangaliso Authority, Ezemvelo KZN Wildlife 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, Ezemvelo KZN Wildlife Wildlife
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, 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	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
	4.3 Develop and implement best practice guidelines for riparian protection (addressing reed removal, grazing, and burning	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, Local and District Municipalities, Traditional Authorities, department of Rural Development and Land Reform
	4.4 Improve access (e.g. walkways and board walks).	Medium	Yes	iSimangaliso Authority and Ezemvelo KZN Wildlife
	4.5 Review and refine the zonation of the St Lucia estuarine system in order to better protect sensitive habitats and species, particularly estuarine dependent biota	High	Yes	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority and Ezemvelo KZN Wildlife
	4.6 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
	4.7 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	yes	iSimangaliso Authority and Ezemvelo KZN Wildlife
	4.8 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, Local and District

				Municipalities, Traditional Authorities, department of Rural Development and Land Reform, Department of water and sanitation
	4.9 Ensure that no permanent structures are built within 100m of the estuary.	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, Local and District Municipalities, Traditional Authorities, department of Rural Development and Land Reform
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, Ezemvelo KZN Wildlife and Department of Forestry, Fisheries and the Environment
	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 Wildllife
	5.3 Social monitoring indicators should be developed which consider the needs of coastal land users within the area. Indicators could include	High	no	Department of Forestry, Fisheries and the Environment, iSimangaliso Authority, Ezemvelo KZN Wildlife

	employment, social grants, income, skills levels, resource harvesting, health, and well-being.			Department of Mineral Resources, KZN Department of Economic Development, Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities, department of Rural Development and Land Reform
	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	iSimangaliso Authority and Ezemvelo KZN Wildlife
	5.5 Prioritize and increase funding for research and enforcement.	High	no	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 Department of Mineral Resources, KZN Department of Economic Development,

				Tourism and Environmental Affairs, Local and District Municipalities, Traditional Authorities, department of Rural Development and Land Reform
	5.8 Research should also address issues of livelihood and means to develop projects which assist in the upliftment of the community.	High	yes	Department of water and sanitation, 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 Rural Development and Land Reform
	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	yes	iSimangaliso Authority, Ezemvelo KZN Wildlife, 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 St Lucia 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.

The zonation’s are divided into **terrestrial (which includes freshwater lakes, rivers, and wetlands) and marine (includes estuarine area) components**. The updated St Lucia terrestrial zones include controlled, wilderness and restricted. The marine zone applicable to the St Lucia system is the controlled zone which is observed at the estuary mouth.

The Wilderness areas within Lake St Lucia have been zoned to include the water surface and shoreline of most of north lake, including the eastern barrier dune complex. The Restricted areas of the estuary have increased since the previous EstMP zonation. Restricted areas now include the northern and southern sections of False Bay, including the delta inlet areas where the Mzinene and the Hluhluwe /Nyalazi interface with the lake, the upper two thirds of the Narrows from a demarcated point at the junction of the old Link Canal northwards to the northern side of Mitchell Island the navigable channel area leading to Hells Gates and the eastern portion of False Bay and the floodplain area from the St Lucia Bridge to the mouth. The balance of the estuary is zoned Controlled (the southern end of the Narrows from the Link Canal entrance in the North to the Skiboat Club, and South Lake from Mitchell Island to Fanies Island including).

Furthermore, no fishing for commercial and recreational angling from the shore or boat using baited/lured rod, reel and line as well as any foul line hooking is permitted in Restricted or Wilderness areas of the Lake St Lucia estuarine system. Restrictions for subsistence small scale fishers may vary.

Small Scale Fishers refer to "Persons that fish to meet food and basic livelihood needs or are directly involved in harvesting / processing or marketing of fish, traditionally operate on or near shore fishing grounds, predominantly employ traditional low technology or passive fishing gear, usually undertake single day fishing trips, and are engaged in the sale or barter or are involved in commercial activity." Many communities surrounding the St Lucia System partake in traditional fishing practices as a way of life. However, in many instances, their fishing methods, E.g., gill netting, is illegal. The Policy for Small Scale Fisheries Sector in South Africa document aims to provide rights to small scale fishing communities and ensure that they have equal access to marine resources. In order for the local communities within the iSimangaliso Wetland Park to continue their subsistence fishing practices and not be viewed as contravening Park regulations, fishing communities must apply to the Minister of DFFE to be recognised as a small-scale fishing community (SSFC). The community will identify members who meet the requirements of a small-scale fisher. Once approved the government will assist in registering the community as a Community Based Legal Entity. The Minister will then issue the entity with a small-scale fishing right. Various details such as areas prioritised for small scale fishing, fishing methods and tools which can be used, and total allowable catches will be discussed with the community. Details can be found in Section 6.2.5 of the Policy for Small Scale Fisheries Sector in South Africa. (Notice 471 of 20 June 2012).

Although a number of small-scale fishers exists within the iSimangaliso Park, only a small number of fishers belong to this community. Additionally, guidelines surrounding this policy are limited and need to be investigated. Community members should be more involved in these discussions to ensure that each party understands the conditions of the policy. Of particular concern are the areas in which small scale fishers can operate and the fishing equipment which can be used. It is suggested that fishing and harvesting of natural resources be permitted to small scale fishers (for own use and not commercial use, also seasonality must be considered) within the restricted zones of the Park. If possible, Wilderness areas should remain prohibited.

Zonation of the St Lucia Estuary is illustrated in Figure 20. The inclusion of the sanctuary zonation has been omitted and is now incorporated into the terrestrial and marine zones of wilderness, restricted or controlled.

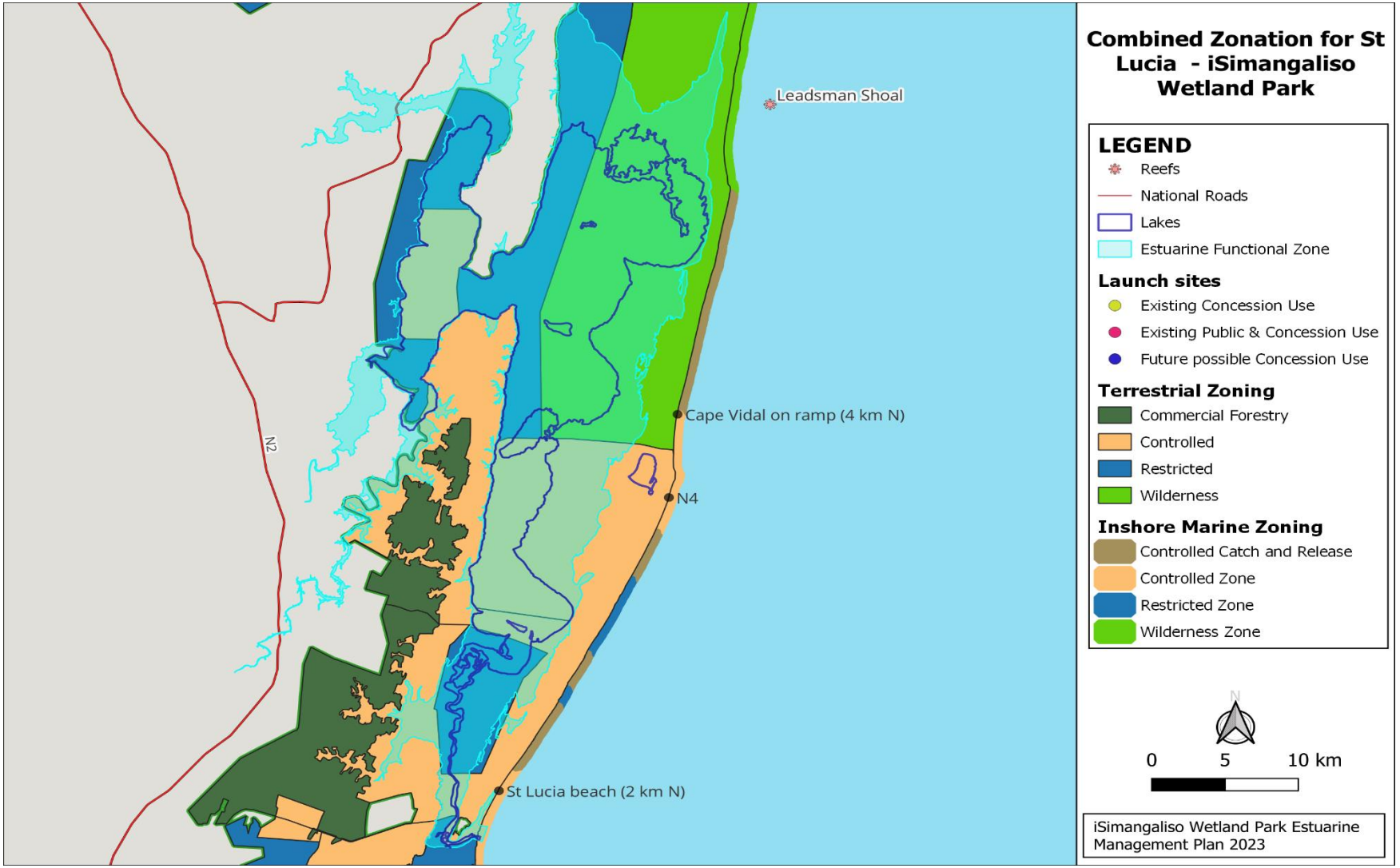

Figure 20: Updated iSimangaliso Wetland Park Marine and Terrestrial Zonation

Wilderness (Terrestrial)

MODIFIED NATURAL ENVIRONMENT. Largely equivalent to IUCN Category 1B Protected Area, but may include areas that are not designated as such, but, nevertheless, have all the attributes and characteristics of true wilderness

Inherent Attributes/ Characteristics	An area with **no** permanent human settlement, infrastructure, consumptive activities (except for limited traditional resource harvesting) or motorised access and where the landscape bears negligible visual evidence (even to the 'educated eye') of these having occurred in the recent past, including residual effects such as alien plants and soil erosion. Thus, even to the 'educated eye', the area has an inherent pristine appearance and character, or at least the potential of being restored accordingly in the short- to medium-term using the 'minimum tool' principle. It must also be sufficiently unspoilt and of a large enough size to: i. Maintain ecological processes with an absolute minimum of management intervention. ii. Provide an authentic wilderness experience by being physically, visually and audibly buffered from adjacent areas of human settlement (heightened 'sense of place' and of World Heritage iii. values).
Focal Purpose of Zone	i.Maintain a scientific benchmark area of biodiversity and ecosystem processes. ii.Provide visitors with a wilderness experience (heightened 'sense of place' and of World Heritage
Permissible Uses & Activities	i.Guided wilderness, special interest/educational activities on foot, horseback, bicycles and nonmotorized watercraft (in freshwater lakes) under special permit only. ii.Overnight wilderness camping with very limited temporary facilities (e.g., fly camps operated iii.under the 'leave no trace' principle). iv.Access to spiritual sites by non-mechanised means. v.Limited traditional subsistence resource harvesting and use using the 'minimum tool' principle vi.under strict regulation and control. vii.Highly regulated scientific research and monitoring that cannot be carried out elsewhere in the park. viii.Special access, assessed on a case-by-case basis, and requiring permits.
Non-Permissible Uses & Activities	i. Mechanised access other than in exceptional or unavoidable circumstances and emergencies ii. (i.e., the 'minimum tool' principle) and subject to a management plan and approved procedures. iii. Motorised visitor activity. iv. Consumptive resource utilisation except for limited traditional harvesting and use as defined v. above under 'permissible uses and activities. vi. Silviculture, agriculture, aquaculture, human settlement, hunting, infrastructure development and mining.

Use Intensity/ Frequency NOTE 4	Law enforcement, management, research, monitoring and visitor use strictly limited to: i The principles of 'minimum tool' and 'leave no trace' apply. ii Very low intensity. iii Very low frequency, the emphasis being on transient use only. iv Small group sizes. v Very strict regulation and control over entry.
Development Nodes	i. Only Type I Wilderness Tourism Overnight Nodes (e.g., temporary fly and tented camps), Tourism Day Visitor Nodes (e.g., temporary bird hides) and Park Management Nodes (e.g temporary law-enforcement camps, research hides) permitted. ii. Park Management Nodes to follow the same principles as for any visitor use of the area.
Development Restrictions	i. Management and tourist roads, other infrastructure (e.g. power lines, water pumps, telephone lines), park signage and buildings (including staff and visitor accommodation) prohibited under all circumstances and without exception. ii. Existing management tracks permitted in exceptional circumstances, with the objective to phase them out over time. iii. Tourist tracks or use of management tracks by tourists prohibited without exception. iv. Fixed campsites prohibited. v. Construction of trails and paths prohibited - use must be made of game trails. vi. No other developments permitted regardless of type, form or need.

NOTES: Wilderness (Terrestrial)

NOTE 1: IUCN Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

NOTE 2: A combination of these purposes will reinforce the branding of the park as a protected area of integrity and quality.

NOTE 3: The impacts of these permissible uses and activities must be managed so as not to impinge upon the natural dynamics of the system, thereby maintaining the inherent wilderness experience of the area. All permissible activities are subject to parameters set by legislation and the Permissible Activities Framework (including respective permits and permit conditions) [Refer to Section 5.1.8 of IMP for more detail].

NOTE 4: Actual density levels, activities and group sizes are specified in the Development Node and Activities Frameworks of the IMP.

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.

Restricted (Terrestrial)

PARTLY MODIFIED NATURAL ENVIRONMENT. Although only partly modified, normally less pristine than Wilderness are. Also, normally less sensitive to 4x4 vehicle and motorised boat access than a Wilderness area

Inherent Attributes/ Characteristics	An area that may have some (but limited in extent and impact) tourism and management human settlement, developed infrastructure and/or consumptive activities (e.g., strictly controlled traditional subsistence resource harvesting and use) and some visual evidence (limited in extent and impact but relatively more than that acceptable for Wilderness zones) of their occurrence in the recent past (including residual symptoms such as alien plants and soil erosion). Nevertheless, regardless of whether ongoing or residual, the human-induced modifications to the environment must either pose no significant threats (to cultural resources, ecological processes, biodiversity, landscape quality) or it must be feasible to dispose of them and/or mitigate their negative impacts within a specifiable time frame. Accordingly, to qualify as a restricted zone, the area must have the potential for restoration to a state that the general public and other stakeholders regard, for the most part, as a largely unmodified landscape.
Focal Purpose of Zone	i Conservation of biodiversity and ecological processes. ii Provide visitors with high quality game/landscape viewing and a close to nature overnight experience.
Permissible Uses & Activities NOTE 1	i. Hiking. ii. Horse riding. iii. Cycling. iv. Non-motorised water craft (kayaking and canoeing). v. Concession 4x4 trails and game drives. vi. Concession boat tours (sail boats and motorised). vii. Freshwater diving (freshwater lakes). viii. Swimming (in secured areas in freshwater lakes). ix. Motorised and non-motorised special interest/educational activities under special permit only. x. Overnighting in bush lodges/tented camps and houseboats. xi. Regulated 2x4 access to low intensity accommodation and day visitor facilities on designated access corridors. xii. Traditional subsistence resource harvesting and use. xiii. Scientific research and monitoring. xiv. Law enforcement patrols and reaction. xv. General management activities and intervention to restore/maintain ecological processes and the unspoilt appearance of the landscape.
Non-Permissible Uses & Activities	i. 2x4 vehicles on gravel/surfaced roads except where existing or designated as an access corridor. ii. 4x4 vehicle trails and boat trips without the acquisition of a special permit, i.e., concession use. iii. Quad bikes and motor cycles except for management purposes. iv. Personal watercraft and private sail boats (freshwater lakes). v. Invertebrate harvesting.

	vi. Fishing (freshwater lakes). vii. Silviculture, aquaculture, agriculture, mining NOTE 2, hunting. NOTE 3 viii. No human settlement except for management staff and tourism accommodation facilities in accordance with the Development Node Framework. ix. Recreational, sport and leisure activities that are not associated with an outdoor nature experience. x. Fireworks
Use Intensity/ Frequency NOTE 4	Regulated and controlled use of low intensity and moderate frequency. Limited and permit-regulated unguided/self-drive activities (e.g., foot, horseback, canoe, motorised boat, 4x4 vehicle trails/trips).
Development Nodes	Only Low Intensity Tourism Overnight Nodes, Tourism Day Visitor Nodes and Park Management Nodes permitted. Where Medium Intensity Tourism Nodes are permitted, this is only for the duration of the activity.
Development Restrictions	i. Road network to be restricted to low impact, all weather 4x4 tracks and designated 2x4 access corridors. ii. Lodging facilities for visitors and management to be restricted to unobtrusive structures. iii. Accommodation facilities to use low intensity lighting. iv. Utility services to be supplied, generated and disposed on-site using eco-friendly and renewable energy technology. No utility services to be supplied from regional bulk supply networks, unless environmentally suitable and compatible with the focal purpose of this zone. v. Appropriate Park signage. vi. All other types and forms of development, not defined in the Development Node Framework, are prohibited.

NOTES: Restricted (Terrestrial)
NOTE 1: All permissible activities are subject to the parameters set by legislation and Permissible Activities Framework (including respective permits and permit conditions) [Refer to Section 5.1.8 of IMP for more detail].
NOTE 2: Mining is not permitted except for the licensed Perlite Mine
NOTE 3: Hunting is not permitted except in the Controlled Hunting Area, which is zoned as restricted and where hunting has been allowed since the late 1980s. Consideration may be given to phasing out this activity in the future.
NOTE 4: Actual density levels, activities and group sizes are specified in the Development Node and Activities Frameworks of the IMP.
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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. xi Restricted small scale invertebrate harvesting, for any person in possession of a recreational fishing permit, in designated areas, i.e. Cape Vidal, St Lucia and Lighthouse Controlled Zones south of Cape Vidal. 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 of the IMP (including respective permits and permit conditions)

Restricted (Marine)

PARTLY MODIFIED NATURAL ENVIRONMENT. Although only partly modified, normally less pristine and less sensitive than Wilderness or Sanctuary areas. Similar in principle to a Terrestrial Restricted Zone.

Inherent Attributes/ Characteristics	A marine area that may have some (but limited in extent and impact) adjacent current human settlement, developed infrastructure (e.g. buoys, piers) and/or consumptive activities, (e.g., fishing), management interventions and some visual evidence (limited in extent and impact but relatively more than that acceptable for Sanctuary zones) of their occurrence in the recent past. Nevertheless, regardless of whether current or residual, the human-induced modifications to the environment must either pose no significant threats (to ecological processes, biodiversity and landscape quality) or it is feasible to dispose of or remove them and/or mitigate their negative impacts over time. Accordingly, the area must have the potential for restoration to a state that the general public regards, for the most part, as largely unmodified and/or near-pristine. This may require proactive and responsive management interventions indefinitely for the maintenance of the above.
Focal Purpose of Zone	i Conservation of biodiversity and ecological processes. ii Where applicable, the restoration and maintenance of natural landscapes and ecological processes. iii Provide visitors with a high-quality nature-based outdoor experience in a marine environment.
Permissible Uses & Activities NOTE 1	*Inshore restricted (no-take)* i Walking on beaches and rocks and fossicking (non-extractive). ii Horse riding. iii Cycling. iv Swimming, snorkelling, surfing, surf-skiing, kite and wind surfing and kayaking. v Concession, research, and monitoring and management beach driving only. vi Boat launching at recognised boat-launching sites (concession, research and monitoring and management only). vii Special interest/educational activities within parameters of other permissible and non-permissible uses and activities. viii Scientific research and monitoring with a scientific permit. ix Fishing and harvesting from Small Scale Fishing Communities provided communities have registered for fishing rights and follow the guidelines set out in their agreed upon policy. Such fishing be limited to own use Permits **(not commercial use).** Inshore restricted (*catch-and-release*): i Walking on beaches and rocks and fossicking (non-extractive). ii Horse riding. iii Cycling. iv Swimming, snorkelling, surfing, surf-skiing, kite and wind surfing and kayaking. v Recreational and small-scale rock and surf angling (catch and release only). Fishing after sunset and before sunrise by special permit only. vi Concession, research, and monitoring and management beach driving only. vii Boat launching at recognised boat-launching sites (concession, research and monitoring and

	management only). viii Special interest/educational activities within parameters of other permissible and non-permissible uses and activities. ix Restricted small scale invertebrate harvesting in designated areas. x Scientific research and monitoring with a scientific permit. xi Law enforcement patrols and reaction. xii Management intervention to restore/maintain ecological processes and the unspoilt appearance of the landscape. *Estuarine Lakes:* i Walking on estuary margins. ii Boats and canoes operating under concessions or licenses only, iii Highly regulated scientific research and monitoring that cannot be carried out elsewhere in the park. iv Swimming (in secured areas) v Special access, assessed on a case-by-case basis, and requiring permits.
Non-Permissible Uses & Activities	*Inshore (no-take)[8]:* i Beach driving except under recreational and educational use permits for concession operators, and authorised management and research, and monitoring vehicles. ii **All forms of extractive use,** including all types of fishing, harvesting of intertidal or shallow sub-tidal organisms, and collection of biota and marine products (e.g., shells, driftwood, rocks, sand). iii Collection of marine aquarium fish, invertebrates and plants except for educational or scientific purposes, and under special permit. iv Collection of organic (e.g., driftwood, shells) and inorganic (e.g., rocks, sand) materials except for educational or scientific purposes and under special permit. v Commercial fishing. vi Launching from non-recognised sites except under special permit. vii Litter or leave any waste including fishing gear, hooks, bait packaging and fishing line. *Estuarine Lakes:* i. All forms of extractive use, including all types of fishing, harvesting of intertidal or shallow subtidal organisms, and collection of biota and marine products (e.g. shells, driftwood, rocks and sand). ii. Fossicking. ii. Driving on estuary margins except for essential management activities and scientific research and monitoring under special permit. v. All motorised vessels without the acquisition of a special permit, i.e. concession use only. v. Parasailing from boats, use of personal watercrafts and wind-surfing. vi. Litter or leave any waste including fishing gear, hooks, bait packaging and fishing line.
Use Intensity/ Frequency NOTE 3	Regulated and controlled use of low and moderate intensity with entry/access restricted to and controlled at entrance gates or other demarcated points of entry.
Development Nodes	Only Low and Medium (temporary) Intensity 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 low water mark to outer limit of Marine Reserve, 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 Restricted or Controlled Zone.

NOTES: Restricted (Marine)

NOTE 1: All permissible activities are subject to parameters set by legislation and the Permissible Activities Framework (including respective permits and permit conditions) [Refer to Section 5.1.8 in the IMP for more detail].

NOTE 2: Measures to make fishing more sustainable may be introduced

NOTE 3: Actual density levels, activities and group sizes are specified in the Development Node and Activities Frameworks of the IMP.

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 ad 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 21 below. It is critical that the revision of this buffer zone considers external threats to the functioning of the St Lucia Estuary. One of these threats would be commercial forestation (plantations) ; its distribution currently extending into the buffer zone of the park.

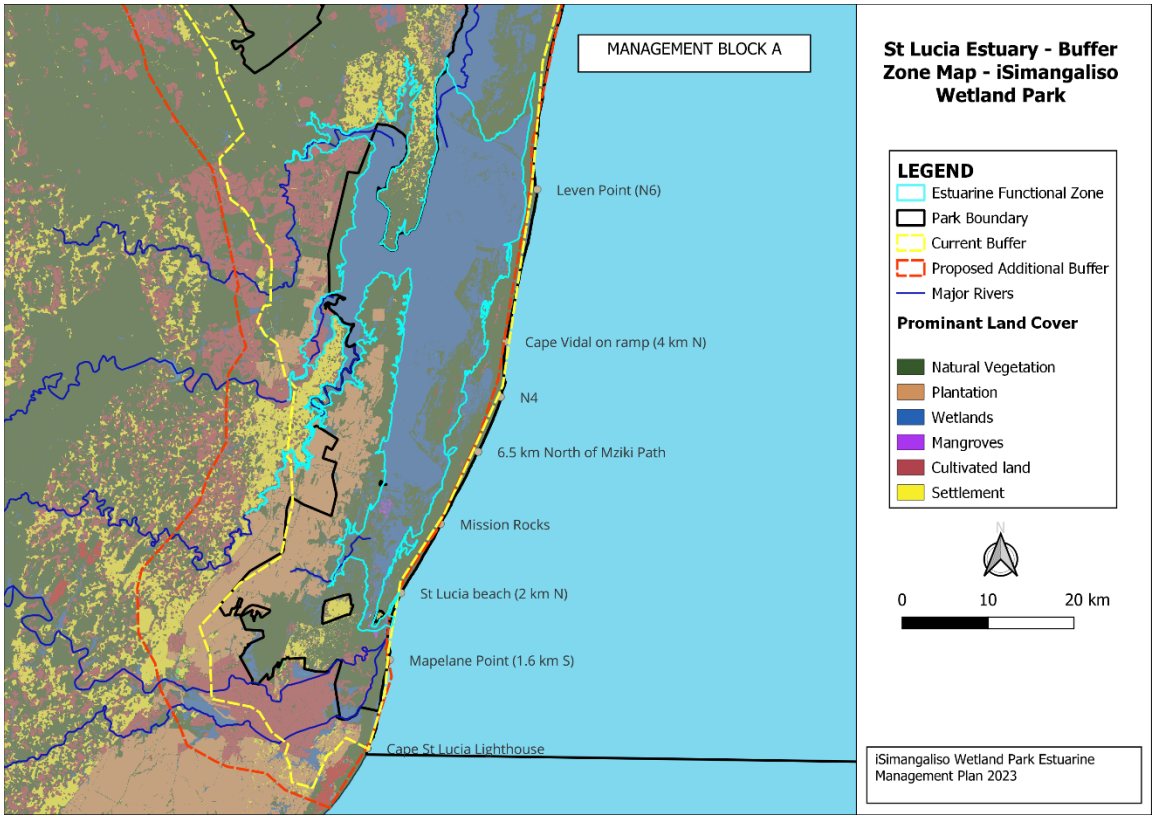


Figure 21: The current and proposed buffer zone for the St Lucia system.

7 Recommended Management Priorities

The following are key action plans that need to be prioritised within the St Lucia 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
- Artificial breaching and mouth manipulation -limiting artificial breaching and allow 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-economic 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.
- Create a single buffer zone that considers the threats faced by the St Lucia Estuary, for the World Heritage property.
- Clearing of the Msunduze channel of vegetation and sediment to allow water to flow freely from the floodplain to the mouth reducing back-flooding.
- Support DFFE in the implementation of the small-scale fisheries policy, including w the functioning of the uMfolozi-St Lucia reconnection, especially estuary mouth
- Develop an EMPr and Emergency Response Plan (ERP) for the St Lucia 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 St Lucia estuarine system. A review of the monitoring plan for the St Lucia 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.

According to the DFFE Independent Panel (2022) iSimangaliso Wetland Park is responsible for continuous monitoring of the conditions in the catchment when water levels become elevated. This can be done at advisory committee/forum meetings or as email communications summarising critical aspects. Monitoring should include the following:

- The actual and expected rainfalls in the catchment
- The water level in the estuary and its rate of increase
- The height and width of the sand berm at the mouth
- The water quality conditions
- Biotic response, such as fish aggregation at the mouth, die-back of macrophytes,
- formation of algal blooms, bird nesting behaviour

The table below defines a comprehensive monitoring plan for the St Lucia 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	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 behaviour 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

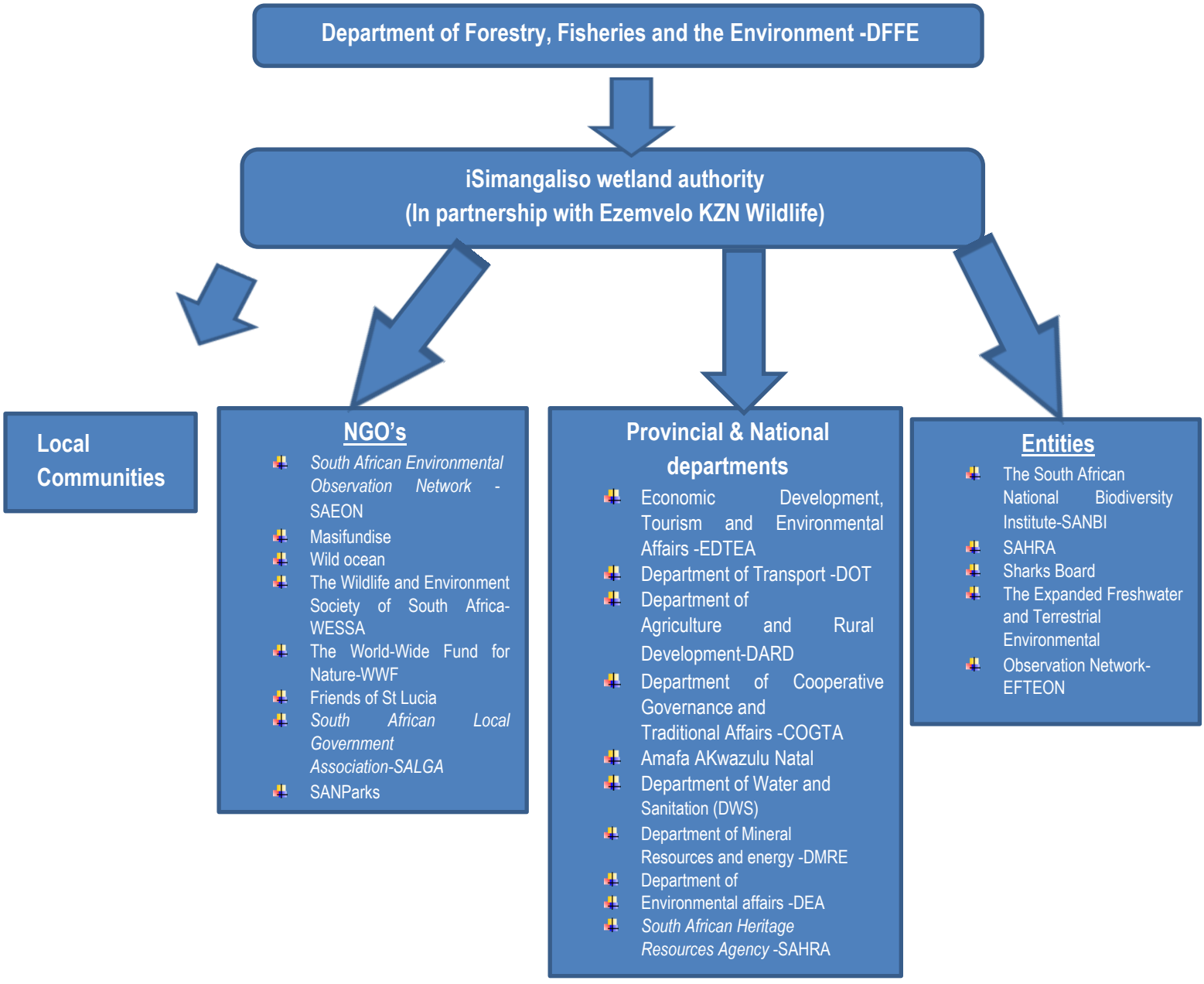
Focal Areas and Indicators	Monitoring Objective	Frequency	Location	Collection/Analytical Method
Biological : Diversity and Abundance and Areal coverage Phytoplankton/Microphytobenthos Macrophytes (reedswamp, other peripheral vegetation types, alien invasives) Macrocrustaceans (prawns and crabs) Fish 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	A minimum of ten fixed sample sites	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 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	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 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 role players 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

The iSimangaliso Wetland Park Authority is responsible for the co-ordination of the implementation of the St Lucia Lake 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 annual basis by iSimangaliso Wetland Park 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 St Lucia estuarine system, the recommendation from the panel of experts must be considered during the management and monitoring phase of the estuary. The EFZ and zonation of the estuary boundaries need to be adhered to. The following actions 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 the functioning of the uMfolozi-St Lucia reconnection, especially estuary mouth
- Review and refine the zonation of the St Lucia 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 with 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 Mbense**
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 Nomcebo 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-year 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 year experience