EZEMVELO KZN WILDLIFE™

Conservation, Partnerships & Ecotourism

BEACHWOOD MANGROVES *Protected Area*

MANAGEMENT PLAN

Photo: Richard Boone

Photo: Eliva Grobler

Beachwood Mangroves Nature Reserve

KwaZulu-Natal
South Africa

Protected Area Management Plan

Prepared by

Brousse-James & Associates and

Ezemvelo KwaZulu-Natal Wildlife Protected Area Management Planning Unit

Citation

Beachwood Mangroves Nature Reserve: Management Plan. Version 1.0 (June 2013), Ezemvelo KZN Wildlife, Pietermaritzburg.

This Management Plan for Beachwood Mangroves Nature Reserve is recommended by the Nature Reserve Planning Committee (NRPC), a multi-disciplinary team consisting of:

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TITLE	NAME	SIGNATURE AND DATE
KwaZulu-Natal MEC: Department of Agriculture and Environmental Affairs	See the next page for MEC approval. The change is due to reconfiguration of provincial government departments.	

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APPROVAL

This Protected Area Management Plan for Beachwood Mangroves Nature Reserve is approved:

TITLE	NAME	SIGNATURE AND DATE
KwaZulu-Natal MEC: Department of Economic Development, Tourism and Environmental Affairs	Michael Mabuyakhulu	

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PREFACE

This Protected Area Management Plan for Beachwood Mangroves Nature Reserve is the primary and overarching management document for the protected area and has been developed during 2013. It forms the framework within which the nature reserve will be managed and developed towards the achievement of its management objectives, derived in collaboration with the protected area's stakeholders during January 2013.

The protected area management planning process and the resultant planning document (elaborated on in the next few pages) has been designed to meet the statutory requirements of the National Environmental Management: Protected Areas Act and other relevant legislation.

The protected area management planning process requires participation from the protected area's stakeholders, the general public and specialists during the various stages of plan development and implementation. Although the management plan and its sub-components are five-year planning documents, an annual review process will ensure an active adaptive management planning approach.

A long-term business approach has also been introduced that ensures that the protected area's management objectives are operationalised and reflected through an annual plan of operation. This costs and prioritises the management actions required to achieve the vision and objectives of the management plan and allows Ezemvelo to actively pursue additional and improved funding and income towards the achievement of the natural and cultural heritage conservation objectives of the nature reserve over the next five years.

Ezemvelo KwaZulu-Natal Wildlife, as the appointed Management Authority for Beachwood Mangroves Nature Reserve, hereby commits itself to the implementation of this plan.

Dr. Bandile Mkhize
Chief Executive Officer

Date:

EXECUTIVE SUMMARY

Introduction

The Beachwood Mangroves Nature Reserve is a 76 ha protected area, situated in the eThekweni Metropolitan Municipality, some 5 km north of the centre of Durban. It lies between the Ruth First Highway (M4) and the sea, stretching from the Mgeni Estuary in the south, to the Beachwood Golf Course in the north. Beachwood Mangroves Nature Reserve was proclaimed in 1977 and the Mangrove Swamps were proclaimed as a National Monument in 1977.

The nature reserve is closed to the public, unless by prior arrangement, when supervised education groups are permitted access. A roving field ranger is on duty during the day, but the office is open at irregular hours. No accommodation, caravanning or camping facilities are available.

Strategic management framework

The following vision has been adopted for Beachwood Mangroves Nature Reserve:

The ecological integrity, function and character of Beachwood Mangroves Nature Reserve is conserved in perpetuity through effective management and community support to maintain a representative sample of this ecosystem that will promote opportunities for environmental awareness and nature-based recreation.

An objective has been identified for each of Beachwood Mangroves Nature Reserve's key performance areas, which relate to the important functions and activities necessary to achieve the vision and protect, develop and manage the nature reserve effectively. The objectives have then been translated into strategic outcomes, which form the basis for the management activities and targets set out in the operational management framework.

The following specific issues have been identified by the Nature Reserve Planning Committee:

- Deposition of litter and sediment from the Mgeni River in the south and heavy urban runoff from Broadway in the north, at Rocket Hut. There is a silt trap at Rocket Hut that is meant to arrest the sediment input, but this has not been maintained by the eThekwini Municipality.
- Pollution from industrial areas and sewer spillages resulting from sewage pump station failure.
- Alien vegetation encroachment.
- General public safety (high crime rate).
- It is believed that reduction in salt water intrusion up the Beachwood Creek, in the vicinity of Rocket Hut, has led to a perceived decrease in the number of whelks and mudskippers and definite proliferation of *Hibiscus tiliaceus.*
- Alien fish (guppies and swordtails) were introduced outside the nature reserve, in the catchment, for mosquito control and escaped into the creek.
- Proposed canalisation of sections of the Mgeni and possible effects thereof.
- Unusual weather in September 2009, with dry salt-laden air, has stressed mangroves. Also, possible excess barrier overwash events have deposited marine-derived sediment into the mangroves, which is aiding the encroachment of dune vegetation.

The following specific strategic outcomes have been identified by the Nature Reserve Planning Committee to address the abovementioned issues:

- There is adequate law enforcement within Beachwood Mangroves Nature Reserve in order to achieve the protected area vision.
- Constructive community involvement in Beachwood Mangroves Nature Reserve's management through effective stakeholder engagement; and provision of support to the community in developing its understanding of the management of Beachwood Mangroves Nature Reserve.
- Capture of buffer zone considerations in IDP's and SDF's and municipal schemes.
- Ensure that all visitor activities are appropriate to the goals of the nature reserve and to its neighbours.
- Support organisations (WESSA, Green Hub, Sea World and Honorary Officers) conducting environmental interpretation and education programme.
- Develop and implement a sedimentation management plan for Beachwood Mangroves Nature Reserve.
- Develop and implement an alien species control plan for Beachwood Mangroves Nature Reserve (fauna and flora).
- Develop and implement an indigenous invasive species control plan for Beachwood Mangroves Nature Reserve.
- Identify, rehabilitate and manage areas that have been significantly impacted by accelerated soil erosion and deposition.
- Collection of biological material is undertaken in a legal manner and conforms to Ezemvelo KZN Wildlife policy.
- Critical ecological processes and functions are maintained within Beachwood Mangroves Nature Reserve.
- Biological monitoring programmes are developed and implemented to determine the success of management interventions in protecting the ecosystems, communities and species of Beachwood Mangroves Nature Reserve.
- Development of a five-year Financial Plan that identifies the resource needs to achieve the objectives for Beachwood Mangroves Nature Reserve.
- Ensure that Beachwood Mangroves Nature Reserve is adequately staffed and conforms to legal staffing practices.
- All facilities and infrastructure in Beachwood Mangroves Nature Reserve are adequately maintained.
- Service infrastructure and practices in Beachwood Mangroves Nature Reserve do not cause environmental harm.

Monitoring and reporting

Monitoring and reporting is a critical component of the adaptive management cycle. It enables the effective assessment of management interventions and, if necessary, can be used to direct modifications of management in an effort to achieve the outcomes required. An annual monitoring schedule for Beachwood Mangroves Nature Reserve, which conforms to the norms and standards for surveillance and monitoring (Goodman 2011), has been

developed, based on the management targets contained in the operational management framework.

Annual plan of operation

Each year an annual plan of operation will be prepared, based on the objectives, strategic outcomes, management activities and targets contained in the management plan. The annual plan of operation should be prepared, based on the findings of the previous year's management plan implementation review. The annual plan of operation will be tied to staff performance contracts, and goals set in them will be categorised in the same key performance areas as the management plan.

Table 1: Abbreviations

Amafa	Amafa aKwaZulu-Natali (KwaZulu-Natal Provincial Heritage Agency)
CCA	Community Conservation Area
CDP	Concept Development Plan (Component of Ezemvelo KZN Wildlife protected area management planning process)
CEO	Chief Executive Officer
CRMP	Cultural Resource Management Plan
CMS	Co-management Structure
DAEARD	KwaZulu-Natal Provincial Department of Agriculture and Environmental Affairs
DEAET	Eastern Cape Department of Economic Affairs, Environment and Tourism
DEA	National Department of Environmental Affairs
DWA	National Department of Water Affairs
EIA	Environmental Impact Assessment
Ezemvelo	Ezemvelo KwaZulu-Natal Wildlife
EMF	Environmental Management Framework
EMP	Environmental Management Plan
FPA	Fire Protection Association in terms of the National Veld and Forest Fire Act (No.1 of 1998)
GDP	Gross Domestic Product
GIS	Geographical Information System
IDP	Municipal Integrated Development Plan
IUCN	International Union for the Conservation of Nature
MEC	Member of the Executive Council
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NEMA	National Environmental Management Act
NPAES	National Protected Area Expansion Strategy
NRPC	Nature Reserve Planning Committee
NSBA	National Spatial Biodiversity Assessment
OIC	Officer in Charge
OPSCOM	Operations Committee
PA	Protected Area
ROC	Ezemvelo KZN Wildlife Regional Operations Committee
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SAPPI	South African Pulp and Paper Industry
SDF	Municipal Spatial Development Framework
SMME	Small, Micro and Medium Enterprises
SWOT	Strengths, weaknesses, opportunities and threats analysis
UNESCO	United Nations Educational, Scientific and Cultural Organisation

1 BACKGROUND

1.1 Introduction

The Beachwood Mangroves Nature Reserve covers an area of 76 ha and is situated in the eThekweni Metropolitan Municipality, some 5 km north of the centre of Durban (1:50,000 Maps 2930DD & 2931CC). It lies between the Ruth First Highway (M4) and the sea, stretching from the Mgeni Estuary in the south, to the Beachwood Golf Course in the north. The main function of this small estuarine reserve, which runs into the Mgeni Estuary, is to provide protection for the mangrove forest. Beachwood Mangroves Nature Reserve was proclaimed in 1977 and the Mangrove Swamps were proclaimed as a National Monument in 1977 (see Appendix C2).

It is an important estuarine habitat at the mouth of the Mgeni River in Durban, and is the largest population of mangrove trees in the Durban area. Associated with the mangroves are a number of conservation important animal species, which also have a limited distribution in KwaZulu-Natal. The mangroves are separated from the sea by sand dunes, some of which reach a height of 10 m above sea level, and where creeping plants and pioneer scrub are to be found.

A tidal creek runs through the mangroves, parallel to the sea, from the Beachwood Golf Course in the north, to the Mgeni Estuary in the south. The creek is about 1 m wide in the north, extending to about 3 m wide in the south, where it opens into the Mgeni Estuary.

The area is used as a nature conservation education centre and the southern area, near the Mgeni Estuary, has an activities centre and a separate thatched gazebo, which are available to educational groups and other interested parties. A boardwalk has been built over the channels to gain access and a footbridge crosses the creek along the path to the sea shore.

The nature reserve is closed to the general public, unless by prior arrangement, when supervised education groups are permitted access. A roving field ranger is on duty during the day, but the office is open at irregular hours. No accommodation, caravanning or camping facilities are available.

No harvesting of bait organisms is allowed and no fishing takes place in the Beachwood Creek as it is very narrow and shallow. Most recreational fishing takes place in the Mgeni Estuary (Mann *et al.*, 1998).

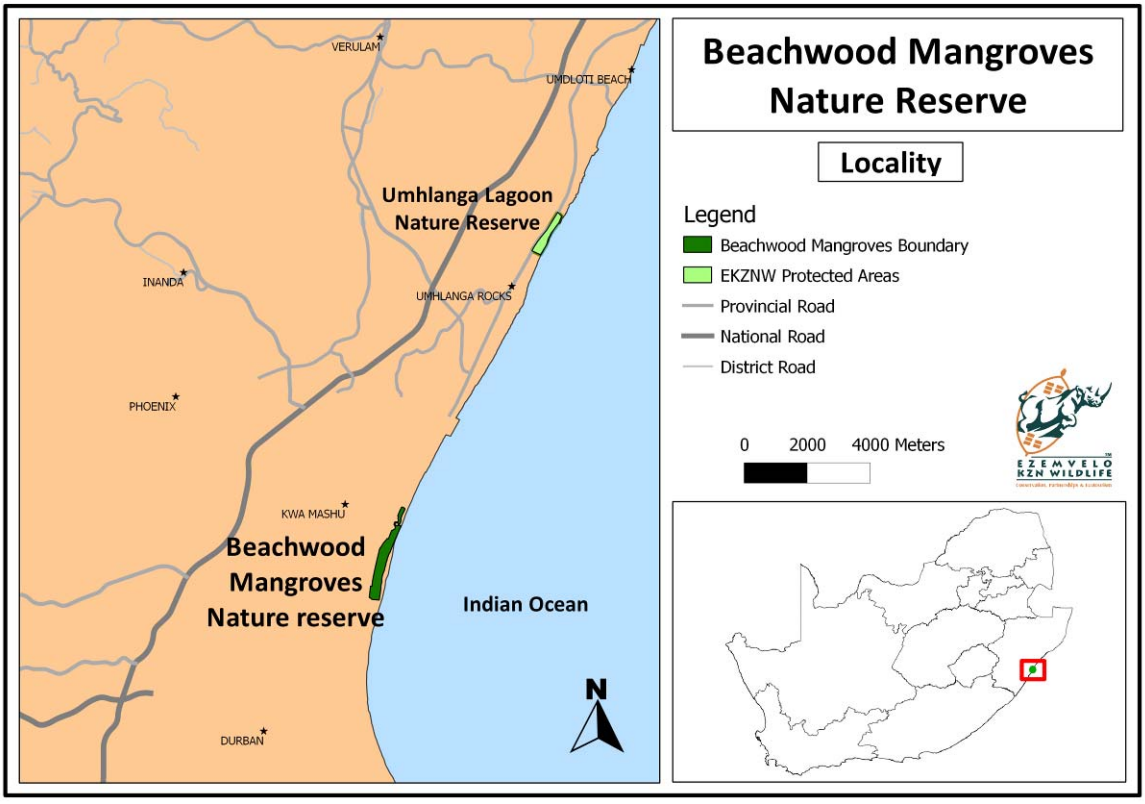
A regional review of the status of marine and estuarine protected areas in KwaZulu-Natal (Mann *et al.*, 1998) was commissioned by the Marine Reserves Task Group, which was established by the Sea Fisheries Research Institute (SFRI) and the South African Network for Coastal and Oceanographic Research (SANCOR), in 1996, to examine the use of Marine Protected Areas (MPA's) in Marine Resource Management in South Africa. The purpose of that review was to investigate the current status of marine and estuarine Protected Areas in KwaZulu-Natal.

The report (Mann *et al.*, 1998) stressed that the estuaries of KwaZulu-Natal are important as "life support systems", which act as fish and crustacean nurseries, and as exporters of detritus into the marine ecosystem. There are 74 estuaries in KwaZulu-Natal, of which only 10 are within official protected areas. Only one estuary south of Durban's Beachwood

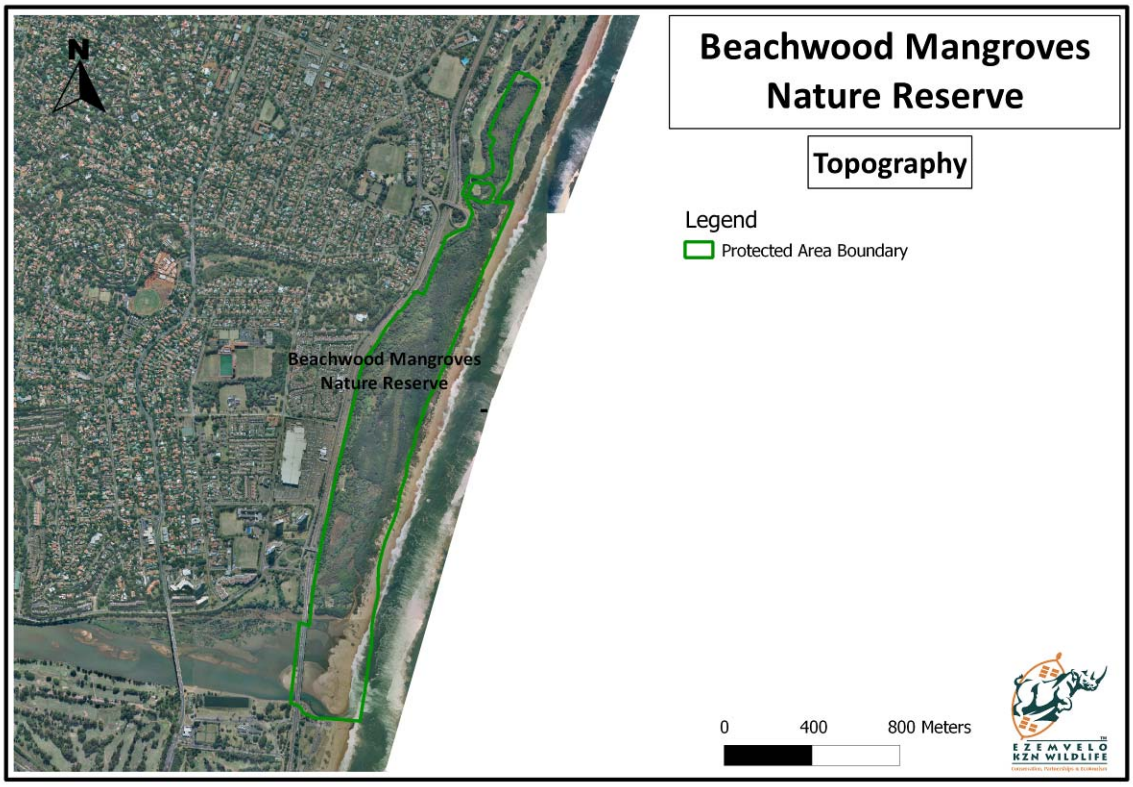
Mangroves (Mpenjati) is formally protected. This is totally inadequate in terms of the importance of estuaries as "life support systems" and more estuaries need to be given full conservation protection.

There are 20 estuaries in South Africa that support the largest mangrove communities and these range from Kosi Bay in the north to Kobonqaba in the Eastern Cape. The total area of these mangroves is approximately 1,700 ha and these mangrove communities are very important habitat formers within estuaries (Berjak *et al*., 2011).

Access to the nature reserve from Durban is via the Ruth First (M4) freeway, travelling north. After crossing the Mgeni River on the Ellis Brown viaduct at Blue Lagoon, turn left off the first off-ramp. This leads to Riverside Road/Prospect Hall Road. Bear sharp left and proceed for 50 m, then take a sharp left turn into the entrance to Beachwood Mangroves Nature Reserve.



Map 1: Regional location of Beachwood Mangroves Nature Reserve



Map 2: Topography of Beachwood Mangroves Nature Reserve

1.2 The values of Beachwood Mangroves Nature Reserve

The values of a nature reserve are considered to be those remarkable attributes that exemplify it and are largely the reason that it has been proclaimed as a protected area. The values are important in planning and management as they are the aspects of the nature reserve that must be protected.

The values of Beachwood Mangroves Nature Reserve include:

Natural values	▪ Largest remaining Mangrove Swamp system in the Durban area. ▪ Provides habitat for a number of important animal species, including Red Data fish, reptile, bird and invertebrate species.
Ecosystem service values	▪ Estuaries, in general, provide a number of ecosystem services, including silt trapping, acting as a carbon sink, a fish nursery for fisheries, processing of sewage and a source of sustainable resources. ▪ Mangroves, in particular, have a number of economic values, i.e., provide a number of ecosystem services, namely: o Protect the land from storm erosion. o Trap sediments. o Important nursery for fish and prawns. o Some adult fish live and feed in mangrove swamps at high tide. o Ecotourism and educational value. o Act as a carbon sink.
Eco-cultural tourism values	▪ Mgeni Estuary is one of the most easily accessible birding locations in the greater eThekwini area.
Cultural and historic values	▪ Provides a glimpse into the past, when Durban was a significant and diverse wetland ecosystem, and is one of the last remnants of that system.
Social values	▪ Valuable and accessible education facility, used by many educational groups, from schools to universities.

1.3 Purpose of the plan

Protected area management plans are intended to be high-level, strategic documents that provide the direction for the development and operation of protected areas. The purpose of the management plan is to:

- facilitate compliance with the National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003) and other relevant legislation;
- inform management at all levels, from the staff on site through to the CEO, the Board and the MEC;
- provide the primary strategic tool for management of Beachwood Mangroves Nature Reserve, informing the need for specific programmes and operational procedures;

- provide motivations for budgets and providing indicators that the budget is spent correctly;
- build accountability into the management of Beachwood Mangroves Nature Reserve;
- provide for capacity building, future thinking and continuity of management; and
- enable Ezemvelo KZN Wildlife to develop and manage Beachwood Mangroves Nature Reserve in such as way that its values and the purpose for which it was created are protected.

Consistent with Section 17 of the National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003), the purpose of Beachwood Mangroves Nature Reserve is to:

- protect an ecologically viable area, representative of South Africa's estuarine biological diversity and natural landscapes and seascapes;
- preserve the ecological integrity of the protected area;
- conserve biodiversity in the protected area;
- protect an area representative of naturally occurring estuarine/ mangrove ecosystem, habitats and species in South Africa;
- protect South Africa's threatened or rare species associated with estuaries and, in particular, mangroves;
- protect an area which is vulnerable or ecologically sensitive; to assist in ensuring the sustained supply of environmental goods and services, particularly those associated with estuaries;
- provide for the sustainable use of natural and biological resources, with particular emphasis on the role that estuaries play in the maintenance of fisheries;
- create or augment destinations for nature-based tourism, particularly as it relates to education;
- manage the interrelationship between natural environmental biodiversity, human settlement and economic development;
- generally contribute to human, social, cultural, spiritual and economic development; and
- rehabilitate and restore a degraded estuarine ecosystem and promote the recovery of endangered and vulnerable species.

1.4 Planning approach

The preparation of this management plan has been undertaken, based on the following guiding principles.

1.4.1 Adaptive management

Adaptive management is a structured, iterative process in which decisions are made using the best available information, with the aim of obtaining better information through monitoring of performance (Figure 1). In this way, decision making is aimed at achieving the

best outcome, whilst accruing the information needed to improve future management. Adaptive management can lead to the revision of a part or, if necessary, the whole management plan.

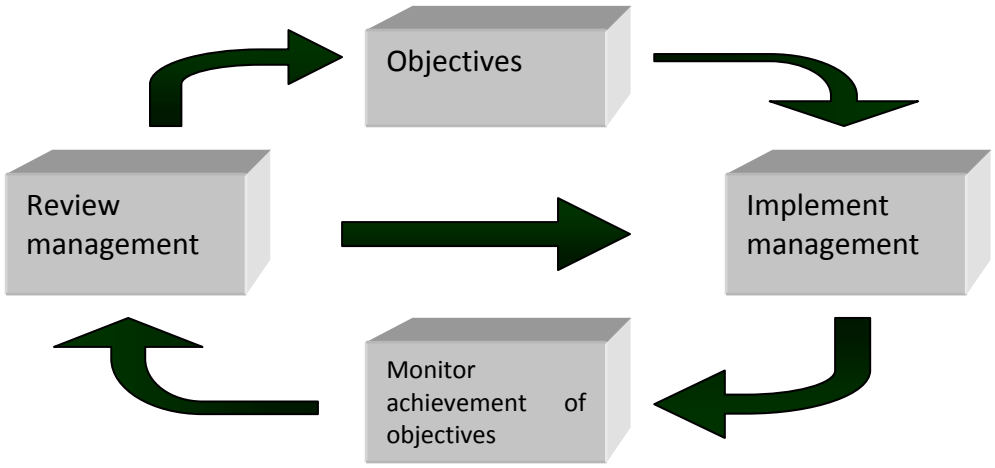


Figure 1: The adaptive management cycle

Adaptive management enables protected area managers to:

i) Learn through experience.

ii) Take account of, and respond to, changing factors that affect the protected area.

iii) Continually develop or refine management processes.

iv) Demonstrate that management is appropriate and effective.

1.4.2 Collaboration and transparency

Stakeholder involvement and support is an important aspect of effective protected area management. It is also a requirement in terms of Sections 39(3) and 41(2) (e) of the National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003). Accordingly, the development of this protected area management plan has been undertaken through a collaborative process, involving local communities and other key stakeholders.

Furthermore, the draft protected area management plan was made available for public review and comment, prior to its finalisation. It is intended that this process will ensure a great deal of valuable input into the development of the protected area management plan, the outcomes of which are incorporated into the plan. A detailed public participation report will be available upon request from the nature reserve manager or Ezemvelo's Planning Unit.

1.4.3 Structure of the plan

The structure of the plan is as follows:

Section1:	Provides an introduction and background to Beachwood Mangroves Nature Reserve and the integrated management plan.
Section 2:	Establishes the context of the Beachwood Mangroves Nature Reserve, providing the basis for the strategic and operational management frameworks that follow.
Section 3:	Sets out the vision and objectives that must be achieved in an effort to effectively conserve the nature reserve.
Section 4:	Provides a plan for zonation of the nature reserve, outlining the land uses that are permissible in particular zones and those that are not.
Section 5:	Describes the administrative structure required to effectively manage Beachwood Mangroves Nature Reserve.
Section 6:	Sets out the detailed management targets that must be achieved in managing the nature reserve.
Section 7:	Sets out the monitoring measures required to determine if management targets are being met and the requirements for reporting on performance in implementing the plan.
Section 8:	Describes some of the components that must be included in the annual plan of operation.

The structure is presented graphically in Figure 2 below, with arrows indicating information and process flows.

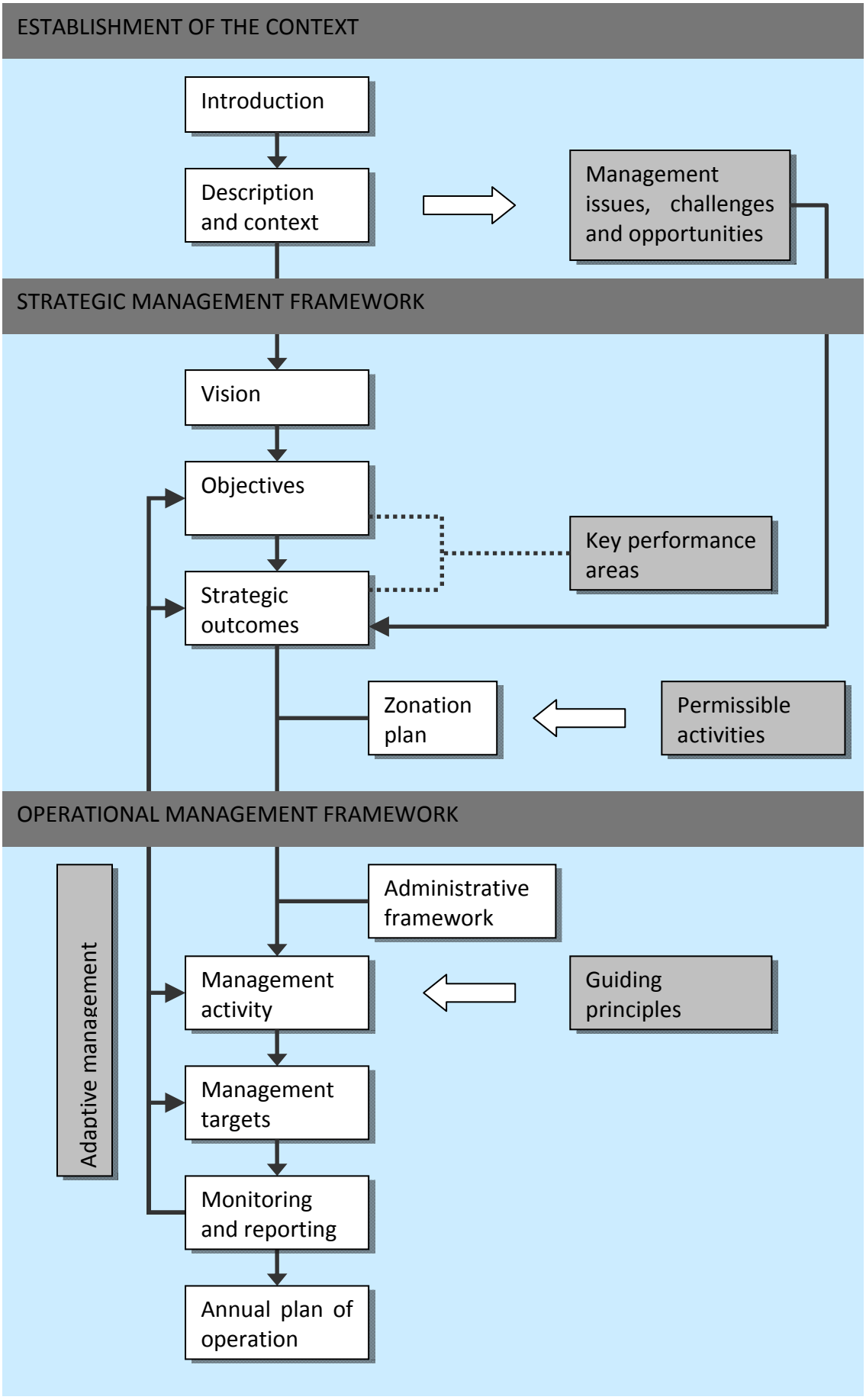


Figure 2: Structure of the Protected Area Management Plan

2 DESCRIPTION OF BEACHWOOD MANGROVES NATURE RESERVE AND ITS CONTEXT

2.1 Institutional and administrative framework for the management of Beachwood Mangroves Nature Reserve

The KwaZulu-Natal Nature Conservation Board, established in terms of the KwaZulu-Natal Nature Conservation Management Act No. 9 of 1997, was appointed by the KwaZulu-Natal MEC: Agriculture and Environmental Affairs as the management authority for all provincial protected areas in KwaZulu-Natal. The Board's implementing agency is Ezemvelo KZN Wildlife.

Management of Beachwood Mangroves Nature Reserve must be undertaken in accordance with relevant legislation and the management policies of Ezemvelo KZN Wildlife. This includes a commitment to maintain the ecological integrity of the site.

The KwaZulu-Natal Nature Conservation Board will be responsible for reporting on the management of Beachwood Mangroves Nature Reserve to the designated KwaZulu-Natal Provincial Member of the Executive Committee (MEC) and the Premier, thus ensuring coordination of those matters that may affect the nature reserve through the relevant provincial departments, district and local municipality.

2.2 The legislative basis for the management of Beachwood Mangroves Nature Reserve

There is a large body of legislation that is relevant to the management of Beachwood Mangroves Nature Reserve, but the primary legislation guiding the management of protected areas is the National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003).

The Protected Areas Act establishes the legal basis for the creation and administration of protected areas in South Africa, as its objectives include provisions "for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes". The Act sets out the mechanisms for the declaration of protected areas and the requirements for their management. A detailed list of relevant legislation is provided in Appendix B. Managers are required to familiarise themselves with the purpose and contents of the statutes and their subsequent amendments and regulations.

2.2.1 Proclamation status of Beachwood Mangroves Nature Reserve

Beachwood Mangroves was proclaimed on 12 May 1977, by means of the Province of Natal Proclamation No.76 of 1977. The Mangrove Swamps were proclaimed as a National Monument in 1977 (see Appendix C2).

Appendix C2 contains the revised regulations governing the management and development of the Beachwood Mangroves area, declared as a National Monument.

In terms of Section 12 of the Protected Areas Act, protected areas that were protected in terms of provincial legislation, prior to the commencement of the Protected Areas Act, and which would be eligible to be declared as nature reserves in terms of the Act, must be regarded to be a nature reserve for the purposes of the Protected Areas Act. The

implication of this is that Beachwood Mangroves Nature Reserve is legally considered to be a proclaimed nature reserve, in terms of the Protected Areas Act.

2.2.2 Invasive species control in terms of the Biodiversity Act

In terms of Section 76 of the National Environmental Management: Biodiversity Act (No. 10 of 2004), the management authority of a protected area must incorporate an invasive species control plan in the management plan. This is addressed in Section 5.6.2.

2.3 The policy framework guiding the management of Beachwood Mangroves Nature Reserve

In conserving and managing the biodiversity of KwaZulu-Natal, Ezemvelo KZN Wildlife operations are undertaken within a broad framework of policies. At a national level, overarching policy is set out in:

i) The White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity of 1997.

ii) The Bioregional Approach to South Africa's Protected Areas, 2001/2002.

iii) Community Based Natural Resource Management Guidelines, 2003.

iv) National environmental management principles, set out in Section 2 of the National Environmental Management Act.

v) Relevant norms and standards set by the Minister and MEC in terms of the Protected Areas and Biodiversity Acts.

Within the province, Ezemvelo KZN Wildlife has adopted a Five Year Strategic Plan and Performance Plan for 2009-2014, which has developed the following corporate strategic profile.

VISION

"To be a world renowned leader in the field of biodiversity conservation"

MISSION STATEMENT

"To ensure effective conservation and sustainable use of KwaZulu-Natal's biodiversity, in collaboration with stakeholders, for the benefit of present and future generations."

STRATEGIC GOALS

i)To conserve indigenous biodiversity in KwaZulu-Natal, both within and outside of protected areas.

ii) To be a sustainable, well resourced and capacitated biodiversity conservation and ecotourism organisation.

iii) To foster the value of biodiversity conservation with stakeholders.

iv) To be an efficient, effective and compliant organisation, with good governance.

v) To effectively promote the mandate of the organisation to stakeholders.

CORE VALUES

Integrity	At all times we act morally, ethically and with honesty.
Respect	We treat stakeholders with patience, politeness and acknowledge and value their right and those of the environment.
Accountability	We involve stakeholders in the organisation's activities, with a culture of openness, and are answerable for the outcome of our actions and activities.
Team work	Working together to achieve our vision through goals.
Innovation	An adaptable organisation that embraces the culture of creativity and learning.
Excellence	We are a progressive organisation, applying best practices to achieve the highest quality and standards.
Commitment	At all times, we undertake our activities with passion, loyalty and dedication.
Productivity	We undertake to produce results timeously, efficiently and effectively.

A number of policies, specific to particular areas of operation, have also been developed by Ezemvelo KZN Wildlife (Appendix C1). These policies have been considered and applied within the plan, where relevant. The nature reserve's manager is required to be familiar with them and to apply them in managing Beachwood Mangroves Nature Reserve.

The management plan has utilised this body of policies to develop a strategic and operational management framework for Beachwood Mangroves Nature Reserve, that is consistent with the broad goals and specific policy requirements of Ezemvelo KZN Wildlife.

2.4 The regional and local planning context of Beachwood Mangroves Nature Reserve

The following text was derived from the eThekwini Municipality Integrated Development Plan 2012/2013.

In terms of the natural environment, eThekwini is situated at the centre of the Maputaland-Pondoland-Albany Region, which is described by Conservation International as a "Biodiversity Hotspot". The eThekwini Municipal area is characterised by diverse topography, from steep escarpments in the west, to a relatively flat coastal plain in the east. It incorporates 98 km of coastline, 18 major catchments and 16 estuaries, 4,000 km of river, and nearly 75,000 hectares of land, identified as part of the Durban Metropolitan Open Space System (D'MOSS) (adopted December 2010). D'MOSS supports a wide variety of terrestrial and aquatic ecosystems, thereby attempting to meet biodiversity conservation objectives, while aiming to secure the supply of the ecosystem services that are provided freely by these ecosystems to the people of Durban. Ecosystem services, and their associated biodiversity, provide probably the most significant buffering effect against the negative impacts of climate change for local communities and infrastructure.

Notwithstanding their value, natural environments in eThekwini have been severely impacted by landscape change, invasive alien species, over-exploitation and pollution. Climate change is a significant and increasing threat. Many people have benefited, over the last century, from the conversion of natural ecosystems to human-dominated ecosystems and from the exploitation of biodiversity. However, these gains have been achieved at growing cost in the form of losses in biodiversity, degradation of many ecosystem services, and the exacerbation of poverty for other groups of people (Millennium Ecosystem Assessment, 2005). The situation in Durban is no different to the global assessment and suggests that current policy, law, governance and environmental management efforts have been inadequate to prevent this degradation.

Virtually every terrestrial habitat in eThekwini has undergone significant levels of transformation and, as a result, every vegetation type requires some level of protection. KZN Sandstone Sourveld, North and South Coast Bushveld, and North and South Coast Grassland, in particular, are vegetation types that are significantly transformed and classified as endangered and require particular attention. Mangrove Forest, which is the primary reason for the proclamation of Beachwood, is Critically Endangered.

Habitat destruction (land transformation), invasive alien species and pollution are regarded as the greatest threats to biodiversity and associated delivery of ecosystem services. At present, a mere 14 % of the D'MOSS area is protected through appropriate conservation zoning, conservation services and land acquisition, whilst only 9.3 % is managed for conservation. Therefore, increasing the total area of D'MOSS that is protected and managed for conservation is critical if the biodiversity of eThekwini and its associated ecosystem goods and services is to be protected. This is an enormous challenge, considering the rapid urbanisation and transformation that is taking place, as well as growing threats, such as alien species invasion and climate change, but some gains have been made.

The river and estuary ecosystems of Durban are in a particularly poor state. The municipality found, in 2010, that 71 of 175 (40 %) of its monitoring sites on rivers were in poor condition and only six (just over 3 %) were classified as near natural. Rivers were

found to be experiencing multiple impacts, including spills and illegal discharges, solid waste dumping, wastewater treatment works not operating to specification or license conditions, sand mining, realignment of watercourses, flow reduction through dams, removal of riparian flora, and infestation by alien flora and fauna. In a survey of the condition of 16 estuaries in eThekwini, published in 2010, only three, together making up 10 % of the total municipal estuarine area, were classified as in good condition (none were classified as excellent). Because of the condition of the larger systems, such as the Mgeni and Durban Bay, a total of 50 % of the municipal estuarine area must be considered highly degraded. Expert opinion would suggest that, based on the current ecological condition of Durban's aquatic ecosystems, they are amongst the lowest ranked systems in the country.

Sand mining, both legal and illegal is having a major impact on aquatic ecosystems and, in particular, on the ability for rivers to replenish sand lost from beaches and coastal dunes through erosion processes. This sand is important for both the buffering of high seas and for making beaches attractive to tourists. Sediment yields have increased through poor land practices, but overall supply to the coastline has decreased by two-thirds of "natural" yields, due to sand mining and 12 large dams constructed on Durban's rivers, which act as sediment traps. This means that the reduction in sand supply could result in a mean erosion of greater than 1 m per year. The combined impacts of sea level rise and increased storms at sea are therefore likely to have severe consequences in terms of coastal erosion.

The areas particularly vulnerable to sea-level rise are coastal wetlands and dune ecosystems and therefore Beachwood Mangroves is likely to be under severe stress in the future.

In terms of current ecosystem values, the mangrove swamp serves as a nursery area for juvenile sport fish, such as the Spotted Grunter and the Ape Stumpnose. A number of smaller fish provide a source of fodder for the juvenile species. Naturally, birds follow the fish and the mangroves also become a haven for a large variety of bird species.

The leaves of the mangrove trees fall into the estuary waters and are, in turn, grazed upon by detrivores, such as crabs and shrimps. A chain of events, starting with grazing and ending with excretion, ensures that the organic material is converted to protein, which becomes a food source for the juvenile estuary fish, which in turn are preyed upon by the larger predators and, in due course, become the centre of attention for marine sports and the commercial fishing industry.

Another important use includes the Mgeni River Mouth, traditionally being an excellent source of building sand in the Durban region. In 1982, the river supplied more than 30 % of the Metropolitan region's sand requirements (Garland, 1998). Although there is an essential use for this river sand, one must guard against removing sand in regions which may lead to a change in the course or flow of the river, as well as associated tidal changes. Therefore, only sand that has been deposited at the entrance to the tidal channel, or in other areas causing a blockage, should be removed.

2.4.1 The National Protected Area Expansion Strategy

In an effort to address a lack of effective protection and representation of all vegetation types within the protected areas system, a National Protected Area Expansion Strategy (NPAES, DEAT, 2008) has been developed and approved at a national ministerial level. The purpose of the NPAES is to provide a national framework for the expansion and

consolidation of the protected area system, focussing on priority areas for representation and persistence of biodiversity.

The closest priority area in terms of the NPAES is well outside of Durban, towards the Tugela area. The areas around the Beachwood Mangroves are highly transformed and therefore not suitable for the expansion strategy.

2.4.2 The Provincial Protected Area Expansion Plan

The KwaZulu-Natal Protected Area Expansion Strategy identifies the Indian Ocean Coastal Belt as a high priority biodiversity area. However, there are no viable opportunities for further expansion of Beachwood Mangroves Nature Reserve, unless the Beachwood Golf Course becomes incorporated and managed as part of the protected area. At the public meeting in January 2013, it was mentioned that, perhaps, in the future, if Virginia Airport is closed, that land could be incorporated, via Beachwood Golf Course, but at this stage this possibility is highly unlikely. There is a small area north of Blue Lagoon, and adjoining Beachwood Mangroves, that is leased from the eThekwini Municipality, which has a cycle track on it, and there may be possibilities to extend the proclaimed area upstream in the Mgeni Estuary, but the practicalities of doing so and competition with other land uses may preclude this.

2.4.3 EIA Regulations in terms of NEMA

In terms of the National Environmental Management Act (No. 107 of 1998) Environmental Impact Assessment (EIA) Regulations, various activities require environmental authorisation before they may commence. In addition, in terms of Regulation RN.546, Listing Notice No.3, there are a number of activities that require environmental approval *specifically* as a result of their proximity to a protected area. The implication of this is that if any of the activities listed in Appendix D are proposed in the nature reserve, or within five kilometres of it, they will be subject to either a basic assessment or a full scoping and EIA process. A number of general activities, and those proposed for either tourism development or operational management within the nature reserve or the buffer areas, will thus require environmental authorisation.

The Dusi-uMngeni Conservation Trust (DUCT) is making an effort to restore some of the integrity of the Umsundusi and Mgeni River systems and one of the ways that they are doing this is to scrutinise all EIA applications that involve developments that may have an impact on the river system.

2.4.4 Local government planning mechanisms

In terms of the principles of cooperative governance, set out in the Constitution of South Africa, the different spheres of government are required to coordinate their actions with one another. In terms of the conservation objectives of a protected area, this is an important aspect in ensuring that appropriate land uses are applied in the areas around a protected area, as they may influence the operation of the protected area and the ecological functioning within it. On this basis, it is important to ensure that local government planning mechanisms, such as integrated development plans (IDP's), spatial development frameworks (SDF's) and municipal schemes, are aligned with the conservation objectives and principles of protected areas within their jurisdiction.

It is important that Ezemvelo KZN Wildlife, in particular the managers of Beachwood Mangroves Nature Reserve, work closely with the eThekwini Municipality in further developing these spatial plans. The focus of these efforts should be to ensure that inappropriate land uses, which may lead to impacts in the nature reserve, are discouraged in the buffer areas and in areas identified as national or provincial priorities for protected area expansion near the nature reserve.

The eThekwini Municipality developed an Integrated Development Plan, that was drafted in 2012, and will be reviewed on an annual basis. This is discussed in Section 2.7.

2.5 The history of the Beachwood Mangroves Nature Reserve

2.5.1 Origins of the name of Beachwood Mangroves Nature Reserve

There are no records of how the Beachwood Mangroves Nature Reserve acquired the name, except that it is located adjacent to the Beachwood Golf Course and there was a school, in Durban North, named Beachwood High School (since amalgamated with Northlands Boys High to form Northwood Boys High School). Much of the area around Durban historically had vast areas of coastal bush and forest and there are records of these sand dunes being flattened and bush being cleared for the construction of both the Durban Country Club and the Beachwood Golf Club (now under the control of the Durban Country Club). Presumably, the name was derived from the fact that there were "woods" on the beach.

2.5.2 History of conservation in Beachwood Mangroves Nature Reserve

Prior to the 1850's, the Mgeni River was connected to Durban Bay by a series of swamps and lakes (Edwards & Moll, 1971) and did not enter the sea at its present location. The Beachwood area was a series of swamps, extending as far north as La Lucia (10 km northwards along the coast). The mangroves in the original Durban Bay would have been key primary producers (Berjak, *et al*., 2011).

Since then, most of the area has been significantly transformed and a golf course, airport and housing cover most of the area, leaving only about 2.5 km along the beach in its undeveloped state, and this undeveloped area includes the Beachwood mangrove swamps, which is a small remnant of what was there historically.

Edwards and Moll (1971) postulated that the area of land now occupied by the Beachwood mangrove swamps was reclaimed from the sea by the following sequence of events, essentially as a result of flood action.

a) The transport of sediment from the former floodplain led to the formation of a sandspit at the new mouth of the Mgeni River. Local northward drift currents extended this sandspit parallel to the new coastline, possibly as far north as La Lucia.
b) Wave and wind action increased the height of the sandspit to above High Water Springs (H.W.S.) and dune formation followed. A long, shallow lagoon, stretching from the present mouth northwards, was formed as a consequence.
c) This lagoon was then infilled from the north by sand and silt transported by tidal action, and as a result of erosion of ground and transport by streams from the higher-lying land to the west.

d) Infilling in the northern regions became essentially complete, i.e. all land above H.W.S. In the southern section, the rates of sedimentation and scour by tidal action were more evenly balanced and the area remained low-lying, virtually all below H.W.S., until the late 1960's/early 1970's.
e) After that, the infilling process in the south accelerated, raising the mean elevation of the area substantially.

Up until the 1930's, the mangroves at Beachwood covered a small area, relatively untouched by man. Over time, the mangroves have expanded their coverage, but since the area was transformed by residential development and roadworks, the mangroves have been negatively impacted (Berjak *et al*., 2011).

In previous years, the area was used as a military base and had a shooting range facing the dunes on the seaward side. Historically, two areas were progressively stripped of sand dunes, i.e. at either end of the swamp, where there is road access to the beach. This was done by the City Engineers Department and others. In 1971, 9,000 cubic yards (just short of 7,000 m^3) of sand was removed to construct an all-weather horse training track at Summerveld, and a long, narrow spur of low dunes, that separated the estuary from the tidal creek, was consequently depleted. The sea subsequently washed over the depleted dunes, carrying sand into the estuary and closing the once broad tidal creek. To enable water to flow out of the swamp into the estuary, an artificial channel was dug further inland. As a result, the tidal influence in the swamps was reduced to almost nothing and the negative effects on the fish was quite dramatic (Edwards & Moll, 1971).

In the north, a large area of dunes was also removed and the flattened area became a parking area for fishermen. In some parts, the level of the area was reduced to below sea level and a stagnant salt water pool, fed by seepage, resulted. Subsequently, more sand was removed and the sea occasionally washed over the dunes, filling the pool (Edwards & Moll, 1971).

In July 1971, Edwards and Moll presented a paper at the Ecosystems Development (S_2A_3) Congress in Durban on the status and plan for the conservation of the Beachwood mangrove swamps. They stressed, in the introduction to the paper, that the mangrove community at Beachwood was one of the largest remaining in Natal. It was also one of the only estuarine and mangrove communities in relatively good condition in the province.

Two species of mangrove are common in the area and occur there naturally, namely *Avicennia marina* (White Mangrove), which is a pioneer mangrove in estuaries, and *Bruguiera gymnorrhiza* (Black Mangrove), which is found mainly on the seaward side of mangrove swamps. A third species, *Rhizophora mucronata* (Red Mangrove), was introduced to the nature reserve from Durban Bay in about 1976. This species fringes estuaries on poorly drained mud and tolerates prolonged flooding. It has branched stilt or prop roots to 2 m.

Two other species were introduced from Kosi Bay, namely *Ceriops tagal* (Indian Mangrove), which usually grows in estuaries on the landward side of mangroves and has roots emerging as knee roots, and *Lumnitzera racemosa* (Tonga Mangrove), which fringes mangrove swamps at approximately the high water mark and requires a sandy substrate. It has an erect stem, with buttress roots (Boon, 2010).

There are no records of why and when the three additional species were introduced, but one record that is available in an old management plan is that, in 1976, the first mass transplant of approximately 160 young trees and seedlings of *Rhizophora mucronata* (Red Mangrove) took place.

In May 1972, the Natal Wildlife Society reported that, with heavy rains, the swamp filled and the mangroves became inundated with fresh water. The water could not flow out freely and this resulted in about 75 % of the white mangroves (*Avicennia marina*) dying, since mangroves can withstand short periods of inundation, but prolonged flooding drowns them.

The mangrove whelk *(Terebralia palustris)* was introduced from Durban Bay, sometime after 1964, but the reason for this has not been recorded.

From 1972 to 1975, the presence of a causeway allowed access to the beach, but the southern part of the causeway was so high that it acted as a dam and thus restricted tidal flow to between 10 and 20 cm. Tidal fluctuations were also restricted by sand blown from unstable dunes into the creek and, during this time, mangroves were only flooded during the spring high tide.

On the 25 February 1976, the Beachwood Management Advisory Committee held their first meeting. The reason for the formation of the committee was to bring about actions, through negotiations with the relevant authorities, to ensure the conservation of the mangroves. It was decided that the area should first be declared a National Monument, and thereafter, the committee could go ahead with conservation measures, such as restricting public access, the erection of fences and the appointment of a guard in the area. It was decided that the Natal Parks Board would be the most appropriate body to administer the area.

In May 1977, the area was proclaimed a Nature Reserve, by virtue of its educational value and proximity to the main centres of education in Natal (now KwaZulu-Natal). This was an effort to protect the area from the pressures which formerly threatened it (such as reclamation, “Disneyland” developments, sand removal, etc.). At this stage, it was under the joint control of the Natal Parks Board and the Department of Defence. The area is now under the exclusive control of Ezemvelo KZN Wildlife (formerly the Natal Parks Board).

In July 1980, after many years of negotiations between the National Monuments Council, the Durban Corporation and the Department of Agriculture, Land Credit and Tenure, the Beachwood Mangroves Nature Reserve was declared a National Monument (Act No.28 of 1969, Proc. No.1461). Most of the credit is due to the Wildlife Society (now WESSA), who were instrumental in initiating the project. The declared area is bounded by the M4 Highway, Mgeni River, Indian Ocean and the Beachwood Golf Course.

In 1985, the Natal Parks Board obtained an additional triangle of land, adjacent to the southern tip of the nature reserve, from the city municipality. The land serves not only to conserve more mangroves and associated vegetation, but also to secure access to the area, and a portion is now also used as parking for visitors.

In 1997, a Beachwood Mangroves Liaison Forum was formed. Neighbours meetings are arranged with the Beachwood Golf Club, Oceanographic Research Institute (ORI), WESSA, Durban North Rate Payers Association, eThekweni Municipality and the local Conservancy.

In 1999, the Ezemvelo KZN Wildlife Regional Ecologist, North Coast, referred, in a memorandum, to a section of Beachwood Mangroves Nature Reserve that had previously been used to dump rubble. The rubble was subsequently used to form structures for the purposes of restricting or diverting high water flow. He suggested that the potential of the salt marsh was being restricted by the structures and recommended that they be removed, so as to enhance the flow of the water over the lower lying areas. In his opinion, the intervention would improve the potential of the boardwalk that was being set out at the time. There is no record as to whether or not this was done.

At present (2013), the situation is that increasing siltation in the estuary has resulted in an increase in *Avicennia marina* into the main estuary and, as the situation continues, could result in an extensive loss of habitat for wading bird species. The silt trap in the upper reaches of the swamp is not being adequately maintained by the municipality and the heavy rains of late 2012, early 2013 have aggravated this situation.

It must be noted that the Beachwood mangrove swamps is a highly dynamic system, changing by the year, and that these changes are caused by both weather/natural phenomena (rainfall in catchment, tides and storms) and the interventions of man.

2.5.3 History of eco-cultural tourism in the nature reserve

A committee has been formed, comprising members from the city of Durban, National Monuments Council, University of KwaZulu-Natal and WESSA. This committee has been instrumental in, amongst other things, obtaining sponsorship, studying problems in the swamps and compiling educational videos and books. The Umgeni Conservancy is primarily focussed on the conservation of the Mgeni River, but has also diverged to incorporate the mangrove swamps and have excelled in the organisation of events, such as bird walks and alien vegetation identification and eradication trips.

In terms of visitor facilities, the entrance to the swamps is enclosed by a bamboo catch fence, which is aesthetically pleasing as it blends well with the natural surroundings. Not only does it serve to enclose a portion of the nature reserve, but it also serves to catch sand and reduce sand drift from the parking area. The boundary between the highway and the nature reserve is fenced with razor wire, to prevent vagrants and fisherman from illegally entering the nature reserve.

The parking areas (both at the southern and northern entrances) have been levelled and are surfaced with ash. Gravel covers the surface of the parking area and the roads in order to minimise wash-off. Quarry is used to resurface the parking area, as the need arises.

There are two public entrance gates, one sliding gate at the main entrance and a pedestrian gate on the M4. There is a management gate at Rocket Hut, which is only used as a management entrance. None of the gates are manned and entrance for the public is only by appointment. A 500 m long road leads from the parking lot at the southern entrance to the staff accommodation, old shooting range and store rooms. The shooting range is no longer utilised, but both storerooms are. In addition, there is a 6 m container on a concrete slab, which is used for storage of management tools. A park-home is used as an office for the Officer in Charge.

Two stormwater drain outlets enter the nature reserve from the western side, bringing with them water runoff, laden with litter and silt from the urban area. In 1997, a maintenance

programme was re-established for the storm water and silt traps, with the silt and litter being monitored by Coastal Drainage and Engineering. The drains at Beachwood, in the south, and Rocket Hut, in the north, are being maintained and cleared of silt by the City Engineers. However, heavy rains throughout the latter part of 2012 and early 2013 have resulted in large quantities of silt being deposited, which has not been removed.

There is an education centre, ablution facility and kitchen near the entrance to the nature reserve. The education centre is a wooden building, raised on stilts above ground level, and houses educational display boards. There is also an open-air lecture space, adjacent to the education centre, which is a grassed area, encircled with a low wooden fence. The kitchen, built of concrete blocks, with a cement tile roof, has no equipment or facilities, except for running water and working surfaces. In February 2002, permanent braai facilities were sponsored and installed. All these structures are in support of the main visitor function of Beachwood Mangroves Nature Reserve, namely estuarine and mangrove swamp education.

There was, previously, a thatched bird hide on stilts behind the education centre, overlooking the river mouth. It was, however, demolished in about 2000 as it had begun to rot and was extremely unstable and the site was also prone to flooding.

A raised, 500 m long boardwalk leads from the open-air lecture space and winds along the creek and through the slightly less dense sections of the swamp and back, in a circular route. In so doing, it incorporates the three dominant ecosystems, namely the mangrove swamps, salt marsh and sand dunes. Visitors to the area are thus able to enjoy the experience and learn about the ecosystems, flora and fauna, without disturbing the natural habitat or getting covered in mud. This raised boardwalk has the added advantage of allowing visitors to view the swamps at both low and high tides. About half-way along, the boardwalk splits, with one fork crossing the creek for about 50 m, to allow visitors access to the beach. The other fork meanders through the mangrove trees and reaches the salt marsh.

2.6 Ecological context of the nature reserve

2.6.1 Climate and weather (http://www.ceroi.net/reports/durban/index.htm)

Durban has a humid subtropical climate, with relatively high rainfall, primarily falling in the summer months. The prevailing winds are north-east and south-west.

Daytime temperatures are typically between 18 and 26°C, with summer maximum temperatures reaching the lower thirties. Night-time temperatures seldom fall below 10°C, even in winter. Relative humidity levels are typically between 50 % and 70 %.

Durban lies within the southern subtropical high pressure belt, coming strongly under the influence of eastward migrating high pressure systems. Parallel winds dominate the coastline, with south-westerly and north-easterly winds roughly balanced in frequency. There is generally high wind variability.

2.6.1.1 Temperature

Temperatures in Durban are mild in winter and warm-to-hot in summer. The mean annual temperature is 20.4°C and the annual range is 8.0°C. Highest mean temperatures are experienced in February and lowest mean temperatures in July. The highest maximum temperatures occur in October, in association with Berg wind conditions. Temperature is

highly variable in any particular area of Durban as a result of topography, type of surface cover, and artificial heat production due to combustion activities in industries and motor vehicles. The presence of green areas, such as Beachwood Mangroves Nature Reserve, assists in mitigating the extremes.

Table 2.1: Monthly mean temperatures and temperature ranges at Durban International Airport

Month	Mean (°C)	Average of daily max (°C)	Average of daily min (°C)	Highest Max (°C)
January	24.4	27.8	21.1	36.2
February	24.6	28.0	21.1	33.9
March	23.9	27.7	20.2	34.8
April	21.7	26.1	17.4	36.0
May	19.1	24.5	13.8	33.8
June	16.8	23.0	10.6	35.7
July	16.6	22.6	10.5	33.8
August	19.9	22.8	12.5	35.9
September	19.3	23.3	15.3	36.9
October	20.4	24.0	16.8	40.0
November	21.8	25.2	18.3	33.5
December	23.4	26.9	20.0	35.9
MEAN	20.8	25.2	16.5	40.0

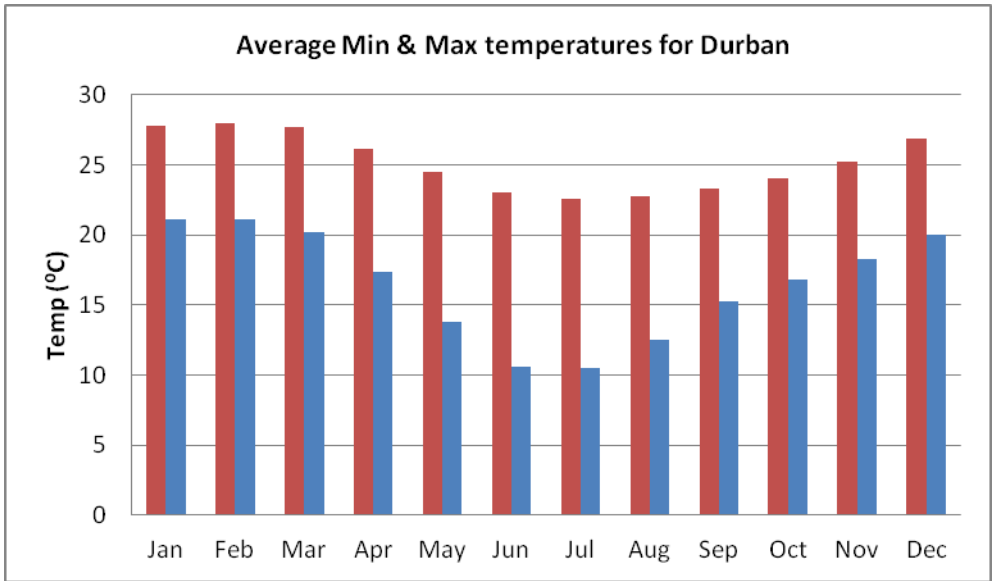


Figure 3: Average min. and max. temperatures (°C) for Durban from 1961-1990

2.6.1.2 Humidity

The relative humidity in Durban is usually fairly high, owing to the supply of moisture from the adjacent ocean. This is higher during summer months as warmer air can hold more moisture.

Table 2.2: Monthly mean relative humidity (RH) as % at 14:00 at Durban International Airport (1986)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RH (%)	70	70	68	65	61	54	56	60	66	69	71	69

2.6.1.3 Rainfall

The total annual rainfall in Durban is usually greater than 1,000 mm, of which the majority is received in summer. Approximately 60 % of the annual precipitation occurs between November and March and the driest month is July. The heavy summer rains can often result in flooding and landslides, causing damage to property and, sometimes, life. Fogs are absent and hail is rare.

Table 2.3: Monthly mean rainfall (mm) for Durban and the maximum experienced in 24 hours (1986)

Month	Mean	No. of rain days	Max. in 24 hrs
January	134	15	110
February	113	13	197
March	120	13	160
April	73	9	106
May	59	7	111
June	28	5	109
July	39	5	69
August	62	7	91
September	73	11	132
October	98	15	105
November	108	16	94
December	102	15	163
TOTAL	**1,009**	**130**	**197**

2.6.1.4 Sunshine

The amount of sunshine Beachwood Mangroves Nature Reserve (within Durban) receives is related to the amount of cloud cover. In winter, with the persistence of high pressure systems and cloud-free skies, Durban receives 60-70 % of possible sunshine. In spring and summer, this figure drops to 50 % of possible sunshine as cloud cover builds up.

2.6.1.5 Radiation

The receipt of solar radiation by Durban varies between seasons, ranging from 1.13×10^{7} $Jm^{-2}\,day^{-1}$ in June, to 2.14×10^{7} $Jm^{-2}\,day^{-1}$ in January. Many people in Durban are involved in outdoor recreational activities, which increases their exposure to harmful UV-A and UV-B radiation, potentially causing cancer and eye cataracts.

2.6.1.6 Wind

The prevailing wind directions of the KwaZulu-Natal coastal belt are predominately from the north-east and south-west. Winds from these broad sectors occur with frequencies in excess of 255 days a year. South-westerly winds are generally stronger and may be accompanied by rain. Mean monthly wind speeds are lowest in May and June. Highest mean wind speeds occur in September and October, a transitional period at the end of winter. Maximum wind speeds occur in the early afternoon (14:00) and minimum wind speeds between 06:00 and 08:00.

The so called “coastal low” is probably the best studied weather system affecting the coastline. Its formation is due to the interaction between large-scale atmospheric flow and

the marked South African escarpment. These systems propagate around South Africa, moving northwards in an anticlockwise direction, and are often associated with strong south-westerly gusts, termed "busters". Rare north-westers in spring bring short periods of hot, dry conditions.

Due to the latitudinal position of the region, it is influenced by both tropical and temperate weather systems. Intense frontal systems, combined with the poleward flowing Agulhas Current, can cause high energy swells along the coastline. Tropical cyclones are relatively rare, but events such as Demoina and Imboa, with the accompanying floods and gale force winds, have caused severe catchment and coastal damage.

Local land/sea breezes and topographically-induced circulations are also significant wind systems, in view of their effect on human climatic comfort and the dispersion or accumulation of air pollutants. Sea breezes, which are onshore north-easterly winds, blow for most of the day along the KwaZulu-Natal coast, particularly during the summer months. They strengthen the prevailing north-easterly gradient winds, which are associated with typical anticyclonic circulation. They ventilate the coastal belt, and because they are associated with unstable atmospheric conditions, they favour the dispersion of pollutants. Sea breezes are known to extend inland as far as Cato Ridge and could thus move pollutants, generated at the coast, inland.

Land breezes develop at night and blow offshore as a north-westerly wind. They are light winds (1-2 ms^{-1}) and develop in a stable atmosphere. They combine with topographically induced winds to produce mountain-plain winds. At night, cooling leads to the development of mountain winds, which blow down the longitudinal axes of the valleys. Under suitable conditions, these winds deepen during the night and overflow their interfluves, so that a sheet of cold, stable air now moves across KwaZulu-Natal towards the coast. This regional wind is known as the mountain-plain wind. It combines with the land breeze near the coast and so the offshore nocturnal wind at Beachwood Mangroves may be a very deep stable layer.

The implications for air pollution dispersion are very important. Pollutants released in the interior of KwaZulu-Natal may travel vast distances towards the coast and, because the air is stable, they are transported as thin fanning plumes, for considerable distances, without dispersion. By day, the circulation reverses and plain-mountain winds develop, which blow from the coast to the interior. They are frequently not as well developed as their nocturnal counterparts.

2.6.2 Topography

The terrain in Beachwood Mangroves Nature Reserve is generally level, but there are, in fact, three distinct zones:

1. Between the highway and the mangrove swamp. Land in this area is between 10 and 100 cm above high water springs (H.W.S.) and is not submerged, except during floods. Edwards and Moll (1971) estimated that at least 50 % of the area falls in this category.
2. The mangrove swamp region lying on either side of the central tidal channel. The elevation varies from H.W.S. to mean sea level in places. Elevation on the western side of the tidal channel was generally higher than that on the east (in 1971). Land in this zone is submerged at intervals, ranging from daily to monthly, depending on a few

centimetres difference in elevation. Edwards and Moll (1971) estimated that about 40 % of the area lay in this zone.

3. The tidal channel shows a very sharp drop in elevation, from the edge of Zone 2 to an elevation varying between mean sea level and L.W.S. (Low Water Springs). This is permanently under water, with the water depth varying from a few centimetres, to a maximum of 150 cm at H.W.S. Less than 10 % of the area is permanently under water.

Edwards and Moll (1971) recorded that the mean land elevation rose over the decade prior to their report (1960's), with an advance of Zone 1 into Zone 2, and Zone 2 into Zone 3, which has simplified the topography, with a number of small tidal creeks and large permanent pools disappearing. There have been changes since then, but as far as is currently known, they have not been recorded. An updated survey is required.

Between the mangrove swamp and the sea, there is a line of sand dunes, which attain a maximum height of some 10 m above sea level. The mangroves themselves occupy the gently sloping valley, running parallel to the sea shore, and border a tidal creek, which is 1 m wide in the north, historically widening to about 30 m in the south (Edwards & Moll, 1971), but now only about 3 m in width.

The topography of the lower-lying parts of Durban has been radically altered since the arrival of European settlers in the area, as a result of levelling of sand dunes and dumping and infilling of swamps and wetlands. Before the 1850's, the Mgeni River did not enter the sea at the present mouth, but was connected to Durban Bay by a series of freshwater swamps, extending as far north as La Lucia, some 10 km up the coast. Most of this has been silted up and was developed for housing, the Virginia Airport and Beachwood Golf Course (Edwards & Moll, 1971).

There is a layer of fine silt at the bottom of the valley in the nature reserve, which is about 1.5 m deep. This indicates that the valley floor has risen considerably. This silt was probably brought in by the Mgeni River when a combined flood and high tides, or a number of floods and high tides, pushed large amounts of silt-laden water into the swamp. This would then have settled out in the slow-moving water between the mangrove roots, thus raising the level of the valley floor (Edwards & Moll, 1971).

In the past, both ends of the mangrove swamps were stripped of sand dunes. In 1971, the City Engineers removed 8,000 cubic yards of sand to be used inland. This sand came from an area which separated the tidal creek from the sea by means of a long, narrow spur of low dunes. These dunes had prevented the sea from washing into the estuary. As a result of removal of this sand, the sea has subsequently washed over the remaining dunes, carrying sand into the estuary and blocking the tidal creek.

To enable water to flow out of the swamp into the estuary, an artificial channel was dug further inland. As a result, the tidal influence in the swamps was reduced almost to zero and there was a remarkable decrease in aquatic life. In the north, a large area of dune was similarly removed. In parts, the level of the area was reduced to below sea level and a stagnant salt-water pool, fed by seepage, has resulted. More sand has subsequently been removed and the sea occasionally washes over the dunes, filling the pool.

The mangrove area is about 2 km^2 (200 ha) and is rectangular in shape.

On 8 August 1984, a letter from the Natal Parks Board Assistant Director of Conservation to the City Engineer discussed the effects of spring tides on the nature reserve. The tides break through the primary vegetation and spread large volumes of sand into the central thicket of the mangroves, thus resulting in a choking effect. The Board was convinced that the single most important factor making the dunes vulnerable to tidal breakthrough was the continued use of off-road vehicles on the beach

The beach is eroded and sand enters the swamp through large breaks in vegetated dunes and blocks tidal creeks. This is particularly noticeable near the old shooting range, where the dunes are low and narrow.

2.6.3 Geology and soils

The mangrove substrate at Beachwood Mangroves Nature Reserve is mud or sandy mud, overlain locally by coarse grained sand where washover fans transgressed the foredunes during storm events. The development of the Beachwood mangrove swamps was associated with the mid-Holocene sea level of +1.5m msl, which incised the "Berea red sand" cliffs defining the western margin of the swamp.

Regression from the sea-level highstand led to coastal progradation that formed a series of low foredune ridges preserved north of the swamp, and confined the Beachwood creek's coast-parallel course. Exposure of organic-rich clays on the beach face during storm events shows that the back-barrier swamp was previously wider, and how the beach has narrowed and regressed inland (Cooper, 1988, 1993a). This change has been attributed to the construction of the groyne on the southern bank of the estuary mouth in the 1930's and the process of adjusting to a new equilibrium in the swash zone. Whereas the mouth position varied in the past, the effect of the groyne has been to alter the incident wave field and the mouth is now stabilised against the groyne. Construction of a causeway over the tidal channel, in the early 1970's, restricted tidal water flow and killed most of the *Avicennia marina* trees and mangrove animals. Removal of the obstruction and restoration of the tidal flow resulted in regeneration of the swamp community (Clarke *et al*., no date).

2.6.3.1 Description of soils

The soils in the nature reserve range from sandy clay loam, through to coarse sand (May, 1994; Maud, 1999).

Alluvium accumulating in the inter-tidal zone is composed of fine-grained particulate matter of both marine and terrestrial origin (Berjak *et al*., 1977). Silt and clay found in the swamp arises from deposition by the Mgeni River. During the rising high tides, the sea deposits sand and the calcareous remains of dead molluscs and other creatures and thus organically rich sediments are found in the southern part of the creek (Berjak *et al.*, 1977).

The bottom material of the Beachwood mangrove swamps was described by Brown (1971) as "fine textured mud with the surface substratum composed largely of faecal pellets of snails". As a result of the fine particulate nature of the soil, the substratum has a tendency to be waterlogged at all times and thus the need for the adaptations to anaerobic conditions that mangroves exhibit. Some aeration is however experienced during the ebbing of the tide, though this is only at the very surface of the soil (Berjak *et al.*, 1977).

The mud has an extremely dark appearance, due to the variety of hydrated ferrous sulphides, which are found in the soil as a result of anaerobic breakdown of organic matter by bacteria. Hydrogen sulphide releases a characteristic odour, which is noticeable when the soil is disturbed. The hydrogen sulphide is extremely reactive and thus has a tendency to reduce ferric iron compounds to hydrated ferrous iron sulphides in the soil (Berjak *et al.*, 1977).

Table 2.4: Percentage of heavy and light minerals found in soils in Beachwood Mangroves Nature Reserve

Heavy Minerals		Light Minerals	
Ilmenite	42.54%	Quartz	13.5%
Magnetite	14.57%	Feldspar	5.03%
Garnet	9.38%	Calcite	3.18%
Pyroxene	6.53%	Lithic Fragments	0.84%
Amphibole	2.51%		
Rutile	1.01%		
Zircon	0.67%		
Monazite	1.17%		

2.6.3.2 Issues affecting soils at Beachwood Mangroves Nature Reserve

i. Construction of dams

The urban centres, from Howick towards the coast, receive their water from the Mgeni system and the water demands on the system are very high. As a result, the Mgeni River has been fully developed, with the construction of four major dams, namely Nagle (1950), Midmar (1965), Albert Falls (1976) and Inanda (1988). To supplement the water supply in the Mgeni system, the last phase of the Mooi-Mgeni Transfer Scheme, namely the Spring Grove Dam, is in the final stages of construction, with the plan to commence inundation by March 2013. This will result in 4.5^3 m/s to be transferred to the Mgeni system on a continuous basis.

Dams have a significant effect on the functioning of a river system and the organisms associated with that system. Briefly, these effects are:

- Attenuation of flood events, thus disturbing a factor which is an essential part of river ecology.
- Prevention of migration of aquatic organisms.
- Blocking of natural flow of sediments downstream.
- Disturbance of water temperatures and oxygenation of the water.

Effects of the building of the Inanda Dam on sediment dynamics of the Mgeni River were studied (Garland, 1998; Garland & Moleko, 2000) and the following was observed:

- Sediment reaching the Mgeni Estuary has become much finer since 1998.
- There was no net accretion of loss of sand/silt in the Mgeni Estuary.
- Estuarine sediments were redistributed.

- An estimated 3.5 million m^3 per year of material, which would once have reached the lower Mgeni, is now trapped behind the dam.

In addition to stream flow reduction/alteration as a result of damming, soil erosion in the Mgeni catchment is fairly severe and the volume of silt carried by the river is high. It is noted that during the period 1958-1961, the silt load was estimated to be 70,000 tons per year (Garland, 1998). Deposition occurs due to the drop in the flow rate of the water entering the creek. The change in salinity also caused coagulation of suspended materials and significant volumes of industrial waste enter the system.

ii. Soil Physico-chemical characteristics

One of the mechanisms that mangroves trees use to control salt concentrations in their cells is to sequestrate ions to balance osmotic transmembrane potential (Liang *et al.*, 2008). Calcium ions therefore play an important role in the mechanisms of salinity tolerance in mangrove trees.

2.6.4 Hydrology

Freshwater flows into the swamps from the north from several seeps on the golf course, through the nature reserve, via the Beachwood creek, to the Mgeni River mouth. There is a major stormwater outlet at the northern Rocket Hut entrance that brings in fresh water from the Broadway area. The entire creek is tidally influenced. There are also three stormwater drain outlet pipes that flow from Durban North into the nature reserve (Edwards & Moll, 1971).

2.6.5 Factors influencing the ecology of Beachwood Mangroves

Mangroves in South Africa occur only in sub-tropical estuaries and only those that are predominantly or permanently open to the sea. This is because estuaries that close off for periods of time result in drowning of any mangroves that they may recruit. They occur in areas with warm coastal waters (Berjak *et al*., 2011).

Mangroves exist in, and depend on, the constantly changing and dynamic environment which characterises estuaries (Berjak *et al*., 2011).

The lower reaches of the Mgeni River are subject to high pollution levels from adjacent heavy industry and there have been catastrophic events in the past, such as an oil spill in 1971, that have had major effects on the estuary. Fortunately, many of these pollutants don't reach the Beachwood Creek and the area thus has potential to serve as a haven for organisms, which can then repopulate the estuary after effects of these events have dissipated.

Apart from the presence of pollutants in general, *Escherichia coli* counts in the estuary are generally low. Presence of *E. coli* is a general indication of the extent of faecal pollution of water.

The aquatic zone covers less than 10 % of the surface area of the nature reserve. Nevertheless, a wide variety of habitats are found there. The important factors to be considered in an aquatic environment are salinity, turbidity, oxygen concentration, tidal influence, water depth and type of substrate. In an estuary, an additional factor is the size

of the connecting link to the sea. These factors interact with one another, in a complex manner, to determine the distribution and variety of species. Each will be discussed briefly, prior to discussion of individual taxa, in order to set the context (Edwards & Moll, 1971). The effects of these factors on each taxon will be discussed within the relevant sections.

2.6.5.1 Salinity

Salinity varies from 35 ppt at the mouth of the Mgeni River, to zero in the freshwater streams and wetlands. The salinity immediately above the bridge over the tidal creek, leading to the swamp, drops because of a salinity gradient. At Rocket Hut, the water in the Beachwood creek is virtually fresh, and is inhabited by the alien swordtail and guppy fish.

2.6.5.2 Turbidity

In general, the name for the Mgeni Estuary, the Blue Lagoon, is a misnomer. The estuary is mostly quite turbid because of erosion in the catchment and pollution in feeder streams near Durban.

2.6.5.3 Oxygen concentrations

The main source of dissolved oxygen in the Beachwood Creek is the well oxygenated sea water brought in by tidal movement. There is virtually no photosynthetic production of oxygen by aquatic plants as these are absent.

2.6.5.4 Substrate

The type of substrate available determines the variety and extent of bottom-dwelling flora and fauna. Many species will colonise only firm, sandy substrates, while algae usually requires a rocky substrate. The type of substrate found in the system includes sand, silt and the root systems of mangroves.

Sandy substrates are mostly found only in the lower estuary, where tidal currents are sufficiently strong to remove the covering layer of silt. Unfortunately, this is not suitable for colonisation, as moving sand is unsuitable for the establishment of plant and animal life.

The substrate supporting the most life is the marginal fringe of mangrove roots. These provide shelter for many of the sedentary species of fish, crustaceans, molluscs and small invertebrates. About 40 % of the adult fish species recorded in the area, and the juveniles of most other species, find shelter and food here. In addition, the mangrove roots are often covered by algae, which may provide food for some of the animal species.

2.6.5.5 Tidal effects

The difference between high and low tides on the Durban coast is about 1.5 m. Because the Mgeni Estuary has a very narrow link with the sea, and there is also a fairly strong inflow of river water, the tidal variation in the estuary is only about 0.4 m. In addition, the natural tidal channel, leading from this point to the swamps, was completely silted up and a new channel, about 1.5 m wide and 20 cm deep, was dug to replace it. Consequently, tidal rise and fall in the swamps varies from a few centimetres in the south, to virtually nothing in the north. This is having significant negative impacts on the health and functioning of the mangrove swamps and many organisms within it.

2.6.6 Vegetation

The Beachwood Mangroves Nature Reserve is located within the Indian Ocean Coastal Belt, as defined by Mucina and Rutherford (2006). This is an almost 800 km long coastal strip, between the South African border with Mozambique, extending as far south as the mouth of the Great Kei River, near East London. It is a climatically, ecologically and biogeographically peculiar region that, they have argued, deserves to stand on its own, at the level of a Biome, within the scope of the South African vegetation. It is characterised by a regional concentration of endemic species. Whilst the northern landscapes are flat, the southernmost landscapes are characterised by elevated plateaus, separated by deep gorges associated with major river valleys.

According to Mucina and Rutherford (2006), the nature reserve can be divided into three vegetation types:

1. The greater part of the nature reserve is part of a Subtropical Coastal Lagoon (W2), which includes a complex of Mangrove Forest (FOa3) and subtropical Estuarine Salt Marsh (AZe3).
2. The seaward edge of the nature reserve consists of Subtropical Seashore Vegetation (AZd4), grading into patches of East Coast Dune Forest (FOz7).
3. The landward edge, and patches of a thin strip between the Seashore Vegetation and the lagoon, is KwaZulu-Natal Coastal Belt Grassland (CB3), with patches of freshwater wetlands.

These will be discussed in turn (the bulk of the discussion being taken directly from Mucina and Rutherford, 2006, unless specifically indicated otherwise):

SUBTROPICAL COASTAL LAGOONS (Mucina & Rutherford, 2006 - W2)

The conservation status for Subtropical Coastal Lagoons (KZN Vegetation type code 55) is Least Threatened (Scott-Shaw and Escott, 2011).

The lagoon consists of a) Mangrove Forest (FOa3) and b) subtropical Estuarine Salt Marsh (AZe3).

In terms of plants within the water, no submerged plants are present in either the swamps or the clean fresh water streams entering the tidal creek, and two common estuarine angiosperms, *Zostera* and *Ruppia,* are absent. The reason that the streams do not have these plants is probably because of the comparatively short courses, rapid currents and unstable substrate, and the reason that the lagoon does not have them is probably because of the high turbidity. However, the edges of the streams are thickly overgrown at their edges with a variety of plants and, in certain places, salt tolerant rushes and reeds (*Typha capensis*, *Phragmites australis* and others) fringe the edge of the tidal creek. The mangrove root systems provide practically the only vegetation cover in most of the area (Edwards & Moll, 1971).

Water hyacinth (*Eichornia crassipes*) has been recorded in the mangroves in the past and it is, in fact, a major problem in the lower reaches of the Mgeni River. In the extreme north of the nature reserve, water conditions are sufficiently fresh for *Vallisneria spiralis* (Eelgrass) and the alien, *Salvinia molesta* (Kariba weed), to develop.

Edwards and Moll (1971) report that the only algae found in any quantity is the seasonal occurrence of sea lettuce, which usually blooms briefly in the winter months when the combination of low river flows and high spring tides brings relatively fresh water into the estuary and turbidity is low. However, Berjak *et al.* (1977) contradicts this and reports that red algae may be found encrusting the pneumatophores, knee roots and prop roots of the various mangrove trees. These reports were done at different times, which may explain the apparent contradiction. This will be discussed in more detail later in this section.

MANGROVE FORESTS (FOA3)

The conservation status of Mangrove Forests (KZN Vegetation Type Code 67) is Critically Endangered (Scott-Shaw & Escott, 2011).

General description of Mangrove Forests.

Mangrove Forests are distributed on the east coast, all the way from Tropical East Africa in the north, as far south as the Kobonqaba Estuary in the Transkei, which is the highest latitude with extant mangroves in the world. They are always located at low altitudes around sea level, in tidal zones of warm coastal lagoons and estuaries. Mangroves are usually only found in the tropics as they need consistently warm conditions for development and survival. They do sometimes occur outside the tropics, where there are warm ocean currents, so it seems that the distribution of mangroves is related more strongly to water temperature than air temperature (Berjak *et al.*, 2011).

Mature mangrove communities are commonly known as mangrove swamps because the terrain is periodically inundated and in most zones the substratum is waterlogged at all times (Berjak *et al.*, 2011).

Mangroves of the east coast of South Africa are not typical because they are sub-tropical. They lack the richness of growth that characterises the mangroves of the true tropics. In addition, there is great variety in characteristics between different communities along the South African coast. The major difference is the gradation of luxuriance between the northernmost and southernmost populations. This is reflected both in the extent and density of tree growth and variety of tree species present and the range of associated plants and animals, with the highest density and greatest variety in the north at Kosi Bay (Berjak *et al.*, 2011).

Mangroves occur below the high water mark of the spring tides and at a point close to, but somewhat above, mean sea level. They occur in sheltered estuaries and tidal flats, built by recent sediments caused by accretion of river-borne sediments, to which material brought in from the sea with the rising tide is added. The soils are poorly drained and anoxic, fine grained and rich in organic content, derived from decomposing plant debris. Mangroves depend on a soft, muddy substratum for initial propagation and subsequent perpetuation of tree seedlings (Berjak *et al.*, 2011).

Within this intertidal belt, the substrate is flushed regularly by seawater. However, there are variations in the pattern of inundation, according to the position of the trees: the extreme upper level experiences flooding bimonthly (during spring tides), whereas the lower levels are flooded approximately twice daily, i.e. at every high tide. The upper levels experience conditions that are far harsher than those experienced in the lower levels. This

is as a result of the evaporation that occurs between tidal flooding and which causes a concentration of sea-salts on the surface layer of the soil (Berjak *et al.*, 2011).

Mangroves are Critically Endangered (Mucina & Rutherford, 2006), with much of the original extent of mangroves in South Africa being lost through harbour development (Durban and Richards Bay), clearing for development (Durban), or through becoming degraded as a result of unfavourable agricultural practices upstream of the rivers feeding into the estuaries.

Mangrove Forests are species-poor and often monospecific forests, consisting of low and dense forests of mangroves, with fringing thickets of *Hibiscus tiliaceus* and *Acrostichum aureum*. Mangroves are trees and shrubs that grow in tidal and saline coastal areas and are thus halophytes (salt-resisting). High tides submerge their aerial roots and lower stems, but they can be exposed for several hours at low tide. They are intolerant of prolonged flooding, with either fresh or saline water that covers their roots, because this restricts exchange of gases, especially oxygen. The stems and roots provide large surface areas for colonisation by small organisms, which, together with leaf litter, supply energy and nutrients for other species (Breen & McKenzie, 2001). The range of salt tolerance varies according to the species and variation in the salinity of mangrove soils is an important factor influencing the occurrence of particular species in the different zones of the mangrove area (Berjak *et al.*, 2011).

In terms of species associated with Mangrove Forests, *Avicennia marina* (White Mangrove) and *Bruguiera gymnorrhiza* (Black Mangrove) are the most common and widely distributed in KwaZulu-Natal. *Rhizophora mucronata* (Red Mangrove) is less common and does not extend as far south, whilst *Lumnitzera racemosa* (Tonga Mangrove) and *Ceriops tagal* (Tagal/Indian Mangrove) occur in highly localised spots in the northernmost parts. Although *Ceriops* is the rarest species in South Africa, it is widely distributed in the Indo-West-Pacific region. *Lumnitzera* is not the rarest, but is the most obscure because it favours the upper tidal reaches of the mangrove zone and seems to have particular substrate requirements; namely, sandy, well-drained soils, which is unique for a mangrove species (Berjak *et al*., 2011).

Despite the fact that mangroves can cope with high salinity, a stage may be reached when salt levels become too high and this will inhibit the growth of the vegetation. The trees themselves contribute to the increase in salinity because simple evaporation is augmented by transpiration through the plants themselves. Fresh water is therefore an essential requirement in the development and maintenance of mangrove communities. The amount of freshwater to be supplied to the system should equal or exceed that which is lost from the substrate so that salinity is kept at moderate levels (Berjak *et al.*, 2011).

Because of the freshwater requirement and because mangroves need shorelines protected from strong wave action, they establish well around the edges of stream-fed marine bays and inlets, and on riverine deltas and tidal estuaries. In these situations, the periodic inundation with sea water at high tide is alternated with fresh water flushing at low tide. All living communities are subject to environmental variations and are always adjusting to them, but a mangrove swamp adapts in a variety of ways to many different transitions (Berjak *et al.*, 2011).

The initial process of Mangrove Forest succession begins when sandy alluvial deposits are overlaid by silt and clay. These deposits are stabilised by the growth of *Avicennia marina*,

whose seedlings become firmly established almost immediately as they germinate. Roots of the *Avicennia* serve to hold the silt so that it is less likely to be removed with the flow of the water. In this way, the silt is able to accumulate and provide a suitable substrate for further development of the mangroves. The mangrove roots also allow deposition of the smaller particles that are carried in suspension by the water. Therefore, although some initial salt deposition is necessary for mangroves to establish, mangroves also assist in the deposition of alluvium. In some areas, the deposition can be so considerable that the mangrove community constantly advances into the water and effectively reclaims land from the sea (Berjak *et al.*, 2011).

Uniform stands of *Avicennia marina* appear and are maintained until the addition of fresh sediment brings about sufficient change to support other species. They have salt glands that secrete salt and have an extensive underground root system, with pneumatophores or breathing roots ("pencil roots") sticking up out of the mud. They are found in more exposed sections on either side of the creek.

Black mangroves (*Bruguiera gymnorrhiza*) are later successional species, colonising swamps pioneered by *Avicennia marina,* and are usually found on the slightly higher lying ground on either side of the White Mangroves. They require a fairly stable substrate, and protection from direct sunlight, to establish. Once established, they eventually replace *Avicennia* since *Avicennia* seedlings do not survive long in shade. They have straight stems, with buttress bases, and the roots emerge from the mud as knee roots (Boon, 2010). In young Mangrove Forests, the presence of *Bruguiera* can give a good indication of the age of the forest (Berjak *et al.*, 2011).

Rhizophora is the most important and widespread of mangrove genera in the world, but *Rhizophora mucronata* is the only one of its genus in South Africa and is not as common as *Avicennia* and *Bruguiera* in the region. They are abundant in large, mature swamps, but are rare in small swamps and those in early stages of colonisation (Berjak *et al.*, 2011).

At one time, there was concern that there were areas or "hot spots" within the dense Beachwood swamp where White Mangroves were dying. Reasons for the death of these trees were unclear. It was proposed that algae could be attacking the trees. It was only on a boat trip up the creek that the Officer in Charge was able to observe regions of the swamp, which are not visible from the boardwalk, and are inaccessible by foot. Observations from this trip indicated that the reason for the death of some of the White Mangroves was purely as a result of the process of succession. In fact, it was an indication that Black Mangroves were starting to replace the White Mangroves, which is not an issue of concern. It is for this reason that one is able to find areas within the swamp where Black Mangroves occur exclusively. However, in recent times, the extent of White Mangroves into the main estuary has increased as a result of increased siltation and this is potentially a negative issue in terms of compromising habitat for wading birds.

Adaptations of Mangroves to their environment.

It must be noted that trees and shrubs which are the dominant life forms in the mangrove community are classified as mangroves or mangrove trees and, although they share many highly specialised features in common, there is no systematic or taxonomic relationship linking them.

i. Salinity

Four principle adaptations enable mangrove trees to survive saline environments, namely:

- The first line of defense for many mangroves is to prevent much of the salt from entering by filtering it out at root level, whilst taking in water. Some species can exclude more than 90 % of salt in seawater. This mechanism has the effect of increasing the salinity around the roots, which affects other organisms. Therefore, mangrove trees are architects of their own local environment, in addition to simply responding to its parameters.
- Another method is to secrete salt through the use of special glands on the leaves of the tree (*Avicennia marina*). This has been shown to be among the most active salt-secreting systems known. This mechanism, however, usually comes with a high metabolic cost.
- Structural adaptations to reduce water loss due to the extreme saline environment are also common to all mangroves. Leaves with thick, waxy cuticles and stomata found only on their lower surfaces, are examples of such modification.
- Finally, salt can, in some instances, be sequestered within special cells and is concentrated in bark or old leaves, far away from sensitive metabolic processes that could be disturbed by high salt concentrations.

In reality, many mangrove species use a combination of all of these mechanisms.

ii. Waterlogging

The principle issues with waterlogged soils are the lack of oxygen for respiration (anaerobic soils) and the unstable growth substrate that they present. In such unstable, sometimes semi-fluid soil, an extensive root system is necessary simply to keep the trees upright. As a result, most mangroves have more living matter below the ground than above it. The main mass of roots, however, is generally within the upper 2 m of the soil and mangroves don't seem to grow tap roots, probably because of the poor oxygen supply below the surface.

In the saturated soil, which has little or no oxygen, soil micro-organisms switch to other electron acceptors in order to break down carbohydrates and create energy. These anaerobic reactions yield a variety of potentially toxic compounds. In marine soils, however, the most toxic compound produced is hydrogen sulfide. The toxicity of hydrogen sulfide is considered to be equal to that of hydrogen cyanide, and very small quantities of this phytotoxin can completely inhibit the aerobic respiration of plants and animals.

In order to adapt to the often-anoxic soil environment, mangrove trees have developed a number of solutions. One of the most widespread mangrove genera, *Rhizophora*, adapts to such conditions by keeping the root mass above the mud surface, surrounded by air. The stretches of these aerial roots carry numerous gas-exchange pores (lenticels), whereas the underground portions are honeycombed with air-filled spaces. This air-filled tissue, aerenchyma, is also a feature of *Avicennia*, whose roots are horizontal and close to the surface.

Avicennia, and several other mangrove species, respire by growing numerous pencil-like pneumatophores, which protrude above the mud surface and allow gas exchange with the underground tissues. This exchange creates an oxygenated rhizosphere that also affects the

edaphic properties of the soil on a microhabitat scale. Leakage of oxygen from the plant roots creates a buffer zone in which toxic, reduced compounds, such as hydrogen sulfide, can be oxidised. Not only is this beneficial for the tree itself, but it has implications for the infauna assemblage (animals living in the sediments of the ocean floor or river or lake beds) that can survive in this zone. Thus, this is another example of how mangrove flora can act as an architect of its own local environment, and not only respond to the parameters around it.

iii. Reproduction (http://www.ecology.su.se/JN/TV/mangrove_text/m_adap.htm)

Many mangrove species show some form of vivipary. Contrary to popular belief, *Avicennia* does not, but *Rhizophora* is one example that does. The ovum is fertilised while still on the parent tree and grows by combination of photosynthesis and acquisition of nutrients from the parent, until it may reach a length of 50 cm. This structure, which is neither a seed nor a fruit and hence usually termed a propagule, then falls to the ground. The propagules of some species root almost immediately, but others appear to have an obligatory floating period before they sink and establish themselves.

The majority of floating propagules probably settle close to the parent, but long distance dispersal is also possible. Floating mangrove propagules may remain viable for a month or longer; depending on current speed and direction they could travel a considerable distance. This great dispersal ability can explain why the mangrove species, *Rhizophora samoensis,* (which is native to Samoa and some adjacent islands) is found at the opposite extremity of the Pacific Ocean from Central America, the habitat of its presumed ancestor, the species *Rhizophora mangle*.

Long-distance seed dispersal mechanisms are also vital when mangrove areas are subject to large scale disturbances, rendering the chances of self-seeding to minimal (due to mass mortality in the affected ecosystem). "Source and sink" mangroves can be discussed in this context. Source mangroves are very important for genetic exchange between populations and providing propagules for recolonisation and reorganisation following a disturbance in a "sink" mangrove area.

Other plants associated with Mangroves.

Algae

Red algae may be found encrusting the pneumatophores, knee roots and prop roots of the various mangrove trees (Berjak *et al*., 2011). The red algae is mostly from the *Bostrychia, Catanella, Caloglossa* and *Murrayella* genera (all collectively known as *Bostrychietum).* They have a tendency to occur in abundance in certain areas of the sea side of the mangroves (in particular, on the outskirts of the swamp). They grow on the root breathing system of the trees (pneumatophores) and, in so doing, clog the lenticels and inhibit gaseous exchange (Berjak *et al*., 2011).

Marine algae are sometimes found at the edge of the mangroves, as well as in areas where there is a frequent and regular flow of salt water. A few species of the simple green algae (*Chlorophyta*) may be found on the surface of stable silt, as well as on the aerial roots and lower parts of the trunks of the smaller trees.

Other tree species

Clumps of *Hibiscus tiliaceus* (Lagoon Hibiscus), *Barringtonia racemosa* (Powder Puff Tree/Brackwater Mangrove) and *Chrysanthemoides monilifera* (Bush Tick Berry) scrub occur in the upper reaches of the swamp, where there is sufficient inflow of fresh water. They are only able to withstand occasional inundation by sea water. Because of the ample inflow and flushing, the upper reaches, where they occur, seldom dry out and thus do not become increasingly salty; instead the area becomes diluted or desalinated. Both *H. tiliaceus* and *B. racemosa* are neither littoral plants proper, nor fully terrestrial or freshwater requiring by nature.

Hibiscus tiliaceus belongs to the family Malvaceae. It is sometimes referred to as a fresh water mangrove, although it is not a mangrove. The species favours wetter soils and has a fairly strict requirement for brackish water. The tree can reach a height of 5 m and has a bushy appearance (Berjak *et al*., 1977). Both *Hibiscus tiliaceus* and *Chrysanthemoides monilifera* are resistant to salt spray. *H. tiliaceus* may overlap markedly with the landward fringes of the mangrove swamp.

Mangroves and animals

The habitat provided by mangroves, with their muddy waters, nutrients and decaying leaves and wood, are home to worms, crustaceans and molluscs and provide shelter for reptiles, birds and mammals, which, together with plants, make up a unique and complex system (Berjak *et al*, 2011. Animal diversity in mangroves is higher at lower latitudes and also higher in the Indo-West-Pacific Region than the Atlantic Region. The fauna is composed of micro- and macroscopic terrestrial and aquatic (marine and freshwater) temporary and resident species.

SALT MARSHES (Mucina & Rutherford, 2006 - AZE3)

The conservation status for subtropical Estuarine Salt Marsh is not listed by Scott-Shaw and Escott (2011).

Wherever open spaces occur in the upper tidal reaches of a mangrove swamp, Salt Marsh plants are quite likely to be found and this does occur at Beachwood. These are herbaceous flowering plants, many of which are conspicuously succulent, with bushy or long trailing stems. Like mangrove trees, they are halophytes and thus have adaptations for salt resistance; however, they are not extreme halophytes. However, Salt Marsh species cannot tolerate the very close proximity to the sea shown by many mangroves and are usually too small and fragile to survive frequent and deep tidal floodings. These plants are also better adapted to the drier tidal zones as they have modifications which enable them to take up only a very little amount of water and conserve the amounts that they do actually take up. Plants found in the Salt Marsh require large amounts of sun and do not grow very well in the shade. Because the mud in these regions is extremely saline, and becomes relatively desiccated between floodings, trees are widely dispersed and there are large patches of open land (Berjak *et al*., 2011).

Typical Salt Marsh species are members of the genus *Sarcocornia* and *Salicornia* (family: Chenopodiaceae), both of which have succulent stems and insignificant leaves. Other species found in salt marshes include *Chenolea diffusa* (also Chenopodiaceae) and *Sesuvium portulacastrum* and both of these species have succulent leaves (Berjak *et al*., 2011).

Throughout the world, salt marshes have experienced a long history of destruction and alteration by human activities. Filling, dredging, ditching, impounding and draining, as well as pollution, have greatly reduced the total area.

Reduction in freshwater input, due to freshwater withdrawal from an estuary catchment, results in an increase in salinity and loss of species preferring brackish habitats (e.g. *Juncus kraussii*, *Cotula coronopifolia*). Freshwater reduction can also reduce the frequency and duration of open mouth conditions in temporarily open/closed estuaries. This can lead to the loss of intertidal species, such as *Sarcocornia perennis* complex and *Spartina maritima*. Prolonged closed mouth conditions, and an increase in water level, can lead to loss of those species sensitive to submerged conditions. Too much freshwater may eliminate the Salt Marsh community.

SUBTROPICAL SEASHORE VEGETATION (Mucina & Rutherford, 2006 - AZD4)

Subtropical Seashore Vegetation is given the KZN Vegetation Type Code of 68 by Scott-Shaw and Escott (2011) and is classified by them as Least Threatened.

A strip of dune vegetation is found on the seaward (eastern) edge of the nature reserve. This consists of pioneer dune species, such as *Scaevola plumieri*, an evergreen, succulent shrublet, which is one of the most important pioneers of a dune plant community. Wind-blown sand builds up against young *Scaevola* plants and a line of baby dunes is started just above the high spring tide mark. The plants continue to grow, branching and sending out roots in all directions and more and more wind-blown sand piles up around them, sometimes burying them temporarily – temporarily because burial stimulates *Scaevola* to grow more vigorously and its shoots soon emerge above the sand again, while its roots and buried stems help to stabilise the dunes, which therefore steadily increase in height (Hennessey, 1974).

In addition to mechanical building of the dunes, these plants contribute to the process of soil formation by adding organic matter (leaves, etc.) to the sand. The physical presence of the dunes creates shelter from salt-spray laden winds in their lee and the combination of more shelter and more stable and better soil allows other plant species to become established. The first line of dunes near the coast is populated by the pioneer species and successive rows of dunes carry more and different species. Initially, the first row of trees are dwarfed and have a shrubby growth form, usually not exceeding 2 m in height, and are referred to as dune scrub. The scrub zone is succeeded by forest. The forest usually contains the same tree species that are present in the scrub, but they are accompanied by many other tree species, as well as climbers or lianas (Hennessey, 1974).

The dune community, all the way from the pioneers to the climax forest species, play an enormously important role in creating and maintaining a stable environment along the shore line. Without this community, there would be no protection from damaging on-shore, salt-laden winds, which only dune plants can tolerate, and nothing to prevent wind-blown sea sand from being blown inland and from blocking the mouths of rivers.

In the case of the Beachwood Mangroves Nature Reserve, the scrub zone contains species such as *Eugenia capensis* and *Passerina rigida*, and in more sheltered areas, there are small patches of dune forest (Edwards & Moll, 1971), which is typically species rich as opposed to the Mangrove Forest. Dominant species in Coastal Dune Forest will be *Mimusops caffra*

(Coastal Red Milkwood) and *Sideroxylon inerme* (White Milkwood), with other characteristic species, such as *Acokanthera oppositifolia* (Dune Poison Bush), *Allophylus natalensis* (Dune False Current), *Aloe thraskii* (Dune Aloe), *Brachylaena discolour* (Coast Silver Oak), *Chaetachme aristata* (Thorny Elm), *Chrysanthemoides monilifera* (Tick Berry), *Cola natalensis* (Coshwood), *Cordia caffra* (Septee), *Deinbollia oblongifolia* (Dune Soap Berry), *Dracaena aletriformis* (Large-leaved Dragon Tree), *Euclea natalensis* (Natal Guarri), *Eugenia capensis* (Dune Myrtle), *Ficus Burtt-davyi* (Veld Fig), *Pavetta Revoluta* (Dune Bride's Bush), *Strelitzia nicolai* (Natal Wild Banana) and *Strychnos decussata* (Cape Teak).

The importance of the vegetated sand dunes on the coast cannot be over-emphasised as they perform the following functions (Branch & Branch, 1981; Garland, 2003).

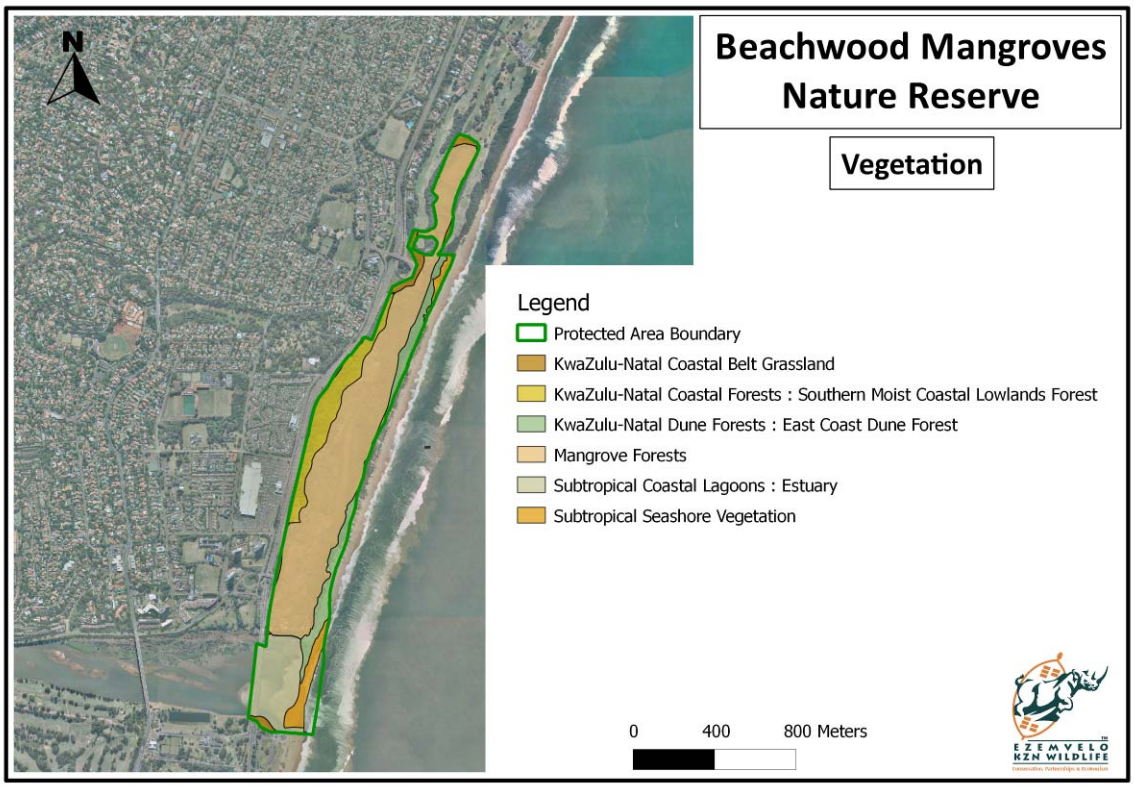
- Prevent excessive erosion of dune sands by wind and water. They also act as reservoirs of sand, which replenish beaches when they are eroded by high seas.
- Act as a biodiversity reservoir, having plant and animals species often no longer found beyond the protected area.
- Provide a screen against the potential impact of corrosive onshore winds on landward vegetation and property owners.
- Are an aesthetically pleasing backdrop to the beach. The presence of an intact dune plant community gives one the feeling of entering a "wild" environment, which is severely contrasted with that created by the presence of coastal dwellings and other developments right on the beach.

Stormier periods can result in beach erosion, or even total removal of the beach, in which case, the base of the mobile dune system may also be attacked and eroded by waves. There is a constant cycle of destruction and accretion, which can be influenced by sea level drops or rises, storm events, rip currents and sand deposits from rivers and estuaries (Branch & Branch, 1981; Garland, 2003).

The frontal dune, or foredune, acts as a barrier protecting inland areas and retaining sand on the beach by both trapping sand blown up from the beach, and returning sand to the beach in times of erosion (Branch & Branch, 1981; Garland, 2003).

KWAZULU-NATAL COASTAL BELT GRASSLAND (Mucina & Rutherford, 2006 - CB3)

This consists of a long and, in places, broad coastal strip along the KwaZulu-Natal Coast. This vegetation type is highly transformed (about 50 %) and is affected by a mosaic of very extensive sugar cane fields, timber plantations, urban sprawls, roads and coastal holiday resorts, with interspersed secondary *Aristida* grasslands, thickets and patches of coastal thornveld. It is recorded as KZN Vegetation Type Code 29 and its conservation status in KwaZulu-Natal is Critically Endangered (Scott-Shaw & Escott, 2011) and, apart from the tiny area in Beachwood, only a very small part is statutorily conserved in Umhlanga Lagoon, Ngoye, Mbumbazi and Vernon Crookes.



Map 3: Beachwood Mangroves Vegetation

2.6.7 Fire regime

No burning takes place at Beachwood Mangroves, but firebreaks are cut near the M4 and around infrastructure.

2.6.8 Invasive vegetation

Invasion of alien species is one of the major problems faced by the protected area. Problematic alien plants in the nature reserve include both terrestrial and aquatic plants.

Water hyacinth (*Eichhornia crassipes*) is the most important aquatic alien plant species in the upper reaches of the Mgeni Estuary. This species is a declared weed in South Africa, according to the Conservation of Agricultural Resources Act, and must be controlled accordingly.

The presence of water hyacinth also increases water treatment costs and places infrastructure (e.g. road bridges) at greater risk in times of flooding. Its presence decreases recreational opportunities, particularly fishing and water sports, as it impacts on aquatic life and blocks the path of water craft.

Water hyacinth has been recorded in the mangroves themselves in the past. It does not actively grow in the nature reserve, but mats of water hyacinth are washed down the Mgeni River during periods of high flow/rainfall, where they may enter the nature reserve via the Beachwood Creek.

A more recent and serious threat is *Sagittaria platyphylla* (Elliptic-leaf [Slender] Arrowhead), found in the creek at the Rocket Hut entrance. This plant is found naturally in the eastern USA, Mexico and Central America. It is an aquatic, herbaceous plant, rooted to the ground, with stems and leaves emerging up to 80 cm above the water surface. Plants may sometimes become detached from the substrate to form floating mats of vegetation near the water surface. It has been introduced on many continents as an ornamental plant. It is a weed of waterways, marshes, drainage ditches, irrigation channels and rice crops in warmer temperate, sub-tropical and tropical environments and spreads by seed, rhizomes and whole floating plants. The vigorous, choking habits of *Sagittaria* threaten indigenous flora and fauna and dense infestations restrict water flow and can substantially alter the flow regime of catchments and waterways, affecting biodiversity and stream health (SAPIA, 2010; NSW, 2011). Within Beachwood Mangroves, SANBI have taken responsibility for clearing/controlling and monitoring this species.

Terrestrial alien plant species in Beachwood Mangroves Nature Reserve include:

Species	**Common Name**	**Species**	**Common Name**
Ageratum houstonianum	Mexican ageratum	*Musa sp.*	Banana
Arundo donax	Spanish Reed	*Nerium oleander*	Oleander
Canna indica	Canna	*Pereskia aculeata*	Barbados Gooseberry
Cardiospermum	Balloon Vine	*Phytolacca dioica*	Belhambra
Cassia sp.	Cassia	*Psidium guajava*	Guava
Casuarina equisetifolia	Casuarina	*Ricinus communis*	Castor Oil
Cestrum laevigatum	Ink Berry	*Sagittaria latifolia*	Broad-leaf Arrowhead
Chromolaena odorata	Triffid Weed	*Schinus terebinthifolius*	Brazilian Pepper
Clerodendrum thomsonii	Bleeding Heart vine	*Senna didymobotrya*	Peanut Butter Cassia
Colocasia esculenta	Madumbi	*Sesbania punicea*	Sesbania
Eugenia uniflora	Surinam Cherry	*Solanum mauritianum*	Bugweed
Lantana camara	Tick Berry	*Syzygium cuminii*	Jambolan
Ipomoea purpura	Morning Glory	*Tecoma stans*	Yellow Bells
Leucaena leucocephala	Giant Wattle	*Thevetia peruviana*	Yellow Oleander
Melia azedarach	Syringa	*Tithonia diversifolia*	Mexican Sunflower

Other alien/exotic plant species do escape from the Japanese Gardens, and other nearby locations, from time to time, and these include difficult species, such as *Canna indica.*

In June 2012, an extensive Working for Water alien plant contract was undertaken at Beachwood Mangroves, over an area of 62.55 ha. These treatments constitute a 5th and 6th follow up treatment and include species such as Brazilian Pepper (*Schinus terebinthifolius*), Paraffin/Triffid Weed (*Chromolaena odorata*), Morning Glory (*Ipomoea purpurea*), Castor Oil (*Ricinus communis*), Canna (*Canna indica*), Giant Spanish Reed (*Arundo donax*), Mexican Sunflower (*Tithonia diversifolia*), Mexican Ageratum (*Ageratum houstonianum*), Syringa (*Melia azedarach*), Peanut Butter Cassia (*Senna didymobotrya*), Lantana (*Lantana camara*), Bugweed (*Solanum mauritianum*) and Red Sesbania (*Sesbania punicea*).

2.6.9 Alien animals

Alien fish species found in Beachwood Mangroves are *Poecilia reticulata* (Guppy) and *Xiphophorus helleri* (Swordtail). They were apparently introduced into the Japanese Gardens in Durban North for mosquito control, but have since washed into the creek during storm events. Neither species are perceived to be a problem, since their numbers are kept in check by increased salinity closer to the estuary. The possibility has also been suggested that some may have been introduced by people emptying their fish tanks into either the estuary or the creek.

Alien birds, such as Indian Mynahs (Common Mynah), are now so much part of Durban that they are impossible to eradicate.

Stray domestic animals, such as cats and dogs, occasionally enter the nature reserve and present a threat to indigenous habitats and species.

Although *Tarebia granifera* (Quilted Melania – Frechwater Snail) has not been found yet in the nature reserve, it has been found in the Umgeni River and in other estuaries and rivers along the coast of KwaZulu-Natal. It should be looked for and eradicated immediately, should it be sighted in the nature reserve.

2.6.10 Mammalian fauna

Mammal species found at Beachwood Mangroves Nature Reserve are restricted to the smaller species, with only one antelope species recorded, namely the Grey Duiker (*Sylvicapra grimmia*). Species that are specifically associated with water/wetlands are Water Mongoose (*Atilax paludinosus)* and Cape Clawless Otter (*Aonyx capensis capensis*). Two other small carnivore species are Banded Mongoose (*Mungos mungo*) and Large-spotted Genet (*Genetta tigrina*). Then there are the ubiquitous Greater Cane Rat (*Thryonomys swinderianus*) and Vervet Monkey (*Cercopithecus aethiops*).

There are no doubt a number of rodent and bat species, but only three have been recorded by Leigh Richards, the Curator of Mammals at the Durban Museum, namely Greater Red Musk Shrew (*Crocidura flavescens*), Angoni Vlei Rat (*Otomys angoniensis*) and Four-striped Grass Mouse (*Rhabdomys pumilio*).

The only mammal species listed as important on the Ezemvelo KZN Wildlife database is the Cape Clawless Otter (*Aonyx capensis capensis*), which is TOPS listed as Threatened and is listed in CITES Appendix II.

2.6.11 Avifauna

The mangroves and Mgeni River Estuary provide a rich and important feeding ground for numerous waterbirds in the middle of Durban. Because of this, the Mgeni River Mouth is considered by some to be the most easily accessible and popular birding spot in Durban. The bird species found there consist mainly of species associated with the sea, estuaries or water in general.

Bird numbers vary according to the level of the water, which, in turn, depends on the tide and whether or not the sandbank at the mouth of the river has been breached.

The water edges are frequented by a great diversity of birdlife, such as Water Thick-knee, Woolly-necked Stork, Osprey, Purple Heron, Grey Heron, Goliath Heron, Common Whimbrel, Common Ringed Plover and Grey Plover.

Large rafts of terns roost on the central sandbanks when the tide is out and these should be scanned for some of the uncommon species, like the Lesser Crested Tern, Sandwich Tern and Little Tern. A telescope is recommended, although not essential. At low tide, a closer approach can be made by wading out to the sandbanks.

Amongst the "specials" that have occurred here are African Black Oystercatcher, Crab Plover, Sooty Tern and Bridled Tern, although these events are rare.

Within the Beachwood Mangroves Nature Reserve itself, the bird life is not as prolific. Historically, the Beachwood mangroves were host to heronries, but this was when there was less pressure on estuaries and the surrounding area was less built up. Now sandpipers, terns and gulls are common. The dune scrub supports a limited number of species, such as Square-tailed Nightjar, White-fronted Plover, Little Bee-eater and Southern Tchagra. Birding in the mangroves themselves is also poor and only about twenty-five species can be found on a regular basis there, but patience is rewarded with views of Black-throated Wattle-eye, Purple-banded Sunbird and, occasionally, in winter, the Mangrove Kingfisher. The fringing grasslands and reedbeds are populated by Red-faced Cisticola, Rattling Cisticola and Rufous-winged Cisticola, plus numbers of widows and weavers.

The dunes were, historically, an important nesting ground for some species, but previous disturbances prevented much of the breeding. However, the beach driving ban has undoubtedly improved the situation considerably. White Fronted Plovers and African Black Oystercatchers would no doubt have benefitted from this respite, although the latter are generally scarce in KwaZulu-Natal.

Not only is the sandbar of the Mgeni River an important contribution to the ecological system, but it also serves as a roost for terns and gulls. The occurrence of White-winged Black Terns is noteworthy, since the Mgeni is virtually the only estuarine system in KwaZulu-Natal to which these birds appear to be regularly attracted for roosting purposes (Begg, 1978). Perhaps one of the major limiting factors, as far as bird life is concerned, is human disturbance.

Avifauna species of conservation importance in Beachwood Mangroves Nature Reserve: (For complete lists see Appendix E)

Scientific Name	Common Name	RDB Status
Charadrius pallidus	Chestnut-banded Plover	Near Threatened
Haematopus moquini	African Black Oystercatcher	Near Threatened
Rostratula benghalensis	Greater Painted-snipe, Painted Snipe	Near Threatened
Sterna caspia	Caspian Tern	Near Threatened
Sterna dougallii	Roseate Tern	Endangered
*Ciconia episcopus**	Woolly-necked stork	Near Threatened
Ciconia nigra	Black Stork	Near Threatened
Morus capensis	Cape Gannet	Vulnerable
Pelecanus onocrotalus	Great White Pelican	Near Threatened
Pelecanus rufescens	Pink-backed Pelican	Vulnerable
Phalacrocorax capensis	Cape Cormorant	Near Threatened
Procellaria aequinoctialis	White-chinned Petrel	Near Threatened

Scientific Name	Common Name	RDB Status
Thalassarche cauta	Shy Albatross	Vulnerable
Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	Near Threatened
Columba livia	Rock dove, Feral Pigeon	
Alcedo semitorquata	Half-collared Kingfisher	Near Threatened
*Halcyon senegaloides**	Mangrove Kingfisher	Vulnerable
Accipiter melanoleucus	Black sparrowhawk	
Accipiter minullus	Little Sparrowhawk	
Accipiter tachiro	African Goshawk	
Falco biarmicus	Lanner falcon	Near Threatened
Falco concolor	Sooty Falcon	
Haliaeetus vocifer	African Fish-Eagle	
Milvus parasitus	Yellow-billed Kite	
Pandion haliaetus	Osprey	
*Podica senegalensis**	African Finfoot	Vulnerable
Acridotheres tristis	Common Myna, Indian Myna	
Corvus splendens	House Crow	
Passer domesticus	House Sparrow	
*Platysteira peltata**	Black-throated Wattle-eye, Wattle-eyed Flycatcher	Near Threatened
Tchagra tchagra	Southern Tchagra	
Zoothera guttata	Spotted Ground-Thrush, Spotted Thrush	Endangered
Bubo africanus	Spotted Eagle-Owl	
Tyto alba	Barn Owl	

Species found on a regular basis within the mangroves and adjacent shallow waterways are indicated with an asterisk (*).

2.6.12 Herpetofauna (reptiles and amphibians)

Reptiles and amphibians form an important part of the ecosystem and certain species serve as bio-indicators due to their sensitivity to environmental factors. Much remains to be discovered about the reptile and amphibian species complement of Beachwood Mangroves Nature Reserve, their life histories, inter-relationships and contributions to the functioning of its ecosystems. The variety and importance of these fauna are poorly studied and little understood, although the nature reserve is considered important for the conservation of this group, as it is for other faunal groups.

Further north, Nile crocodiles (*Crocodylus niloticus*) occur in the mangroves and in areas of the Indian Ocean, marine turtles, such as the Green Turtle (*Chelonia mydas*) and Olive Ridley Turtle (*Lepidochelys olivacea*), forage in the mangroves, the Green Turtle eating the fallen fruit of *Avicennia marina*. However, none of these species are found at Beachwood (Berjak *et al*., 2011).

A particular reptile of importance and interest is the KwaZulu (Black-Headed) Dwarf Chameleon (*Bradypodion melanocephalum*).

This chameleon is endemic to KwaZulu-Natal, where it lives mainly along river valleys, although its distribution is patchy. Numbers of this chameleon have declined significantly over the past 30 years and it has become a threatened species. The threats to its survival include the loss of its bushy grassland habitat, due to urban and agricultural expansion, increased mortality caused by introduced predators (e.g. cats, dogs, Mynah birds), motor vehicles, grass cutting, pollution and human superstition.

The KwaZulu Dwarf Chameleon requires tall grasses, reeds, bushes, shrubs and trees for foraging and roosting, unpolluted drinking water, in the form of dew, mist or rain droplets, in areas with adequate sources of insect prey. Its preferred habitats are reeds, grasses and bushes along rivers and wetlands, and the interface (ecotone) between forests and grassland.

While on a perch, the female gives birth to the young and the potential exists for three or four parturitions (birth events) per female per year. Thus, three to four generations may be found living concurrently in any suitable area. An individual may remain in the same area for years, often returning to the same roost night after night. These chameleons are often found in pairs or in small groups, and males and females may be found close together as pairs.

It was during one of Beachwood's Open Mornings, in April 2009, that the North Durban Honorary Officers first recorded the KwaZulu Dwarf Chameleon at Beachwood Mangroves Nature Reserve. Coincidentally, Ezemvelo KZN Wildlife published a request in their Rhino Club Magazine around the same time, asking the public to look out for this rare little chameleon as they were establishing a database of its locations and population numbers.

This led to the North Durban Honorary Officers adding "chameleon monitoring" to their list of responsibilities. All KwaZulu Dwarf Chameleons found in the nature reserve are photographed, their GPS positions and other information being recorded on prescribed data sheets. These are then forwarded to Ezemvelo KZN Wildlife for capture onto their database.

Since April 2009, 45 individual sightings have been recorded, five of which were baby chameleons. This monitoring programme is ongoing.

In addition to the chameleon, the Ezemvelo KZN Wildlife database records five snake species, a gecko species, leguaan and skinks. The KwaZulu Dwarf Chameleon is the only reptile species listed in that database as being of specific conservation importance and its Red List status is Vulnerable (South African Reptile Conservation Assessment).

The Ezemvelo KZN Wildlife database records seven frog species for the nature reserve. Complete lists of Herpetofauna can be found in Appendix E.

2.6.13 Invertebrates

Invertebrate fauna constitutes the greatest component of species diversity in natural systems, but it is usually poorly understood and, in the case of Beachwood, records of terrestrial invertebrates are few. In terms of biodiversity and the provision of ecosystem services, however, it is important to acknowledge that invertebrates are fundamentally important.

Mangroves support rich invertebrate communities, including sponges, polychaetes (worms), bivalves (mussels and oysters), barnacles and ascidians (sea squirts), which are all important food sources for larger invertebrates and fish. There is a high abundance and biomass of floating zooplankton, which range in size from microscopic to large jellyfish, and act as a food base for larger invertebrates, fish and birds, such as flamingos. Within mangroves, it is not only the plants, but also the animals which need to be adapted to the high salinity and anaerobic conditions. The biggest issue is that they need to be able to cope with rapid and severe fluctuations in salinity and oxygenation of water. They therefore show a

combination of physical and behavioural adaptations to this environment (Berjak *et al.*, 2011).

According to a study by Cliff in 1976, conditions in the creek do not favour the survival of estuarine and marine forms of zooplankton. Fresh water forms of zooplankton are dominant. In addition, crab, fish and prawn larvae are the most abundant forms of mesoplankton (Begg, 1978).

The effect of the high turbidity in the Mgeni Estuary is marked. Forms such as barnacles (Infraclass - Cirripedia) and oysters (family - Ostreidae), which depend on a delicate filtering mechanism for food foraging, are generally absent. In fact, very few molluscs occur in the estuary and burrowing animals, such as the cracker shrimp, are rare. On the other hand, the "rain" of inorganic and organic detritus may provide food for the various small species of shrimp, fish and plankton, which form the basis of the food chain. Edwards & Moll, (1971) recorded that the amount of silt that is deposited every summer was gradually reducing the mean depth of the water and the surface area and this deposition and alteration of the system has been continues to this day, to the extent that mangroves are growing in the main channel of the Mgeni, where they didn't grow before.

The Beachwood mangroves has the richest assemblage of mangrove associated Gastropods in South Africa (Brown, 1964) and (Herbert, Pers. Comm., 2013). The mangrove whelk *(Terebralia palustris)* was introduced from Durban Bay, sometime after 1964. The reason for this has not been recorded, except that it has all but disappeared from South African mangroves, probably due to declining water quality and possible loss of food resources. Interestingly, its mega-hemocyanin has unusually high oxygen affinities (Lieb *et al.*, 2010), which would be an adaptation to the oxygen depauperate environment in which it lives. A more obvious whelk at Beachwood is the climbing whelk (*Cerithidea decollata*), which moves between the ground and the trunks of mangrove trees in a 14 day tidal cycle, with numbers building up on the trees during spring tides and decreasing over neap tides. This behaviour is thought to be a predator avoidance strategy (Berjak *et al*., 2011).

Of the larger crustacea in the Beachwood swamp, shrimps *(Caridina)* are said to be the most dominant (Begg, 1978; Edwards & Moll, 1971). There is evidence that they breed in the swamps as females in berry have been recorded in all areas of the swamps and, in spring, large numbers of juveniles have been observed. This occurs at the same time that the sea lettuce (*Ulva* sp.) blooms. Species of prawns and shrimps that occur include *Upogebia africana* (Mud Prawn) and *Alpheus lobidens* (Pistol shrimp), *Marsupenaeus japonicus* (Ginger Prawn), *Fenneropenaeus indicus* (White Prawn) and *Penaeus monodon* (Tiger Prawn) (Berjak *et al*., 2011).

Many species of crab are essentially terrestrial, while other species, such as the hermit crab, spend most of their time on submerged branches, roots or rocks. The most common crabs in mangroves are Sesarmids, but there are also Ocypodids (Ghost Crabs, Fiddler Crabs) and Portunids (Swimming Crabs). Crabs found in mangroves are adapted to the sediment conditions, tidal fluctuations and varying salinities associated with them (Berjak *et al*., 2011).

Common Sesarmid species in South Africa's mangroves are *Chiromantes eulimene*, *Parasesarma catenatum* (Marsh Crab) and *Neosarmatium meinhertii* (Red Mangrove Crab). Sesarmids play a significant role in detritus formation and nutrient recycling. *Neosarmatium meinhertii* play a key role in forest growth and development as they are largely vegetarian

and take large numbers of fallen leaves down their burrows, which assists in the retention and recycling of nutrients. These leaves would otherwise have been flushed away and lost from the habitat with the next tide. The digging behaviour of crabs also enhances aeration and facilitates drainage of mangrove soils (Berjak *et al*., 2011).

There are 94 species of fiddler crabs throughout the world and five of these (*Uca* spp) occur in South African estuaries, generally on the fringes of the mangroves or on adjacent intertidal sand and mudbanks. Not all are equally common and each has a different arrangement of bristles in the mouthparts, which allow different species to forage on different sediments and they are able to sort food particles from sediment. Fiddler crabs are small (<3 cm) and occupy areas of the intertidal zone which are exposed at each low tide. They are characterised by the bright colours of the males and, particularly, their one very enlarged pincer, or cheliped, which can either be on the left or right. Feeding is done at low tide and at high tide they retreat to their burrows to avoid predators and block the burrow entrance with a mud plug (Berjak *et al*., 2011).

Both fiddler crabs and Sesarmids are amphibious and breathe by means of gills contained in chambers on either side of the carapace. While out of the water, they are able to keep the gills moist and aerated. When they need to replenish or refresh the water, they move to the nearest standing water or move back to their burrows, which extend below the water table (Berjak *et al*., 2011).

The Portunids are characteristically swimming crabs, in which the hind legs are flattened and act as oars, propelling the crab sideways through the water. *Scylla serrata* (Giant Mud Crab) is a particularly large Portunid and can exceed 25 cm in carapace width, with a maximum weight of 2-3 kg (Berjak *et al*., 2011). The crab inhabits soft, muddy bottoms, where it digs deep burrows. Adults remain buried during the day and emerge at sunset to feed on molluscs and crustaceans.

Additionally, the presence of the crab, *Cardiosoma carniflex* (also called the “Tangoman”), has been recorded in the nature reserve.

The Ezemvelo KZN Wildlife database records seven frog species for the nature reserve. Complete lists of Herpetofauna can be found in Appendix E.

2.6.14 Fish species

Because the mangroves occupy the intertidal zone, fish are not permanent inhabitants and the species that do occur are those found in estuaries. So, their presence in mangroves will be limited to high tide periods when the mangrove floor is inundated (Berjak *et al*., 2011).

Some 60 species of fish occur in the Mgeni Estuary. There are five groups of estuarine fish:

1. Residents – breed there and do not migrate. Typically poor swimmers, such as gobies.
2. Marine migrants – breed at sea, but use the estuary as a nursery ground (most of the species are included here).
3. Marine stragglers – normally occur at sea, but may wander into estuaries.
4. Freshwater stragglers – typically freshwater species, which can tolerate some salinity.

5. Passage migrants – species, such as eels, which use estuaries as transit zones during migration between freshwater and the sea.

Quite a large proportion of the fish species are from the Gobiidae family, which are essentially marine. Only two fish species that occur in the nature reserve are recorded in the Ezemvelo KZN Wildlife database, namely *Butis butis* (Duckbilled Sleeper) and *Rhabdosargus holubi* (Cape Stumpnose). These data are clearly in need of being updated, as the complete list in Appendix E has been taken from published sources.

Species listed as important by Edwards & Moll (1971) include the following.

1. *Hypseleotris dayi* (Golden Sleeper) - In 1971, the *Hypseleotris dayi* was confined to just five rivers in KwaZulu-Natal and not found in the sea at all and, at that stage, it was thought that Beachwood would soon be the only habitat which would be inhabited by the species. The available literature does not mention whether or not that has occurred, except to say that it has limited distribution in South African estuaries.

2. *Glossogobius giuris* (Common Goby) - This fish has been recorded both in the sea and as far upstream of the Mgeni River as Albert Falls. There is evidence that it can breed in fresh water, making it one of the few marine fish that can.

3. *Mugilobobius (Gobius) durbanensis* (Durban Goby) - This species has been observed sitting on mangrove roots, with its head out of the water. This behaviour is not exhibited by specimens kept in an aquarium and so it is thought that it may be a reaction to the shortage of oxygen in the swamp water.

4. *Periopthalmus kalolo (cantonensis)* (Common Mudskipper) - The mudskipper spends most of its time out of the water and only returns occasionally to wet its gills. It is the characteristic hopping movements of *Periopthalmus kalolo* out of the water which enables one to distinguish it from other fish species. The ability to remain out of the water is made possible by retaining water in the gill chamber, which is re-oxygenated when it takes in large gulps of air. Movement on land is achieved by using its pectoral fins as levers. They cling to surfaces, and the lower branches of trees, with the pelvic fins (which are modified into a sucker). Mudskippers eat small pelagic invertebrates and fish larvae. They have bulbous eyes, which are situated on the top of their heads. This gives them the advantage of being able to sight predators and prey with relative ease. The mudskipper population in South African bays and estuaries is diminishing and Edwards and Moll (1971) surmised that the population at Beachwood was probably the last one south of the Tugela River and, since the tidal channel was cleared, their numbers diminished. Their latest status needs to be verified. A comment was made at the Beachwood public meeting, in January 2013, that they are thought to occur at Umhlanga Lagoon as well, but this needs to be verified.

5. Mullet species - The most dominant group of fish species in the area (in terms of numbers) are the mullet. A ratio of juvenile mullet to other species recorded by netting in the estuary is 20:1. It is common to see large schools of mullet in the shallows. Mullet are often seen breaking the surface of the water in jumps to escape predators. They are unable to breed in the estuaries and thus they migrate to sea for this purpose, only to return to the estuary as juveniles for the next part of their life cycle, where they utilise the protected environment and food-rich estuarine areas as nurseries.

2.7 Socio-economic context

The following description of the socio-economic situation in the region around Beachwood Mangroves was drawn from the 2012/2013 eThekwini Municipality IDP.

The eThekwini Municipality spans an area of approximately 2,297 km^2 and is home to 3.5 million people. It consists of a diverse society, which faces many social, economic, environmental and governance challenges; which include high rates of unemployment and poverty and low economic growth, which are exacerbated by low levels of skills development and literacy. From these flow the additional issues, such as exceptionally high levels of HIV/AIDS, communicable disease, such as TB, high crime rates and risky behavior. Problems of infrastructure degradation and limited access to basic household and community services are compounded by local government ineffectiveness and inefficiency.

The majority of the population are Black African (predominantly Zulu) (71 %), followed by Indians (19 %), Whites (8 %) and Coloureds (2 %). Most of the population falls within the 15-34 year age group. The greatest population concentrations occur in the central and north regions (Durban and northwards). In 2010, it was estimated that 30.5 % of eThekwini's Black African population were battling the effects of poverty, as opposed to 0.3 % of the White population, 19.5 % of the Coloured population, and 9.2 % of the Asian population.

The eThekwini economy is less diversified in terms of its economic activity spread than KwaZulu-Natal and South Africa as a whole and this can be attributed to the Municipality being highly dependent on its tertiary sector, namely finance (23 %), community services (17 %) and construction (3 %). Other activities include manufacturing (22 %), transport (16 %) and trade (16 %). Nevertheless, on the whole, economic growth in eThekwini outperformed that of the province and country as a whole.

The vision for the city is to move towards a "sustainable city that is caring and liveable". Therefore, to address the many challenges, the city has devised an eight-point plan, of which the first component is to develop and sustain the spatial, natural and built environment to ensure sustainable and integrated growth and development of the municipality.

Major development projects planned for the eThekwini Municipality are anticipated to have positive impacts on the local economy in the next 10-15 years, though some, like the Dig-out Port at the old airport site, can result in negative environmental impacts.

In terms of the economic value of Beachwood Mangroves, estuaries rank, along with tropical rainforests, as the world's most productive ecosystems and are more productive than either the rivers or the ocean that influence them from either side. This is related to the combination of nutrient-rich rivers, with warmer shallow coastal waters, which generates high levels of primary productivity. The mixing of fresh water and heavier salt water traps and circulates nutrients, such that they are often retained and recycled by the estuarine organisms to create self-enriching systems (Berjak *et al*., 2011).

Estuaries are the beneficiaries of energy subsidies through the tidal transport of food and nutrients and removal of wastes. This means that animals do not need to expend much energy in their search for food, but rather that rivers, tides and currents combine to provide this service by "replenishing the table" frequently. The specific contribution by mangroves

to estuaries is through the leaves of the mangroves decomposing and being transformed into detritus, which in turn is eaten by fish, prawns and other detritovores (Berjak *et al*., 2011).

Estuaries provide a number of important ecosystem goods and services, where ecosystem goods refer to products, such as seafood, which can be extracted from the ecosystem and ecosystem services refer to the conditions or processes through which ecosystems, and the species that constitute them, sustain and contribute to human well-being. Table 2.5 summarises the ecological economy of a mangrove system (Berjak *et al*., 2011).

Table 2.5: The ecological economy of mangrove systems

THE ECOLOGICAL ECONOMY OF MANGROVE SYSTEMS Mangrove forests play a central role in transferring organic matter and energy from the land to marine ecosystems. There are many mangrove products and services, not all of which are easily quantified in economic terms. Typically, as per the functional groups of the MEA, mangrove ecosystems generate some of the following services.		
Provisioning	**Regulating**	**Cultural**
Food (fish, crabs, shrimps)	Atmosphere and climate regulating	Recreation
Timber for fuel* (charcoal, firewood)	Hydrological balance	Spiritual and religious
Building Materials* (boats, houses, furniture)	Waste assimilation	Aesthetics
Curios*	Erosion control	Inspirational
Fibre*	Storm/flood protection	Educational heritage
Medicines*		Research
Genetic resources		
Supporting Nutrient cycling. Primary production. Providing habitat. Supporting life cycles.		

Table reproduced in its entirety from Berjak *et al*. (2011).
Items marked with asterisk (*) **not** relevant to Beachwood.

2.8 Operational management within Beachwood Mangroves Nature Reserve

Effective operational management within the nature reserve is dependent on its staff, the equipment and infrastructure.

2.8.1 Management infrastructure

Management infrastructure in the Beachwood Mangroves Nature Reserve consists of:

- Entrance gates
  - Two public entrance gates – one sliding gate and one pedestrian gate adjacent to the M4.
  - One management gate at Rocket Hut.
- Administration office
  - Park home, which serves as the office for Beachwood Mangroves and Umhlanga Lagoon Nature Reserves.
- Storerooms/workshops
  - Two storerooms and a 6 m container on a concrete slab.
- Staff accommodation
  - General Assistant and Field Rangers' accommodation for 12 people.
  - Park home for the Trainee Officer.

2.8.2 Conservation infrastructure

Conservation infrastructure consists of:

- Fencing – maintained by eThekwini Municipality.
- Roads – 500 m of gravel road.

2.8.3 Bulk infrastructure

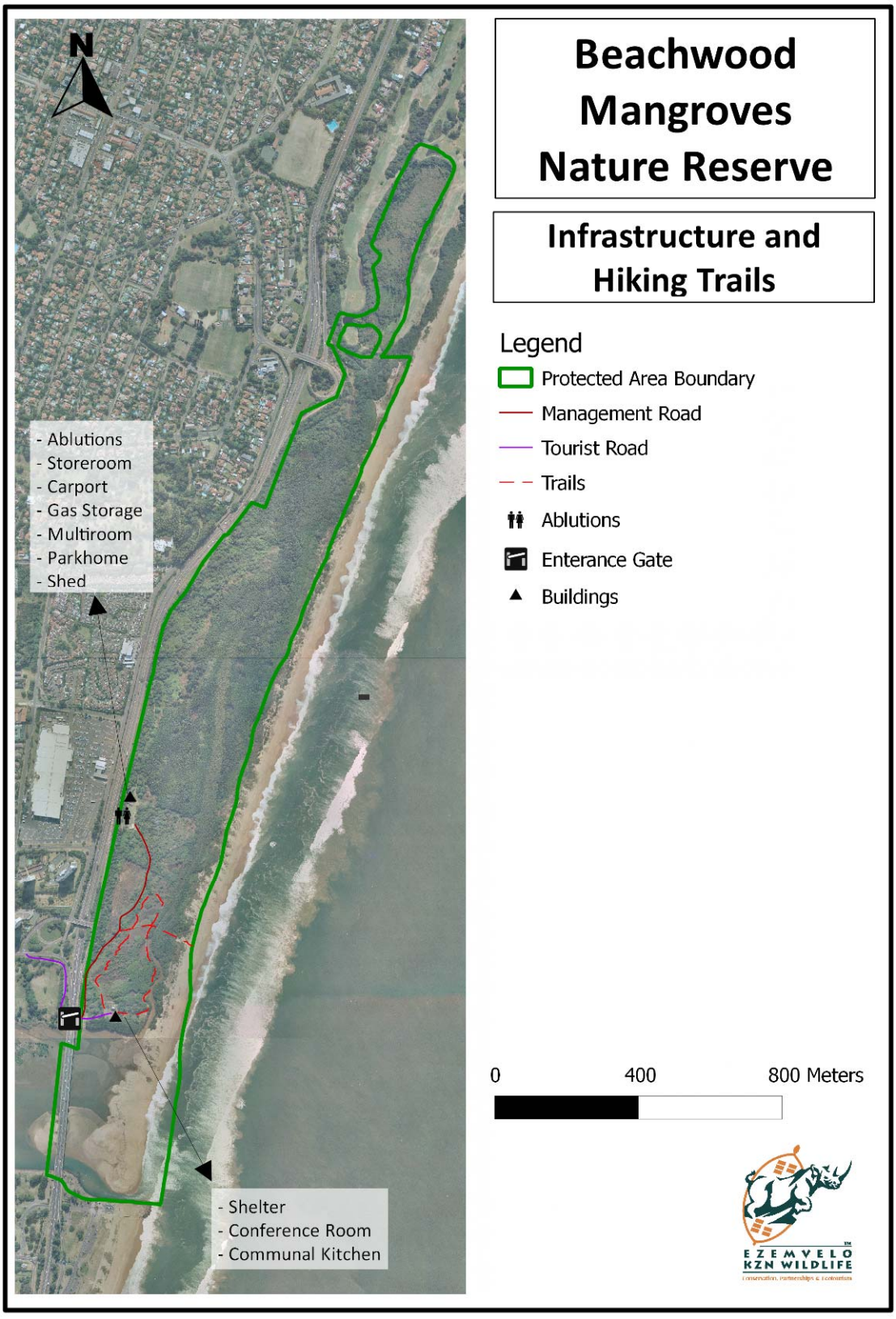
Bulk infrastructure consists of:

- Conservancy tanks for sewage. This is emptied by the eThekwini Municipality.

2.8.4 Eco-tourism (environmental education) infrastructure

Beachwood Mangroves Nature Reserve is not open to the general public, but it is open by prior arrangement to educational groups. The education infrastructure consists of:

- A wooden building, raised on stilts above ground level, which houses educational display boards.
- An open-air lecture space (amphitheatre) adjacent to the education centre, which is a grassed area encircled with a low wooden fence.
- An ablution block.
- A kitchen, built of concrete blocks, with a cement tile roof, which has no equipment or facilities, except for running water and working surfaces.
- Braai facilities.
- Boardwalks.



Map 4: Infrastructure and hiking trails within Beachwood Mangroves Nature Reserve

2.8.5 Staff establishment

There are ten permanent staff members at Beachwood Mangroves Nature Reserve, in the following positions:

- 1 Conservation Manager
- 1 Principal Field Ranger
- 5 Field Rangers
- 3 General Assistants

Half of the Field Rangers' time is spent doing marine law enforcement.

Beachwood Mangroves Nature Reserve has 0.105 staff per hectare, should all vacant positions be filled (Carbutt & Goodman, 2010).

Other protected areas on the coast of similar size include Harold Johnson (104 ha) – 0.058 staff/ha, Mpenjati (66 ha) – 0.2667 staff/ha, North Park (53 ha) – 0.0943 staff/ha, Bluff (45 ha) – 0.0889 staff/ha and Umhlanga Lagoon (32ha) – 0.0938 staff/ha.

The OIC reported that staff numbers are sufficient. However, the staff are shared between Beachwood Mangroves and Umhlanga Lagoon Nature Reserves and the same OIC manages both, so this can cause problems during crises.

2.8.6 Funding levels at Beachwood Mangroves Nature Reserve

According to the management effectiveness assessment, Beachwood Mangroves Nature Reserve receives an annual operational budget of R1,103,243 (2010). This budget works out to R15,124.53 per hectare (Carbutt & Goodman, 2010). Staff and funding for Beachwood Mangroves Nature Reserve are used to look after the Beachwood Mangroves Nature Reserve and do marine law enforcement in the area. The funding is reported as being adequate for the protected area.

2.8.7 Management effectiveness in Beachwood Mangroves Nature Reserve

In 2010, Ezemvelo KZN Wildlife conducted management effectiveness assessments for all of its protected areas (Carbutt & Goodman, 2010). Management effectiveness assessments consider protected area design, the appropriateness of management systems and processes, and delivery of protected area objectives. Such assessments are intended to enable conservation organisations to refine their conservation strategies, re-allocate budget expenditures, and develop strategic, system-wide responses to the most pervasive threats and management weaknesses (Carbutt & Goodman, 2010). They are not performance assessments of individuals, but serve to reflect an organisation's proficiency for protected area management as a whole. The Ezemvelo KZN Wildlife minimum standard for protected areas is 67 %, which is the national minimum standard set by National Department of Environmental Affairs. Beachwood Mangroves Nature Reserve achieved a management effectiveness score of 60 % in the 2010 assessment and scored 80 % in the 2013 assessment.

The following issues were highlighted in the assessment:

- Management of siltation and pollution.
- Litter, detergents and chemicals as run-off.

- Visitor management and educational tours.
- Inventory review and monitoring.
- Control of alien plant species.

2.8.8 Key operational issues at Beachwood Mangroves Nature Reserve

The following specific issues have been identified, associated with the facilities, infrastructure and operations within the nature reserve.

Pressures and threats identified through the management effectiveness assessments (Carbutt & Goodman, 2010). Note that these are time-bound.

Threats (Future):	**Pressures (Current):**
Alien animals Alien plants Climate change Dam building Diseases – native Land-use change within the protected area PA isolation Poaching Pollution Siltation Solid waste – from management activities Unsustainable tourism	Alien animals Alien plants Climate change Dam building Diseases – native Land-use change within the protected area PA Isolation Poaching Pollution Purposeful species eradication Siltation Solid waste – from management activities Unsustainable tourism

Pressures:
Issues identified by the Nature Reserve Planning Committee and nature reserve stakeholders are as follows.

- Heavy urban runoff and deposition of litter and sediment from the Mgeni River.
- Pollution from industrial areas in the lower areas of the Mgeni catchment.
- It is believed that reduction in salt water intrusion has led to a decrease in the number of whelks and mudskippers.
- Alien fish (guppies and swordtails) were introduced into the upper reaches of the Beachwood Creek for mosquito control. These have subsequently reached the upper parts of the Beachwood Creek.
- Alien vegetation encroachment.
- General public safety (high crime rate).

It must be noted that the Beachwood mangrove swamps is a highly dynamic system, changing by the year, and that these changes are caused by both weather/natural phenomena (rainfall in catchment, tides and storms) and the interventions of man. This makes management planning all the more challenging.

Over the years, there have been a number of management interventions in Beachwood Mangroves Nature Reserve and there have been various recommendations for interventions in the nature reserve in response to various issues. However, there is not a readily accessible record of why interventions took place, what exactly the interventions were and

what the results of those interventions were. Neither is there a readily accessible record, particularly in a spatial format, of changes in the system over time.

As part of the process of adaptive management, which is an essential strategy towards the management of protected areas, particularly one as dynamic as Beachwood Mangroves, documenting these interventions, as management continues, is essential.

2.8.9 Summary of management issues and challenges

The following section summarises the key management issues and challenges outlined in the descriptive sections above, which must be addressed through the management plan. The issues and challenges have been grouped under key performance areas, which flow through the strategic and operational management frameworks that follow.

Table 2.6 Management challenges and issues

Key performance area	Issue that must be addressed
Legal compliance and law enforcement	▪ General public safety (high crime rate).
	▪ Illegal resource utilisation (netting and fishing).
	▪ Vandalism – damaging infrastructure and theft of any saleable metal items for scrap.
	▪ Illegal entry at various places.
Stakeholder engagement	▪ Good support from Umgeni Conservancy, DUCT, Rotary, WESSA, Honorary Officers, Green Hub (tours), WESSA Environmental Education.
	▪ Capacity issues with Municipality.
Buffer zone protection and regional management	▪ Protected Area isolation.
	▪ The nature reserve is not buffered and the land uses adjacent to the PA are currently incompatible with biodiversity conservation.
Eco-tourism development	▪ The nature reserve is developed to capacity and there are no opportunities for developments.
	▪ There has been political interference in allowing inappropriate events to take place (Jazz concert).
	▪ The nature reserve is a National Monument and needs to be managed with this in mind.
Conservation management	▪ Alien plants – terrestrial and aquatic.
	▪ Heavy urban runoff and deposition of litter and sediment from Mgeni River.
	▪ Pollution from industrial areas of Mgeni catchment.
Operational management	▪ Staffing establishment: shared between Umhlanga & Beachwood. Also do marine law enforcement. Sufficient staff, but sharing staff can be challenging.
	▪ Lack of training and capacity building in staff in terms of Occupational Health and Safety compliance and requirements.
	▪ Consistent and sufficient funding levels.
	▪ Only threat to staffing is if project funding is lost.

3 STRATEGIC MANAGEMENT FRAMEWORK

In an effort to ensure that Beachwood Mangroves Nature Reserve is effectively managed, the following strategic framework has been developed. It is aimed at providing the strategic basis for the protection, development and operation of the nature reserve over the next five years and has been prepared collaboratively, through a process involving stakeholders within Ezemvelo KZN Wildlife, the communities around the nature reserve, local and provincial government departments, and other stakeholders.

The vision describes the overall long-term goal for the operation, protection and development of the nature reserve. The objectives and strategic outcomes that follow are intended to provide the basis for the achievement of the vision. The objectives provide a broad description of the goals for each key performance area. The strategic outcomes, which flow from the objectives, set out what is needed to achieve the objectives, based on the management challenges and issues described in Section 2 above.

3.1 Beachwood Mangroves Nature Reserve vision

"To effectively manage the Beachwood Mangroves Nature Reserve, such that it maintains the representivity of its natural habitats, species and ecological processes to ensure that they contribute to national and provincial targets, maintain ecosystem services and create an environment for nature-based recreation and awareness opportunities for the local communities and general public."

3.2 Objectives and strategic outcomes

An objective has been identified for each of Beachwood Mangroves Nature Reserve's key performance areas, which follow from the management challenges and issues and relate to the important functions and activities necessary to protect, develop and manage the protected area effectively. The objectives have then been translated into strategic outcomes, which form the basis for the management activities and targets set out in the operational management framework, described in Section 5 below.

Table 3.1 sets out the key performance areas, the objective for each key performance area and the strategic outcomes required to realise the objectives.

Table 3.1: Objectives and strategic outcomes for Beachwood Mangroves Nature Reserve

Key performance area	Objective	Strategic outcome
Legal compliance and law enforcement	Comply with and enforce legislation pertaining to the protection, development and management of Beachwood Mangroves Nature Reserve, ensure that infrastructure is protected from vandalism and theft and visitors to the nature reserve are safe from harm.	There is adequate law enforcement within Beachwood Mangroves Nature Reserve in order to achieve the protected area vision.
Community participation	Maintain relationships with various stakeholder groups, such as Umgeni Conservancy, DUCT, Honorary Officers, eThekwini Biodiversity Forum, Beachwood Golf Course.	Constructive community involvement in Beachwood Mangroves Nature Reserve's management through effective stakeholder engagement; and provision of support to the community in developing its understanding of the management of Beachwood Mangroves Nature Reserve.
Buffer zone protection and regional management	Negotiate the buffer zone requirements for inclusion into the local and district municipality IDP's and SDF's and municipal schemes in order to avoid inappropriate land uses in Umhlanga Lagoon Nature Reserve's buffer zones.	Capture of buffer zone considerations in IDP's and SDF's and municipal schemes.
Visitor management	To understand the number and type of visitor utilising the nature reserve in order to tailor interpretive and educational facilities and displays to best target that group.	Ensure that all visitor activities are appropriate to the goals of the nature reserve and to its neighbours.
Environmental interpretation and awareness	To have appropriate and adequate educational material available and adequate signage on trails in order to provide high quality educational opportunities and promote the natural values of the nature reserve.	Support organisations (WESSA, Green Hub, Sea World & Honorary Officers) conducting environmental interpretation and education programmes.
Conservation management	Manage the nature reserve to maintain its ecological integrity.	▪ Develop and implement a sedimentation management plan for Beachwood Mangroves Nature Reserve. ▪ Develop and implement an alien species control plan for Beachwood Mangroves Nature Reserve (fauna and flora).

Key performance area	Objective	Strategic outcome
		▪ Develop and implement an indigenous invasive species control plan for Beachwood Mangroves Nature Reserve. ▪ Identify, rehabilitate and manage areas that have been significantly impacted by accelerated soil erosion. ▪ Collection of biological material is undertaken in a legal manner and conforms to Ezemvelo KZN Wildlife policy. ▪ Critical ecological processes and functions are maintained within Beachwood Mangroves Nature Reserve. ▪ Biological monitoring programmes are developed and implemented to determine the success of management interventions in protecting the ecosystems, communities and species of Beachwood Mangroves Nature Reserve.
Operational management	Provide adequate human resources, capacity, equipment and funding to enable the effective protection, development and management of Beachwood Mangroves Nature Reserve.	▪ Development of a five-year financial plan that identifies the resource needs to achieve the objectives for Beachwood Mangroves Nature Reserve. ▪ Ensure that Beachwood Mangroves Nature Reserve is adequately staffed and conforms to legal staffing practices. ▪ All facilities and infrastructure in Beachwood Mangroves Nature Reserve are adequately maintained. ▪ Service infrastructure and practices in Beachwood Mangroves Nature Reserve do not cause environmental harm.

4 ZONATION PLAN

The purpose of zonation within a protected area is to identify types and levels of usage that are acceptable, based on an area's sensitivity and resilience. Zonation may be used to identify areas in which appropriate uses and infrastructure may be located and developed.

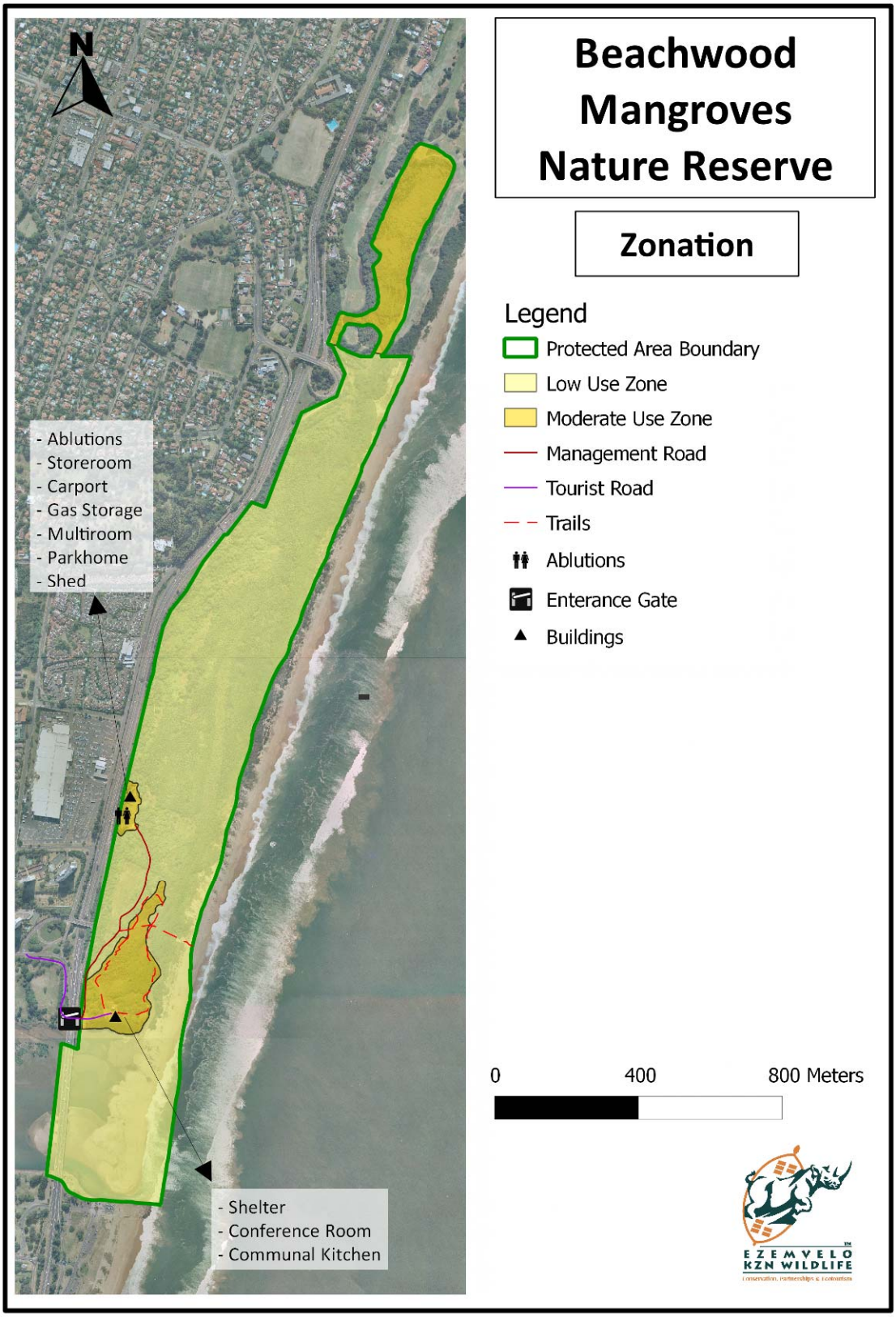
The zonation categories used for the Beachwood Mangroves Nature Reserve are the standardised zonation categories developed for all of Ezemvelo KwaZulu-Natal Wildlife's protected areas (Goosen, 2011). The zonation system recognises and reflects the following:

- Sensitive features associated with a protected area (i.e. biophysical, cultural and sense of place).
- Influence of existing development and use on these features and experiences.
- Opportunities and constraints (biophysical, social or managerial constraints) for use.
- Potential threats to wilderness, either within or adjacent to it.

General principles of zonation include the following:

- There is a general gradation in the zonation categories, ranging from high to low protection.
- An overlay zone provides additional protection and may be overlaid onto another zone in order to strengthen the protection, e.g. Key Feature Protection Zone.
- A node is an area where tourism, management and service infrastructure can be developed and that has a specified footprint.
- A Wilderness Zone will be buffered by the Low Use Zone.
- Where possible, both management and tourism infrastructure should be developed outside the protected area.
- Development of infrastructure should preferably be on the periphery of the zone, towards a higher impact/less sensitive adjacent zone.
- Deviations or exceptions in all zones require approval from the management authority.
- Any activities permitted in a category of higher protection are also permitted in a category of lower protection, e.g. activities permitted in the Low Use Zone can also be permitted in the Moderate Use Zone.
- All activities will take place in accordance with the local protected area rules and regulations.

4.1 Zonation of Beachwood Mangroves Nature Reserve



Map 5: Beachwood Mangroves Nature Reserve Zonation Map

4.2 Conceptual development guidelines

The purpose of the zonation of Beachwood Mangroves Nature Reserve is to control the intensity and type of use within it, in efforts to ensure the overriding goals of biodiversity conservation are met, whilst enabling acceptable levels of eco-cultural tourism. On this basis, the permissible intensity of use will be relatively higher within some zones, than in others.

Zones

Low Use Zone:

Description: An area where there is little evidence of modification of natural processes and landscapes, that is more sensitive than the moderate use zone and where the ecotourism principles of low human impact will prevail.

Objective: To designate an area for tourism experiences and management activities that is focused primarily on low impact activities and where general sensitivity requires that management and tourism impacts on the natural landscape should be mitigated.

Permissible activities and infrastructure: (Activities that could be allowed, subject to the reserve management standard rules and regulation in terms of authorisation)

- Facilities of a rustic nature, such as small bush camps, rustic overnight hiking huts, hides and trails.
- Motorised access is low key and 4 x 2 access is provided to points where trails start or to tourist facilities.
- 4 x 4 tracks are allowed in this zone (limit to number of tracks and frequency of use) as per site specific rules and regulations.
- Hiking and formalised trails. Management activities must focus on protecting park resources and core values.
- Limited management roads and tracks.
- Controlled extractive resource use, in line with Ezemvelo KwaZulu-Natal Wildlife policies and norms and standards.

Constraints and implementation:

- Activities are mostly low impact and low density.
- No modern facilities, such as restaurants and shops, are permissible in this zone.
- Where possible, facilities should be developed on the periphery of the zone, towards the less sensitive adjacent zone.

Moderate Use Zone:

Description: An area where natural processes and the landscape may be altered to support protected area operations. This zone is less sensitive than the low use zone and this is where experiences, facilities, infrastructure and services are provided to visitors and where general park management activities can take place.

Objective: To designate a tourism area that is primarily focused on visitor experience, while still securing the values of the protected area and an area that serves the operational and support functions of the protected area.

Permissible activities and infrastructure: (Activities that could be allowed, subject to the reserve management standard rules and regulation in terms of authorisation)

- Hiking on formalised trails.
- The tourism road network, including access roads and game viewing roads.
- Traditional game viewing routes with associated more formalised infrastructure.
- Infrastructure is accessible by motorised access.
- Management roads and tracks.
- Management activities are directed to maintaining park infrastructure for biodiversity conservation, park operations, equipment and material storage.
- Controlled extractive resource use.

Constraints and implementation:

- Within the Moderate Use Zone, a specific *Tourism Development Node* will be defined, which could include areas of commercial use.
- Where possible, this node should be outside the protected area.
- The node should preferably be on the periphery of the Moderate and Low Use Zones, to ensure a quality visitor experience in the lower use zone, but with the bulk of the impact, *e.g.* access roads and services, in the higher use zone.
- This node should be developed in the less sensitive part of the Moderate Use Zone.
- The Tourism Development Node can only be developed in areas where it does not compromise the values of the protected area.
- The node must have a specified footprint.

o *Park Administrative Node* (within the Moderate Use Zone)

- Cater for facilities such as staff accommodation, administrative offices, other operational required infrastructure, waste handling sites, *etc.*

- Wherever possible, facilities and infrastructure related to park operations should be located outside of the protected area. If not possible, they will form part of this node.

- The node must have a specified area as a footprint.

Key Feature Protection Overlay

Description: An area that is vulnerable and or scientifically important, where specific additional controls are imposed in order to prevent undesirable impacts on identified sensitive or threatened species, habitats, ecosystems, bio-control release sites, research sites, archaeological, living heritage and palaeontological sites.

Objective: This zone is for permanent, temporary or seasonal protection of important core protected area values*. It aims to provide additional protection for the integrity of key areas.*

Permissible activities and infrastructure:

- The zone may overlay other zones where a range of infrastructure may already exist.
- In addition to restrictions of the underlying zone, site specific rules and regulations will apply.

Constraints and implementation:

- This is a protection zone and would only allow for access and development under site specific constraints. (Does not cater for further developments or resource utilisation.)
- This zone provides a higher level of protection than the underlying zone.
- Could be permanent, temporary or seasonal overlay.
- Changes to this overlay can be implemented through the nature reserve planning committee and the annual management meeting and recorded as such.

Protected Area Buffer Zone:

Description: An area outside of the protected area where actions and agreements are taken to protect the integrity of the protected area and to enhance the livelihoods of protected area neighbours.

Objective: To influence land use adjacent to the protected area in order to manage external pressures and threats that may threaten its values and objectives.

Permissible activities and infrastructure: Each protected area must define these desirable or non-desirable activities in terms of its specific values, objectives and risks and considering factors, such as:

- Alien and invasive species.
- Pollution.
- Impact on sense of place or wilderness.
- Habitat fragmentation and isolation.
- Water resource protection.
- Damage causing animal management.
- Climate change adaptation.
- Compatible land use.
- Priority species management.

5 OPERATIONAL MANAGEMENT FRAMEWORK

This section translates the strategic framework, described in Section 3 above, into management activities and targets, which will be used to inform annual plans of operation and the resources required to implement them. The management targets will form the basis for monitoring of performance in implementing the plan and are thus measurable.

5.1 Determination of priorities for strategic outcomes

In the tables that follow in this section, a column has been included entitled "Priority", which is intended to convey the level of priority attached to its strategic outcome. The purpose of prioritising activities is to direct funds and resources to the most important activities, in the event that there are insufficient funds or resources to undertake all of the activities outlined in a particular year. Priorities are ordered in three categories, which have been determined on the following basis:

Priority 1:	A management target that is central to the responsibilities and mandate of Ezemvelo KZN Wildlife or that addresses an aspect of management that is fundamental to the protection of the values and purpose of Beachwood Mangroves Nature Reserve.
Priority 2:	A management target that addresses an aspect of management that contributes towards community involvement and support for the conservation of Beachwood Mangroves Nature Reserve, which is a key principle of effective protected area management.
Priority 3:	A management target that indirectly contributes towards the protection of biodiversity or the development of social and/or economic benefits and opportunities for Beachwood Mangroves Nature Reserve and/or its surrounding local communities.

The priorities are presented in the tables below, using the colour system above, which depicts the level of priority shown for the particular strategic outcome. In addition, a date is indicated in the priorities column for each strategic outcome, which is intended to convey the end date by which the management target should be achieved.

5.2 Legal compliance and law enforcement

Through its mandate to undertake the conservation and management of protected areas in KwaZulu-Natal, Ezemvelo KZN Wildlife must ensure that the province's protected areas are appropriately legally protected and that the laws governing the use of protected areas and the prohibition of particular activities are enforced. In fulfilling this role, the managers of Beachwood Mangroves Nature Reserve will adhere to the following guiding principles.

- All reasonable efforts must be made to ensure the effective conservation of biodiversity within and on the boundaries of the nature reserve. It should be noted that Ezemvelo KZN Wildlife's mandate to protect biodiversity extends beyond the protected areas; however, this responsibility is taken up by other components of the organisation.

- Cooperative structures should be established to enable participation by key stakeholders, such as local communities, and the South African Police Service in addressing offences and breaches of the law.

- Law enforcement within the nature reserve will be undertaken through surveillance, monitoring and appropriate reaction in the event of an offence.

5.3 Stakeholder engagement

Constructive relationships with adjacent landowners and communities are an important aspect of the effective conservation of protected areas. Community participation should be aimed at developing a strong sense of partnership between the communities around the nature reserve and its managers. The following guiding principles should be adhered to.

- Efforts should be made to ensure that the communities living around the nature reserve are aware of the role that it fulfils in biodiversity protection and the provision of ecological services to the region.

- Community participation should be undertaken to engender a sense of ownership of the nature reserve, within the communities, and support for its biodiversity conservation goals and objectives.

- A common understanding of the issues that affect both the nature reserve and the surrounding communities should be developed and efforts to resolve them should be undertaken cooperatively.

The operational requirements for legal compliance and enforcement, and community participation, are set out in Tables 5.1 and 5.2 below.

Table 5.1: Framework for legal compliance and law enforcement

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
LAW ENFORCEMENT					
There is adequate law enforcement within Beachwood Mangroves Nature Reserve in order to achieve the protected area vision.	Set annual security targets at the annual management meeting to address security issues.	Minutes of the annual management meeting indicating security targets.	▪ Trespassing. ▪ Illegal bait collection. ▪ Vandalism and theft.	**Year 1**	OIC and regional management
	Implement the annual plan of operation and a programme of patrols of the nature reserve and its boundaries, as contained in the abovementioned plan, to address security issues.	▪ Regular patrols covering the full extent of the nature reserve. ▪ Prosecution of offender caught committing an offence.	Specific security targets, as set out in the annual security plan of operations, not achieved.	**Annually**	OIC

Table 5.2: Framework for community participation

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
Stakeholder Engagement					
Constructive community involvement in Beachwood Mangroves Nature Reserve's management through effective stakeholder engagement; and provision of support to the community in developing its understanding of the management of Beachwood Mangroves Nature Reserve.	Attend relevant community forums in order to ensure open lines of communication between members of the local communities, stakeholders and the Beachwood Mangroves Nature Reserve Manager.	Maintain relationships with various stakeholder groups, such as Umgeni Conservancy, DUCT, Honorary Officers, eThekwini Biodiversity Forum, Beachwood Golf Course.	▪ Scheduled meetings with forum are not held or attended by KZN Wildlife Staff. ▪ Community dissatisfaction with Beachwood Mangroves Nature Reserve.	**Year 1 Ongoing**	OIC
	Provide background to the management decisions to the Beachwood Mangroves stakeholders.	Reserve plans and management information presented to the stakeholders as they are developed.	Lack of understanding of management practices at Beachwood Mangroves Nature Reserve.	**Year 1 Ongoing**	OIC

5.4 Buffer zone protection and regional management

5.4.1 Protected area expansion

Ezemvelo KZN Wildlife's Protected Area Expansion Plan has not identified any areas for protected area expansion around Beachwood Mangroves Nature Reserve. However, in order to safeguard the biodiversity within the nature reserve, and to counter any threatening processes or edge effects, suitable buffer zones and appropriate land uses in these zones should be identified. Appropriate actions may then be taken to secure these buffer zones through protected area expansion mechanisms and local planning tools, as described in Section 5.4.2 below. In ensuring the protection of its biodiversity, the following guiding principles will be adopted in terms of protected area expansion and buffer zone management:

- If under threat, efforts must be made to formally protect areas located outside of the nature reserve.
- Threatening processes and edge effects on the nature reserve's boundary, and beyond it, must be identified.
- Appropriate actions must be taken to manage threatening processes and edge effects on the nature reserve's boundary, and beyond it.

While it is acknowledged that the land use around Beachwood Mangroves has a negative impact on the nature reserve, it is still important that management should influence and comment on land use change in order to ensure that the land use does not change to something that could potentially be more detrimental to the nature reserve.

5.4.2 Local and regional planning

It is important, in managing the buffer areas around the nature reserve, that Ezemvelo KZN Wildlife work with local government authorities to ensure that their land use planning considers the biodiversity conservation imperatives of Beachwood Mangroves Nature Reserve. In this regard, it is necessary to ensure that buffer zone considerations are captured in planning tools, such as IDP's and SDF's. In developing relationships with the local and district municipality, Ezemvelo KZN Wildlife will adhere to the following guiding principles:

- Relationships with local government and other provincial and national departments will be developed in the spirit of cooperative governance.
- Ezemvelo KZN Wildlife will endeavour to assist the local and district municipality in determining appropriate land uses and development strategies in the areas surrounding the nature reserve.
- Ezemvelo KZN Wildlife will endeavour to align its plans and strategies with the programmes and strategies of the local and district municipality, where appropriate.

The detailed operational requirements for buffer zone protection and regional management are set out in Table 5.3 below.

Table 5.3: Framework for buffer zone protection and regional management

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
LOCAL AND REGIONAL PLANNING					
Capture of buffer zone considerations in IDP's and SDF's and municipal schemes.	Negotiate the buffer zone requirements for inclusion into the local and district municipality IDP's and SDF's and municipal schemes in order to avoid inappropriate land uses in Beachwood Mangroves Nature Reserve's buffer zones.	Report presented and negotiated with the municipalities for inclusion in their IDP's and SDF's and schemes.	Approval of inappropriate land uses on the boundaries of the nature reserve.	**Year 3**	OIC

5.5 Eco-tourism development

5.5.1 Visitor Management

Ezemvelo KZN Wildlife has the mandate to sustainably develop Beachwood Mangroves Nature Reserve to fully realise its potential, within the context of protecting its biodiversity and cultural values. However, the focus of Beachwood Mangroves Nature Reserve is on environmental education and not on tourism. It has been developed to its full capacity and there are no additional opportunities, and nor is it appropriate, to develop income-generating tourist activities within the nature reserve.

5.5.2 Environmental interpretation and education

Environmental interpretation and education of Beachwood Mangrove Nature Reserve's natural and cultural resources will be aimed at creating awareness, understanding and appreciation of its biodiversity and ecological functions, and their significance. In developing an environmental interpretation and education programme, the following guiding principles should be adhered to:

- There should be a strong focus on neighbouring communities, in efforts to engage, inform and benefit them.
- Wherever possible, local community members should be trained to assist and operate environmental interpretation and education tours.

The detailed operational requirements for eco-cultural tourism development and environmental interpretation and education are set out in Table 5.4 below. It must be noted that WESSA conducts environmental education within the Beachwood Mangroves Nature Reserve.

Table 5.4: Framework for eco-cultural tourism

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
VISITOR MANAGEMENT					
Ensure that all visitor activities are appropriate to the goals of the nature reserve and to its neighbours.	Capture visitor information in order to better understand the nature reserve's visitor numbers and target group. This will assist in developing an understanding of the needs in the region in order to inform the types of products and activities that may be offered within the existing infrastructure (which cannot be expanded).	Annual report of visitor information. This will create understanding of annual tourist numbers and a tourism market profile for the protected area.	▪ Changing visitor trends. ▪ Declining visitor numbers.	**Annually**	OIC
ENVIRONMENTAL INTERPRETATION AND AWARENESS					
Support organisations (WESSA, Green Hub, Sea World & Honorary Officers) conducting environmental interpretation and education programmes.	Support efforts to identify and produce educational material and signage for the education centre and existing hiking trails.	▪ Education material in education centre. ▪ Adequate signage on trails.	▪ Outdated or material not available in education centre. ▪ Negative publicity.	**Year 1**	OIC

5.6 Conservation management

5.6.1 Invasive species control

A listed invasive species means any species, which is listed in terms of section 70 of the Biodiversity Act, whose establishment and spread occurs outside of its natural distribution range. Such plants are considered to be a serious threat to the ecological functioning of natural systems and to water production, and must be strictly controlled. In undertaking invasive plant control, the following guiding principles will be adhered to:

- Invasive plant control will require an ongoing programme that prioritises key infestations along water courses, drainage lines and upper catchment areas.
- Initial clearing efforts should focus on containing infestations that are most likely to spread into new areas.
- All follow-up requirements must be strictly adhered to, otherwise the problem will be exacerbated.
- Strategic partnerships and poverty relief programmes, such as the Working for Water programme, should be utilised in controlling invasive plants.
- If herbicide treatment is required, only herbicides registered for use in or near water must be used in that context and the surfactant in the herbicide, or that used in conjunction with it, must be non-detrimental to aquatic animal life.

Alien animal species can threaten the ecological, genetic or natural aesthetic integrity of Beachwood Mangroves Nature Reserve and can be vectors for the spread of diseases. In dealing with the control of alien animals, procedures to deal with animals that stray into the nature reserve should be developed. In addressing alien animal control, the following guiding principle should be adhered to:

- Feral animal species that pose a threat to indigenous species will be destroyed (as humanely as practicably possible, with due regard to the tourist experience).

Alien plants and animals that occur within Beachwood Mangroves Nature Reserve, as noted in Sections 2.6.8 and 2.6.9, include:

- The fish, *Poecilia reticulata* (Guppy) and *Xiphophorus helleri* (Swordtail). Neither species are perceived to be a problem, since their numbers are kept in check by increased salinity closer to the estuary.
- Birds, such as Indian Mynahs, which are now so much part of Durban that they are impossible to eradicate.
- Stray domestic animals, such as cats and dogs, which present a threat to indigenous habitats and species.
- Water hyacinth (*Eichhornia crassipes*), which is the most important aquatic alien plant species in the upper reaches of the Mgeni Estuary. This species is a declared weed and must be controlled accordingly. Water hyacinth has been recorded in the mangroves themselves in the past.

- The plants, *Vallisneria spiralis* (Eelgrass) and *Salvinia molesta* (Kariba weed). These plants are found in the extreme north of the nature reserve, where the water is sufficiently fresh.
- A more recent and serious threat is *Sagittaria platyphylla* (Elliptic-leaf [Slender] Arrowhead). In South Africa, it is a serious weed and forms dense colonies on very wet soils that become more open as the species mixes with other species of deeper water levels. The plant has strong roots and can survive through wide variations of the water level, slow currents and waves. It displays an affinity for high levels of phosphates and hard waters. Within Beachwood Mangroves, SANBI have taken responsibility for clearing/controlling and monitoring this species.
- A number of terrestrial invader plants found in the nature reserve and these are listed in Appendix E.

There is an ongoing need to monitor and control alien invasive plants and animals within the nature reserve, as well as to monitor for those that could eventually enter the nature reserve, such as the mollusc, *Tarebia granifera.*

5.6.2 Soil erosion control

At the moment there is no perceived problem with soil erosion at Beachwood Mangroves Nature Reserve; there is only one road in the nature reserve and the trail system is on a boardwalk and there are gabions present adjacent to the M4. Therefore, potential erosion-inducing structures and activities within the nature reserve are limited. Nevertheless, ongoing monitoring for areas of accelerated erosion will take place.

5.6.3 Sedimentation management

An estuarine and mangrove environment is normally dynamic and successional changes are inevitable and a normal part of the system. However, the nature of the urban environment in which Beachwood Mangroves is located means that changes to the system are highly accelerated. The main impact to the northern aspect of Beachwood Mangroves Nature Reserve, in the vicinity of Rocket Hut, is the issue of siltation. In the past, a working group, consisting of the local Parks Department, Coastal Drainage Department, Ezemvelo KZN Wildlife and the Durban Municipality Environment Section was formed to address this issue by servicing the silt trap and maintaining the water flow through the Beachwood Creek. This working group was reconstituted in 2010 to address these issues.

The two main issues relating to siltation at the Rocket Hut entrance area are:

1. The freshwater runoff draining the Durban North/Broadway area. This freshwater and its silt load enter the nature reserve via a culvert. A silt trap has been constructed to mitigate this.
2. The Beachwood Creek, which periodically clogs up, especially when the silt trap mentioned above has not been emptied. This results in reduced tidal influence and drainage at the upper reaches of the creek and mangroves.

Over time, the saltwater influence in the northern aspect of the nature reserve has diminished because of the above, and the blockages that impede drainage of the mangroves at the golf course end stress the mangroves there when their pneumatophores become

submerged for prolonged periods. Increased sediment input will raise the level of the substrate, effectively taking it out of tidal influence as well. The net effect over the years is the "freshening" of that portion of the nature reserve. This proliferation of the freshwater mangrove, *Hibiscus tiliaceus,* in the immediate vicinity may be an indicator of this (Taylor, 1998).

See Table 5.5 below for details of sedimentation management.

Table 5.5: Framework for conservation management – invasive species control and soil erosion control

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
INVASIVE SPECIES CONTROL					
Implement alien species control plan for Beachwood Mangroves Nature Reserve fauna and flora.	Implement the alien species control plan that addresses the biological, legal and operational requirements for terrestrial and aquatic fauna and flora.	▪ Continue alien species control efforts. ▪ Compliance with the Biodiversity Act.	▪ Non-compliance with NEMBA and CARA. ▪ Further spread of existing levels of infestation of listed invasive species. ▪ New infestations of listed invasive species. ▪ Input and output of control operations not at optimal level due to lack of planning.	**Year 1**	OIC
	Develop an annual plan of operation for alien species control in the nature reserve, setting specific targets.	Minutes of annual management meeting containing the annual plan of operation and targets for alien species control.	▪ Non-compliance with NEMBA and CARA. ▪ Further spread of existing levels of infestation of listed invasive species. ▪ New infestations of listed invasive species. ▪ Input and output of control operations not at optimal level due to lack of planning.	**Annually**	OIC

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
SOIL EROSION AND SEDIMENTATION CONTROL					
Identify, rehabilitate and manage areas that have been significantly impacted by accelerated soil erosion.	Once an area of accelerated erosion is identified, an approach will be developed and implemented to rehabilitate the area.	▪ Erosion problems identified. ▪ Implementation of accelerated soil erosion control measures in areas identified.	▪ Erosion areas not being identified. ▪ Further erosion of impacted areas.	**Ongoing**	OIC
Reduce volume of sediment entering the nature reserve near Rocket Hut and reduce clogging up at Beachwood Creek.	▪ Silt trap needs to be adequately maintained and cleared of accumulated sediment frequently. ▪ Silt plugs need to be cleared from the Beachwood Creek to transmit tidal influences to the upper reaches of the mangroves.	Coordinated, ongoing communication and timeous clearing of silt coordinated with Municipality.	▪ Loss of saltwater influence in northern aspect of nature reserve. ▪ Blockages impeding drainage of nature reserve. ▪ Proliferation of freshwater mangrove, *Hibiscus tiliaceus*.	**Ongoing**	OIC and eThekwini Municipality

5.6.4 Collection of biological material

There are no opportunities within Beachwood Mangroves Nature Reserve for sustainable use of natural resources, although fishing does take place within the Mgeni Estuary and off the beach. However, activities such as the collection of biological materials/samples for legitimate scientific purposes, from *bone fide* South African research institutions, and in accordance with relevant Ezemvelo KZN Wildlife policies, will be considered.

The success of these applications will be influenced by the ability of the nature reserve's managers to effectively control and monitor such resource use.

The detailed operational requirements for collection of biological material are set out in Table 5.6 below.

Table 5.6: Framework for conservation management – Collection of biological material

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
COLLECTION OF BIOLOGICAL MATERIAL					
Collection of biological material is undertaken in a legal manner and conforms to National Legislation (NEMBA, Act No.10 of 2004, Chapter 6).	Monitor registered research projects to ensure that collection conforms to policies and that appropriate permits are in place.	Ensure that all collecting is done under permit.	Illegal collection of biological material or samples.	**Ongoing**	Ezemvelo's Ecological Advice Unit and implementation by OIC

5.6.5 Wildlife management

No active management of any wildlife species takes place within Beachwood Mangroves Nature Reserve. Instead, the system is managed as a whole, on the basis that a healthy system supports the species dependent upon it. Nevertheless, the general principles for wildlife management within protected areas are laid out below, in the unlikely event that any interventions are needed.

Management interventions related to indigenous wildlife will be limited to those that are for the purposes of safeguarding populations of key species, including rare and endangered species, or enhancing ecological functioning to meet set conservation targets. In addition, interventions may be required for human/wildlife conflict management. In addressing wildlife management, the following guiding principles should be adhered to:

- Wildlife management must be focussed primarily on protecting the ecological functioning of the nature reserve and meeting set provincial conservation targets for species and vegetation types.

- The introduction of indigenous species into the nature reserve must be undertaken in accordance with relevant Ezemvelo KZN Wildlife policies.

- Animals that become a danger or excessive nuisance to persons and property, due to either habituation or aberrant behaviour, must be managed in accordance with relevant Ezemvelo KZN Wildlife policies.

5.6.6 Conservation targets

The 2011 version of the KwaZulu-Natal Systematic Biodiversity Plan identifies the provincial conservation targets referred to in Section 5.6.5, above. The conservation of Beachwood Mangroves Nature Reserve contributes towards the achievement of a portion of some of these targets. Targets will continue to be updated as knowledge develops about the ecology of areas, connectivity between them, and other process requirements for ecosystems, communities and species. On this basis, the conservation targets should be viewed as a set of working hypotheses, around which conservation planning and evaluation can take place. An advantage of developing strategies around targets is that this process highlights critical knowledge deficits, thus guiding future research.

See Table 5.7 for systematic biodiversity planning conservation targets to which Beachwood Mangroves Nature Reserve contributes and Table 5.8 for specific identified targets for Beachwood Mangroves Nature Reserve.

Table 5.7: Systematic biodiversity planning conservation targets to which Beachwood Mangroves Nature Reserve contributes

Feature	Description	Percentage of target located within Beachwood Mangroves	Notes
Eremidium sp.	Grasshopper	0.00	% of historic distribution
Doratogonus falcatus	Millipede	0.01	% of historic distribution
Doratogonus rubipodus	Millipede	0.33	% of historic distribution
Edouardia conulus	Mollusc	0.00	% of historic distribution
Barleria natalensis	Plant	0.27	% of historic distribution
Begonia rudatisii	Plant	7.70	% of historic distribution
Dahlgrenodendron natalense	Plant	3.85	% of historic distribution
Diaphananthe millarii	Plant	38.50	% of historic distribution
Gerrardanthus tomentosus	Plant	3.08	% of historic distribution
Pseudoscolopia polyantha	Plant	3.08	% of historic distribution
Streptocarpus molweniensis	Plant	6.16	% of historic distribution
Vernonia africana	Plant	0.27	% of historic distribution
Bradypodion melanocephalum	Reptile	1.01	% of historic distribution
Scelotes inornatus	Reptile	0.24	% of historic distribution
KwaZulu-Natal Dune Forests	Vegetation Type	0.04	% of historic distribution
Mangrove Forests	Vegetation Type	0.35	% of historic distribution
North Coast Grassland	Vegetation Type	0.00	% of historic distribution

Where possible, specific conservation and monitoring strategies should be established for ecological features and species for which conservation targets have been set.

The detailed operational requirements for the achievement of conservation targets are set out in Table 5.8 below.

Table 5.8: Framework for conservation management – conservation targets

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
Critical ecological processes and functions are maintained within Beachwood Mangroves Nature Reserve.	The maintenance of critical ecological processes must be included in all subsidiary plans.	All subsidiary plans must reflect critical ecological processes.	▪ Ecological degradation ▪ Change in composition. ▪ Don't know what these critical processes are yet.	**Ongoing**	Ezemvelo KZN Wildlife Ecological Advice Unit
Biological monitoring programmes are developed and implemented to determine the success of management interventions in protecting the ecosystems, communities and species of Beachwood Mangroves Nature Reserve.	The biological monitoring and surveillance programme must be included in all subsidiary plans.	▪ All subsidiary plans must include a biological monitoring programme. ▪ Surveillance and monitoring plans for key threatened processes are required. ▪ Monitoring plans for key rare and endangered species to be developed.	Lack of awareness of the status of key threatening processes, including infestations of invasive plant species and severity and extent of soil erosion.	**Ongoing**	Ezemvelo KZN Wildlife Ecological Advice Unit

5.7 Operational management

5.7.1 Financial and human resources

Beachwood Mangroves Nature Reserve cannot be effectively managed without adequate sustained funding and sufficient human resources. In addressing the financial and human resource needs of the nature reserve, the following guiding principles should be adhered to:

- Adequate funding must be provided for the management of the nature reserve to ensure the protection of its biodiversity and cultural values and the continued provision of its ecosystem services.
- A capable, experienced administrator and leader is required to fulfil the position of nature reserve manager.
- Adequate, properly trained and experienced staff must be employed at the nature reserve to undertake the operations required for its effective management.

5.7.2 Facilities and infrastructure

In order for Beachwood Mangroves Nature Reserve to operate appropriately, adequate facilities and infrastructure need to be developed and maintained both for management and education purposes. In addressing facilities and infrastructure needs in the nature reserve, the following guiding principles will be adhered to:

- Facilities and infrastructure must be maintained to avoid any damage to the environment and ensure the safety of staff and visitors to the nature reserve.
- Facilities and infrastructure must be provided to ensure the effective management and operation of the nature reserve.

The detailed operational requirements for financial and human resource, and facilities and infrastructure development and management, are set out in Tables 5.9 and 5.10 below.

Table 5.9: Framework for operational management – financial and human resources

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
FINANCIAL RESOURCES					
Development of a five-year Financial Plan that identifies the resource needs to achieve the objectives for the nature reserve.	▪ Undertake an assessment of past income and expenditure trends in the nature reserve. ▪ Develop a five-year projection of income and expenditure targets that will allow for the effective achievement of the nature reserve's objectives.	▪ Adequate funding to achieve the objectives of the nature reserve.	▪ Inadequate funding to effectively protect and operate the nature reserve.	**Year 1**	Ezemvelo KZN Wildlife Regional Management Unit
HUMAN RESOURCES					
Ensure that Beachwood Mangroves Nature Reserve is adequately staffed and conforms to legal staffing practices.	▪ Motivate for all vacant staff positions to be filled. ▪ Comply with OH&S legislation, labour legislation and internal Ezemvelo policies.	▪ Sufficient staff to achieve nature reserve objectives. ▪ Clean bill of health.	▪ Vacant post. ▪ Non-compliance with legislation and policies. ▪ Outstanding grievances.	**Ongoing**	OIC

Table 5.10: Framework for operational management – facilities and infrastructure

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
FACILITIES AND INFRASTRUCTURE					
All facilities and infrastructure in Beachwood Mangroves Nature Reserve are adequately maintained.	Develop and implement an infrastructure maintenance schedule for the nature reserve that will address: ▪ Environmental, health and safety requirements. ▪ Road maintenance - including rehabilitation plans where necessary. ▪ Fence maintenance - maintenance and monitoring. ▪ Building maintenance and compliance with relevant building regulations and legislation.	▪ Infrastructure maintenance plan developed. ▪ Regular scheduled maintenance of all facilities and infrastructure.	Environmental, health or safety incidents associated with inadequately maintained facilities and infrastructure.	**Year 1**	OIC
	Develop an annual plan of operation for infrastructure of the protected area through the annual management meeting.	Regular scheduled maintenance of all facilities and infrastructure.	▪ Environmental, health or safety incidents associated with inadequately maintained facilities and infrastructure. ▪ Environmental damage resulting from poorly maintained, roads, tracks and trails.	**Annually**	Regional Management
	Implement the annual plan of operation and infrastructure maintenance schedule.	Targets set in annual plan of operation through the management meeting.	Not achieving the targets, as set in the annual plan of operation.	**Ongoing**	OIC

Strategic outcome	Management activities	Management targets	Indicators of Concern	Priority	Responsibility
Service infrastructure and practices in Beachwood Mangroves Nature Reserve do not cause environmental harm.	▪ Where service infrastructure, including that for water supply, electricity and sewerage, is causing environmental harm, ensure proper maintenance is being undertaken and, if necessary, upgrade infrastructure or modify practices to address this. ▪ Determine and implement appropriate strategies for the management and recycling of waste in the nature reserve.	Appropriately functioning service infrastructure and systems that do not cause harm to the environment.	Pollution events or incidents associated with service infrastructure and systems.	**Ongoing**	OIC

6 MONITORING AND REPORTING

Monitoring and reporting is a critical component of the adaptive management cycle. It enables the effective assessment of management interventions and, if necessary, can be used to direct modifications of management in an effort to achieve the outcomes required.

6.1 Annual monitoring

The annual monitoring schedule should be designed to monitor the implementation of aspects or components of the management plan. It should be designed to be straightforward and relatively easy to implement by on-site staff. In accordance with the Ezemvelo KZN Wildlife norms and standards for surveillance and monitoring (Goodman, 2011), monitoring is characterised by:

- An objective, target or desired state of the attribute or resource (as described in the management targets in Section 5 above).
- Being part of a formalised adaptive management cycle.
- Establishing and repeatedly evaluating the measures of success of conservation projects or management interventions.

Records should be maintained of all key management interventions and of problem events or incidents such as uncontrolled access, poaching, illegal plant collection or uncontrolled/arson fires. In terms of the norms and standards set for surveillance and monitoring (Goodman, 2011), these incidents would be deemed to be surveillance.

Scientific monitoring programmes may be established to monitor specific management interventions, such as measures for the protection of flagship species. Not all of the management interventions will be monitored through the monitoring schedule. Most of the outcomes of the monitoring process will be captured in an annual plan, which will be used to inform the following year's annual plan of operation.

On this basis, a monitoring schedule for Beachwood Mangroves Nature Reserve is set out in Table 6.1.

Table 6.1: Annual monitoring schedule for Beachwood Mangroves Nature Reserve

Management issue	Parameters to be monitored	Monitoring measures	Monitoring frequency	Responsibility	Reporting requirements
Law enforcement	Schedule of patrols	Written record	Weekly	Nature Reserve Manager	Annual report
	Illegal incidents	Photographs/written record	Per event		Record of event
	Access control measures	Written record	Annually		Annual report
Protected area expansion	Influx of listed invasive vegetation on the nature reserve's boundaries	Surveillance plan	To be determined	Nature Reserve Manager	Annual report
Local and regional planning	Land uses that are approved in the areas around the nature reserve in local and regional IDP's and SDF's	Written record	Annually	District Manager	Annual report
Visitor Management	Visitor statistics	Visitor entries, bookings and accommodation data	Ongoing	Nature Reserve Manager	Annual report
	Attendance of environmental interpretation and education programmes	Written records	Annually	Ezemvelo KZN Wildlife Community Conservation Unit	Annual report
Invasive plant control	Areas subject to invasive plant control	Monitoring plan	To be determined	Nature Reserve Manager	Annual report
	State of areas in which invasive plants have been eradicated				
	Records of labour hours/days	Written record	Annually		Annual report
	Herbicide usage	Written record	Annually		Annual report
Alien animal control	Control measures for alien animals found within the nature reserve	Written record	Per event	Nature Reserve Manager	Record of event

Management issue	Parameters to be monitored	Monitoring measures	Monitoring frequency	Responsibility	Reporting requirements
Soil erosion control	Areas subject to erosion control	Monitoring plan	To be determined	Nature Reserve Manager	Annual report
	State of rehabilitated areas of erosion				Annual report
Conservation targets	Incidents related to flagship species	Photographs/written record	Per event	Nature Reserve Manager	Record of event
	Status of key rare and endangered species, particularly those for which conservation targets have been set	Monitoring plan	To be determined	Nature Reserve Manager	Annual report
Biological collection	Species and amount of material collected	Photographs/written records	Per event	Nature Reserve Manager	Annual report
Human resources	Staffing levels	Number of full-time staff	Annually	Nature Reserve Manager	Annual report
Facilities and infrastructure	State of roads, tracks and trails	Photographs/written records	Quarterly	Nature Reserve Manager	Annual report
	State of the boundary fence	Photographs/written records	Monthly		Annual report
	Rainfall	Written record	Monthly		Annual report
	State of facilities and service infrastructure	Maintenance schedule/written records	Monthly		Annual report
	Pollution events	Photographs/written records	Per event		Record of event

As set out in Table 6.1, the following issue requires a surveillance plan:

- The influx of listed invasive vegetation on the nature reserve's boundaries.

In addition, the following issues require a monitoring plan:

- Measures taken to control invasive plant species (indigenous and alien).
- Measures taken to control soil erosion.
- Measures taken to manage rare and endangered species, particularly those for which conservation targets have been set.
- The ecological status of the hydrological system within the nature reserve.

These surveillance and monitoring plans must be developed and implemented in accordance with the Ezemvelo KZN Wildlife Norms and Standards: Surveillance and Monitoring Plans for Biodiversity (Goodman 2011).

The preparation of these plans must be undertaken by the Ezemvelo KZN Wildlife Regional Ecological Advice Unit, with the support of the Surveillance and Monitoring Working Group of Ezemvelo KZN Wildlife.

6.2 Annual management plan implementation review

The purpose of undertaking an annual performance review of implementation of the management plan will be to:

- Determine how effectively the management plan has been implemented.
- Assist in determining the focus for the annual plan of operation and the setting of appropriate time frames and budgets.
- Enable effective adaptive management by identifying changes and modifying management interventions.

The report produced from the annual management plan implementation review should be submitted to the Regional Operations Committee, prior to the annual management meeting for Umhlanga Lagoon Nature Reserve, for its review and comment. Records of recommendations for update/changes to the management plan should be kept so that when the plan is revised, these recommendations can be assessed and included, where necessary. This should be undertaken in the form of a running list, which is updated in each annual report so that the final annual report before the review of the management plan contains the complete list of recommendations. The review process should include:

- Any recommended minor amendments to the management plan that do not affect the substance of the vision, objectives or zonation.
- The results of an evaluation of the management effectiveness achieved for the nature reserve, calculated using Ezemvelo KZN Wildlife Protected Area Management Effectiveness evaluation tool, which meets the criteria of the national Department of Environmental Affairs' effectiveness evaluation guidelines, and was developed using

the WWF and World Bank Protected Area Management Effectiveness Tools (Stolton *et al*., 2007).

Any proposed significant changes to the management plan that are likely to result in amendment to the vision, objectives and zonation must be supported by the Regional Operations Committee and the Operations Committee (OPSCOM, or its operational successor) before being subjected to the appropriate stakeholder participation process and before OPSCOM recommends that the proposed amended management plan be submitted for authorisation to the Ezemvelo KZN Wildlife Executive Committee, Board, and onward to the MEC.

7 BEACHWOOD MANGROVES NATURE RESERVE ANNUAL PLAN OF OPERATION

Each year, an annual plan of operation will be prepared, based on the objectives, strategic outcomes, management activities and targets contained in the protected area management plan.

7.1 Implementation of the protected area management plan

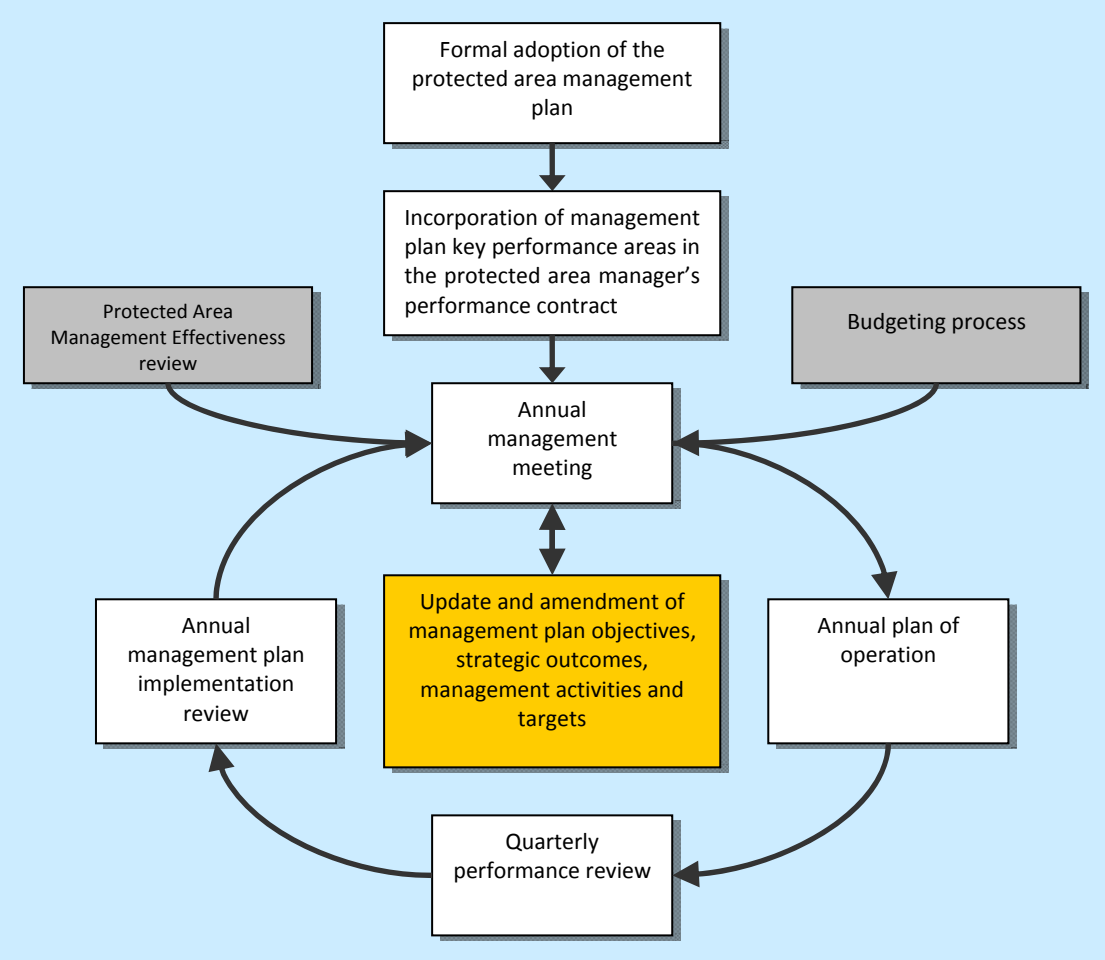


Figure 7.1: Process for the implementation of Protected Area Management Plans

Each year, an annual management meeting is held for each protected area managed by Ezemvelo KZN Wildlife. In terms of the implementation of the management plan, the purpose of the annual management meeting for the nature reserve will be to:

- Finalise the annual report, as part of the annual management plan implementation review, described in Section 6.2 above.
- As part of the annual performance review, determine the need to modify or change any of the management plan's objectives, strategic outcomes, management activities or targets.
- Determine management activities for the coming year and set goals for each quarter, based on the key performance areas set out in the management plan, in accordance with the nature reserve manager's performance contract.

- Determine how budgets will be spent in an effort to achieve the goals for each of the quarters of the coming year.

The minutes and notes of the annual management meeting will be compiled in an annual plan of operation, which will include all of the information, set out above, and will determine what management activities need to be completed for the coming year, based on the management plan. The annual plan of operation will be tied to staff performance contracts, and goals set in them will be categorised within the same key performance areas as the management plan. A pro forma annual plan of operation is set out in Appendix F.

7.2 Responsibilities in implementing the management plan

In the tables in the operational management framework, the responsibilities for the completion of management activities are identified. In many cases, the people responsible for implementing the activities will be in attendance at the annual management meeting and the requirements for the achievement of the management activities can be discussed and agreed to at the meeting. In some cases, however, the management activities may be required to be referred to the Regional Operations Committee and the Biodiversity Conservation Operations Management Meeting (BCOMM) in order to assign responsibility for the completion of the management activity.

7.3 Beachwood Mangroves Nature Reserve resource requirements

In developing annual plans of operation for Beachwood Mangroves Nature Reserve, the resource requirements, associated with management activities and targets set out in the operational management framework, must be considered and budgeted for. The following section broadly identifies the issues that must be considered in determining adequate human resources, funds and equipment for the nature reserve.

7.3.1 Staff and equipment

Annual plans of operation must consider the staff and equipment needs to undertake the following activities:

- Administration and management of the nature reserve.
- Patrolling of the nature reserve and its boundaries.
- An annual burning programme and fire fighting response to wildfires.
- An ongoing invasive plant species control programme.
- An ongoing soil erosion control and rehabilitation programme.
- Ecological monitoring and data capture.
- Maintenance of roads, paths and fences within the nature reserve.
- Maintenance of facilities and infrastructure within the nature reserve.
- Capture of visitor information and statistics.
- Admitting visitors to the nature reserve and charging entrance fees.
- Community liaison and cooperation.
- Environmental interpretation and education.

7.3.2 Projects

In addition to the requirements for annual recurrent funding for the issues outlined above, there will be a need to identify funding requirements for capital projects, as and when these are identified.

7.4 Annual financial plan

The annual plan of operation must contain a financial plan, which must be approved by the Regional Operations Committee. The annual goals, contained in the annual plan of operation, will be prioritised with the approved budget and guided by the strategic direction of the integrated management plan.

7.5 Financial accounting system

It is accepted that all fiscal management will be guided by the Public Finance Management Act (No.1 of 1999) and the Ezemvelo KZN Wildlife Financial Policy and Procedures directive. Funding sources not generated internally will be accounted for in the prescribed process, as determined by the donor source.

7.6 Financial reporting

Annual and quarterly fiscal reports will be submitted, as directed by the Regional Operations Committee.

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9 APPENDICES

Appendix A: Definition of Terms

Appendix B – List of statutes to which the Beachwood Mangroves is subject

Appendix C – List of unpublished and supporting documentation

Appendix C1 – Ezemvelo KZN Wildlife corporate policies

Appendix C2 – Copy of Beachwood Mangroves Nature Reserve proclamation

Appendix C3 – Beachwood Mangroves Nature Reserve Public Participation Report, June 2013

Appendix D – Listed activities requiring environmental authorisation in terms of Regulation R.546, Listing Notice No.3

Appendix E – Species lists

Appendix F – Pro forma annual plan of operation

Appendix A – Definition of terms

Alien species	Species or genotypes, which are not indigenous to Beachwood Mangroves Nature Reserve and the surrounding area including hybrids and genetically altered organisms.
Biodiversity	The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems (as per the National Environmental Management: Biodiversity Act, 2004 [Act No. 10 of 2004]).
Bioprospecting	In relation to indigenous biological resources, means any research on, or development or application of, indigenous biological resources for commercial or industrial exploitation, and includes – the systematic search, collection or gathering of such resources or making extractions from such resources for purposes of such research, development or application (as per the National Environmental Management: Biodiversity Act, 2004 [Act No. 10 of 2004])
Board	The KwaZulu-Natal Nature Conservation Board as defined by the KwaZulu-Natal Nature Conservation Management Act, 1997 (Act No.9 of 1997).
Buffer zone	An area surrounding Beachwood Mangroves Nature Reserve that has restrictions placed on its use or where collaborative projects and programmes are undertaken to afford additional protection to the nature reserve.
Co-management	The term 'Co-management' must be understood within the context of Section 42 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).
Cultural heritage	As defined in Article 1 of the World Heritage Convention (UNESCO) 1972 , 'cultural heritage' is considered as "monuments, architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of (…) value from the point of view of history, art or science, groups of buildings, groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of significance from the point of view of history, art or science, sites, works of man or the combined works of nature and man, and areas including archaeological sites which are of (…) value from the historical, aesthetic, ethnological or anthropological point of view." For the purpose of this IMP, living heritage features such as mountains, pools, rivers, boulders, etc. as well as palaeontological features are included under this definition.
Eco-cultural Tourism (ecotourism):	The travel to natural areas to learn about the way of life and cultural history of people, the natural history of the environment, while taking care not to change the environment and contributing to the economic welfare of the local people (adapted from a definition of ecotourism by Hecto Ceballos Lascurain).
Ecological integrity	The sum of the biological, physical and chemical components of an ecosystem and its products, functions and attributes (as per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
Ecosystem	A dynamic complex of animal, plant and micro-organism communities and their non-living environment interacting as a functional unit (as per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).

Ecosystem services	As defined in Section 1 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) as "environmental goods and services" meaning: a. Benefits obtained from ecosystems such as food, fuel and fibre and genetic resources. b. Benefits from the regulation of ecosystem processes such as climate regulation, disease and flood control and detoxification. c. Cultural non-material benefits obtained from ecosystems such as benefits of a spiritual, recreational, aesthetic, inspirational, educational, community and symbolic nature;" For the purposes of this IMP, sustainable water production is also specifically included under this definition.
Environmental degradation	The deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the loss of species or undesirable reduction of species population numbers from a specific area from an environmental health perspective
Ezemvelo KZN Wildlife	Nature Conservation Service as established in terms of the KwaZulu-Natal Nature Conservation Management Act No. 9 of 1997.
Indigenous species	In relation to a specific protected area, means a species that occurs, or has historically occurred, naturally in a free state of nature within that specific protected area, but excludes a species introduced in that protected area as a result of human activity (as per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
Invasive species	Means any species whose establishment and spread outside of its natural distribution range – Threaten ecosystems, habitats or other species or have a demonstrable potential to threaten ecosystems, habitats or other species. May result in economic and environmental harm or harm to human health. (As per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
Joint management	The agreed co-ordination of management and/or management actions by landowners and/or mandated managers on their individual or combined properties in order to achieve common management objectives.
Local community	Any community of people living or having rights or interests in a distinct geographical area (as per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
Management	In relation to a protected area, includes control, protection, conservation, maintenance and rehabilitation of the protected area with due regard to the use and extraction of biological resources, community-based practices and benefit sharing activities in the area in a manner consistent with the Biodiversity Act (as per the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).

Management authority	In relation to a protected area, means the organ of state or other institution or person in which the authority to manage the protected area is vested (as per the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
Monitoring	The collection and analysis of repeated observations or measurements to evaluate change in status, distribution or integrity in order to track the impacts of directed management implemented to achieve a stated management objective.
Nature conservation	The conservation of naturally occurring ecological systems, the sustainable utilisation of indigenous plants and animals therein, and the promotion and maintenance of biological diversity (as per the KwaZulu-Natal Nature Conservation Management Act, 1997 [Act No.9 of 1997]).
Neighbouring community	The communities and people permanently living in the local municipal area/s bordering onto the Nature Reserve.
Natural heritage	As defined in Article 2 of the World Heritage Convention (UNESCO) 1972 'natural heritage' is as: "natural features consisting of physical and biological formations or groups of such formations, which are of (…) value from the aesthetic or scientific point of view, geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of (…) value from the point of view of science or conservation, natural sites or precisely delineated natural areas of (…) value from the point of view of science, conservation or natural beauty." For the purposes of this IMP, this would include the required ecological integrity of the protected area for the production of ecosystem services.
Partnerships	A co-operative and / or collaborative arrangement between the Game Reserve management / Ezemvelo and a third party that supports the achievement of the Game Reserve management objectives.
Protected areas	Means any area declared or proclaimed as such in terms of section 3 or listed in the Second Schedule to the KwaZulu-Natal Nature Conservation Management Act, 1997 (Act No. 9 of 1997); or Means any of the protected areas referred to in section 9 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).
Protected area management committee	Is the management body that deals with the day-to-day management of the protected area and is chaired by the OIC.
Ramsar Convention	Means: "The Convention on Wetlands of International Importance, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty, which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources." (There are presently 158 Contracting Parties to the Convention, the Convention has broadened its scope to cover all aspects of wetland conservation and wise use, recognising wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities.)

Stakeholders/ interested parties	These are interested individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public. According to the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), "stakeholder" means a person, an organ of state or a community contemplated in section 82 (1) (a), or an indigenous community contemplated in section 82(1) (b).
Surveillance	The collection and analysis of single or repeated measurements to establish status or distribution or integrity at a point in time in the absence of a specific management context or objective.
Sustainable	In relation to the use of a biological resource, means the use of such resource in a way and at a rate that would not lead to its long-term decline; would not disrupt the ecological integrity of the ecosystem in which it occurs; and would ensure its continued use to meet the needs and aspirations of present and future generations of people (as per National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Wilderness area	Means an area designated in terms of section 22 or 26 for the purpose of retaining an intrinsically wild appearance and character, or capable of being restored to such and which is undeveloped and roadless, without permanent improvements or human habitation (as defined by the National Environmental Management: Protected Areas Act, 2003 [Act No. 57 of 2003]).
World heritage site	Means a World Heritage Site as defined in the World Heritage Convention Act, No. 49 of 1999 under Chapter 1, section 1 subsection (xxiv).

Appendix B – List of statutes to which the Beachwood Mangroves Nature Reserve is subject

Biodiversity and Cultural Resource Management and Development:

- Animals Protection Act [No. 71 of 1962]
- Atmospheric Pollution Prevention Act [No. 45 of 1965]
- Conservation of Agricultural Resources Act [No. 43 of 1983]
- Constitution of the Republic of South Africa [No. 108 of 1996]
- Criminal Procedures Act [1977]
- Environment Conservation Act [No. 73 of 1989]
- Forest Act [No. 122 of 1984]
- Hazardous Substances Act [No. 15 of 1973]
- Integrated Coastal Management Act [No. 24 of 2008]
- KwaZulu Nature Conservation Act [No. 8 of 1975]
- KwaZulu-Natal Heritage Management Act [No. 10 of 1997]
- KwaZulu-Natal Nature Conservation Management Act [No. 9 of 1997]
- Natal Nature Conservation Ordinance Regulations [No. 15 of 1974]
- National Environmental Management Act [No. 107 of 1998]
- National Environmental Management: Biodiversity Act [No. 10 of 2004]
- National Environmental Management: Protected Areas Act [No. 57 of 2003]
- National Forests Act [No. 84 of 1998]
- National Heritage Resources Act [No. 25 of 1999]
- National Water Act [No. 36 of 1998]
- National Water Amendment Act [No. 45 of 1999]
- National Veld and Forest Fire Act [No 101 of 1998]
- Nature Conservation Ordinance [No. 15 of 1974]
- Marine Living Resources Act [No. 18 of 1998]

General Management:

- Development Facilitation Act [No. 67 of 1995]
- Disaster Management Act [No. 57 of 2002]
- Fire Brigade Services Act [No. 99 of 1987]
- Local Government: Municipal Systems Act [No. 32 of 2000]
- National Road Traffic Act [No. 93 of 1996]
- National Building Standards Act [No. 103 of 1977]
- Natal Town Planning Ordinance [No. 27 of 1949]
- Occupational Health and Safety Act [No. 85 of 1993]
- KwaZulu-Natal Planning and Development Act [No. 5 of 1998]
- Water Services Act [No. 108 of 1997]

Financial Management:

- Public Finance Management Act [No. 1 of 1999]

Human Resource Management:

- Basic Conditions of Employment Act [No. 75 of 1997]
- Broad-Based Black Economic Empowerment Act [No. 53 of 2003]
- Compensation for Occupational Injuries and Diseases Act [No. 130 of 1993]
- Employment Equity Act [No. 55 of 1998]
- Labour Relations Act [No. 66 of 1995]
- Occupational Health and Safety Act [No. 85 of 1993]
- Pension Funds Act [No. 24 of 1956]
- Skills Development Act [No. 97 of 1998]
- Skills Development Levies Act [No. 9 of 1999]
- Unemployment Insurance Act [No. 63 of 2001]

Appendix C – List of unpublished and supporting documentation

Copies of documents not included in this PAMP available from:

(a) Reserve Management and / or,

(b) Regional Ecologist

Item:

1. Ezemvelo KZN Wildlife Corporate Strategic Plan and Performance Plan for 2009 – 2014.
2. Ezemvelo Corporate Policies and Procedures (Norms & Standards), listed in the table in Appendix C1.
3. Proclamations of Beachwood Mangroves Nature Reserve – Appendix C2.
4. Beachwood Mangroves Nature Reserve Public Participation Report, June 2013 – Appendix C3.

Appendix C1 - Ezemvelo KZN Wildlife corporate policies

The table below lists the Ezemvelo KZN Wildlife corporate policies (norms and standards) referenced from the intranet that are most relevant to Ezemvelo KZN Wildlife protected area management. It is the responsibility of all management and other personnel associated with management of protected areas to ensure that they familiarise themselves and comply with the most recent versions of all Ezemvelo KZN Wildlife Board Approved Policies.

Ezemvelo KZN Wildlife CORPORATE POLICIES (NORMS & STANDARDS)	
Policy File No.	**CORPORATE AFFAIRS**
B 2	· Access to Ezemvelo KZN Wildlife Areas and Employment.
B 5	· Outsourcing of Functions and Services
B 7	· Monuments, Memorials and Names of Protected Areas under the control of Ezemvelo.
B 8	· Restricted use of Board Theatres, Halls and Conference Facilities etc.
B 9	· Code of Ethics / Conduct.
B 10	· Photography in Board Protected Areas.
B 13	· Mission Statement
B 14	· Access to Information.
Policy File No.	**INTERNAL AUDIT**
C 5	· Management Control
	BIODIVERSITY CONSERVATION OPERATIONS
	1. NATURAL RESOURCE SUSTAINABILITY
Policy File No.	**Threatened Species and Ecosystems**
D 1.1	· Disposal of Black Rhino.
D 1.2	· Disposal of Surplus White Rhino.
D 1.3	· Strategy for the Management of Southern White Rhino in KwaZulu-Natal.
D 1.4	· Strategy for the Biological Management of Black Rhino in KwaZulu-Natal.
D 1.5	· Rhinoceros Products.
D 1.6	· Crocodilians
D 1.7	· Cycads.
D 1.8	· Disposal of Threatened Species.

EZEMVELO CORPORATE POLICIES (NORMS & STANDARDS)	
	BIODIVERSITY CONSERVATION OPERATIONS
	1. NATURAL RESOURCE SUSTAINABILITY
Policy File No.	**Exotic and Invasive Species**
D 1.9	· Release of Alien Species.
D 1.10	· Control Measures for Red-billed Quelea.
D 1.12	· Grass Carp.
D 1.13	· Establishment of Alien Plantations.
	·
Policy File No.	**Migratory Species**
D 1.14	· Black Wildebeest and Blue Wildebeest Hybridization and Conservation.
D 1.15	· Permit authorising the collection of Biological Material within Board Areas.

	2. CONSERVATION EFFECTIVENESS
Policy File No.	**Strategic Applications**
D 2.1	· Involvement of the KwaZulu-Natal Nature Conservation Board in Project 8 of the MAB (Man an Biosphere) Programme.
Policy File No.	**Conservation Management: Protected Area Management**
D 2.2	· Management of Wilderness Areas.
D 2.3	· Protected Area Development.
D 2.4	· Prohibition of Works and Servitudes in Board Areas.
D 2.5	· Zonation and Regulations for the control of off-road vehicles on beaches controlled by the Boa
D 2.6	· Quarries in KZN Protected Areas.
D 2.7	· Re-establishment and Management of Vegetation on Development Sites in the Ezemvelo KZN Wildlife Protected Areas.
D 2.8	· Ecotourism and Protected Areas.
D 2.9	· Solid Waste Management within Protected Areas.
D 2.10	· State Security Service Activities within Board Areas.
D 2.11	· Shark Nets in or bordering KwaZulu-Natal Nature Conservation Board Controlled Areas.
Policy File No.	**Integrated Environmental Management**
D 2.12	· Integrated Environmental Management - incorporating the procedure for the assessment of th impact of proposed development projects on nature conservation concerns.
D 2.13	· Precautionary Principle.
D 2.14	· Shark Net Installations.
D 2.15	· Bioprospecting in KwaZulu-Natal.
D 2.17	· Use of Pesticides by the Ezemvelo KZN Wildlife: Safety to Humans and the Environment.
D 2.18	· Interference with the Mouth of a Lagoon or River (Breaching).
Policy File No.	***Ex Situ* Wild Animal Management**
D 2.21	· Re-establishment of Terrestrial Mammals in Board Areas.
D 2.22	· Translocation of Animals.
D 2.25	· Elephant Introductions and Elephant in Enclosures.
D 2.27	· Introduction and Keeping of Large Predators in Enclosures in KZN.
D 2.28	· Use of Narcotic Drugs.
D 2.29	· Falconry.

EZEMVELO KZN WILDLIFE CORPORATE POLICIES (NORMS & STANDARDS)

	BIODIVERSITY CONSERVATION OPERATIONS
	2. CONSERVATION EFFECTIVENESS
Policy File No.	**Human Animal Conflict - Inside and Outside Protected Areas**
D 2.30	· Disposal of Leopard from Ezemvelo KZN Wildlife Protected Areas.
D 2.31	· Problem Animal Control.
D 2.32	· Compensation claims in respect of damage caused by Lion, Cheetah, Wild Dog and Elephant to Stock and Crops.
D 2.33	· Instances of Death as a result of an Unprovoked Attack by a Wild Animal Normally contained and originating from within a Fenced Protected Area under the Control of the KwaZulu-Natal Nature Conservation Board.
Policy File No.	**Environmental Awareness**
D 2.34	· Environmental Education Policy.

	3. BIODIVERSITY PROTECTION
Policy File No.	**Co-management**
D 3.1	Supply of Game to Conservancies, Community Conservation Areas and Biosphere Reserves in KwaZulu-Natal
D 3.2	Establishment and Management of Community Conservation Reserves (CCR)
D 3.4	Community Conservation Programmes
D 3.5	Neighbours' Access to Board Protected Areas
D 3.6	Relationship with Local Boards
D 3.7	Conservation Partnerships Between KwaZulu-Natal Nature Conservation Board and Adjacent Landowners
D 3.8	Community Trust
D 3.9	Community Levy Policy and Guidelines
D 3.10	Land Claims on Proclaimed and Unproclaimed Provincial and Assigned National Protected areas in KwaZulu-Natal
D 3.11	Amafa Policy Guidelines for the access of rock art sites in KwaZulu Natal
Policy File No.	**Resource-use benefits**
D 3.12	Disposal of Venison from Ezemvelo KZN Wildlife Management Operations.
D 3.13	Sustainable use of wildlife resources.
D 3.14	Freshwater Angling.
D 3.15	Freshwater species utilisation.
D 3.16	Use of plant resources from protected areas.
D 3.17	Use of doomed biological material.
D 3.19	Provision of hunting by Ezemvelo KZN Wildlife.
Policy File No.	**4. RELATIONSHIPS**
D 4.1	Neighbour Relations.
D 4.2	Participation - Non Government Organisations.
D 4.3	Data Access.
D 4.4	Consultation and Communication with Stakeholders: Policy and Guidelines.

EZEMVELO CORPORATE POLICIES (NORMS & STANDARDS)	
Policy File No.	**COMMERCIAL OPERATIONS**
E 1	· Concessions for Welfare Groups.
E 2	· Hiking and Mountaineering.
E 3	· Educational Concessions.
E 4	· Club Facilities within Board Areas.
E 5	· Hutted Camps.
E 6	· Joint Venture Scheme.
E 7	· Allocation of Sites in terms of the Joint Venture Scheme.
E 8	· Access to Protected Areas through Unofficial Entry Points.
E 9	· Visitor Facilities Management by Ezemvelo KZN Wildlife.
E 10	· Lease of Lakeshore at State Dam Protected Areas.
E 11	· Execution, Control and Management of Leases and Concession Contracts (excluding Biodiversity Conservation Partnerships and Leases of Wildlife).
E 12	· Private Sector Reservations Policy.
E 13	· Partnerships for Eco-Tourism Development within or Adjacent to Protected Areas.
E 14	· Discounting of Tariffs for Walk-in Guests.
E 15	· Ecotourism Discounting Strategy.
E 16	· Travel Trade Commissions: Tour Operator/ Travel Agency.
E 17	· Policy and Procedure for the establishment and monitoring of Commercial Operations Public Private Partnership (PPP) Agreements.
E 18	· Administrative and operational policy on Professional hunting in South Africa.
E 19	· Commercialisation.

Appendix C2 – Copy of Beachwood Mangroves Nature Reserve proclamation

Appendix 1 Beachwood Mangrove Nature Reserve Proclamation

*No. 76, 1977.

[*Afrikaans text signed by the Administrator.*]

PROCLAMATION

by the Administrator of the Province of Natal

UNDER the powers vested in me by section 2 of the Nature Conservation Ordinance, 1974 (Ordinance No. 15 of 1974), I do hereby proclaim, declare and make known that, with effect from the date of publication hereof the area defined in the schedule hereto shall be a Nature Reserve and shall be known as the Beachwood Mangroves Nature Reserve.

Given under my hand at Pietermaritzburg, Natal, this 9th day of May, One Thousand Nine Hundred and Seventy-seven.

W. W. B. HAVEMANN,
Administrator.

*No. 76, 1977.

[*Afrikaanse teks deur die Administrateur onderteken.*]

PROKLAMASIE

van die Administrateur van die provinsie Natal

KRAGTENS die bevoegdhede aan my verleen by artikel 2 van die Ordonnansie op Natuurbewaring, 1974 (Ordonnansie No. 15 van 1974), proklameer, verklaar en maak ek hierby bekend dat die gebied wat in die bylae hiervan omskryf word met ingang van die afkondigingsdatum hiervan 'n natuurtuin is en as die Natuurtuin Beachwood Mangroves bekend moet staan.

Gegee onder my handtekening te Pietermaritzburg, Natal, op hede die 9de dag van Mei eenduisend negehonderd sewe-en-sewentig.

W. W. B. HAVEMANN,
Administrateur.

12 Mei 1977.] Die Offisiële Koerant van die provinsie Natal 1005

SCHEDULE

BOUNDARIES OF THE BEACHWOOD MANGROVES NATURE RESERVE

From the intersection of the High Water Mark of the Indian Ocean with the prolongation of the Right Bank of the Umgeni River; thence in a westerly direction along the said prolongation and Right Bank of the Umgeni River to where it is intersected by the eastern edge of the Ellis Brown viaduct; thence in a northerly direction along the said eastern edge of the Ellis Brown viaduct and its abutments to where it is intersected by the High Water Mark of the Umgeni River; thence in an easterly direction along the said High Water Mark of the Umgeni River to where it is intersected by the eastern boundary of Lot Boyd No. 14173; thence along the boundaries of the following properties, in succession, so as to exclude them from this area, the said Lot Boyd No. 14173, Lot 12 No. 1548, Sub 2 of Graham No. 12774, Subs DC1, 1344, DC2, D and DC3, all of Lot 13 No. 1545, Sub 5 of Graham No. 12774 and Flyover No. 14377 to its Northernmost beacon on the western edge of the lagoon; thence along the edge of the lagoon as shown on the diagrams of Golf Course No. 13500, and Graham No. 12774 so as to include the lagoon in this area to where it is intersected by the southern boundary of Golf Course No. 13500; thence eastwards along the said boundary of Golf Course and its prolongation to where it intersects the High Water Mark of the Indian Ocean; thence southwards along the said High Water Mark to the intersection first mentioned, but excluding the portion of the island shown on the diagram of Golf Course No. 13500.

BYLAE

GRENSE VAN DIE NATUURTUIN BEACHWOOD MANGROVES

Vanaf die kruising van die hoogwaterlyn van die Indiese Oseaan en die verlenging van die regteroewer van die Umgenirivier; daarvandaan weswaarts langs voornoemde verlenging en regteroewer van die Umgenirivier tot by sy kruising van die oostelike rand van die Ellis Brown-viaduk; daarvandaan noordwaarts langs voornoemde oostelike rand van die Ellis Brown-viaduk en sy brughoofde tot by sy kruising van die hoogwaterlyn van die Umgenirivier; daarvandaan ooswaarts langs voornoemde hoogwaterlyn van die Umgenirivier tot by sy kruising van die oostelike grens van Lot Boyd No. 14173; daarvandaan agtereenvolgens langs die grense van die volgende eiendomme, sodat hulle van hierdie gebied uitgesluit word: genoemde Lot Boyd No. 14173, Lot 12 No. 1548, Ond. 2 van Graham No. 12774, Onds. DC1, 1344, DC2, D en DC3, almal van Lot 13 No. 1545, Ond. 5 van Graham No. 12774 en Flyover No. 14377 tot by sy noordelikste baken aan die westelike rand van die lagune; daarvandaan langs die rand van die lagune soos aangetoon op die diagramme van Golf Course No. 13500 en Graham No. 12774, sodat die lagune by hierdie gebied ingesluit word tot waar hy gesny word deur die suidelike grens van Golf Course No. 13500; daarvandaan ooswaarts langs voornoemde grens van Golf Course en sy verlenging tot by sy kruising van die hoogwaterlyn van die Indiese Oseaan; daarvandaan suidwaarts langs voornoemde hoogwaterlyn tot by eersvermelde kruising, maar uitgenome die deel van die eiland aangetoon op die diagram van Golf Course No. 13500.

For locating beacons, refer to the attached SG diagram.

S.R. Gibson – Land Surveyor | CONSOLIDATED DIAGRAM | Sheet 1 of 2 Sheets

SIDES Metres		ANGLES		CO-ORDINATES Y System Lo 31° X
AB	244.58	A	98 46 20	
BC	1 819.55	B	89 29 00	
CD	130.60	C	114 50 50	
DE	99.37	D	158 23 00	
EF	134.75	E	90 26 40	
FG	96.07	F	196 47 30	
GH	78.10	G	204 50 00	
HJ	74.68	H	144 32 20	
JK	51.21	J	173 18 20	
KL	187.10	K	172 51 00	
LM	21.37	L	259 59 40	
MN	94.48	M	89 51 10	
NP	1.80	N	107 19 20	
PQ	90.59	P	269 58 50	
QR	30.39	Q	90 00 00	
RS	56.99	R	249 21 50	
ST	348.68	S	201 10 00	
TU	10.67	T	89 28 10	
UV	151.52	U	257 44 50	
VW	103.85	V	186 54 40	
WX	289.03	W	184 31 50	
XA	154.64	X	169 24 40	

S.G. No.
845/1997
Approved
1997-05-06
Surveyor-General

COMPONENTS :

1. The figure LMNP represents Lot 2179 Durban North. Vide diagram S.G. No. 7479/1949 and Certificate of Registered Title No. 3991/1952.
2. The figure Aa Curved Line 9.14m above High Water Mark of Indian Ocean bDEFGHJKLPQRSTUVWX, including part of the Island and excluding the Lagoon, represents Lot 963 Durban North. Vide diagram S.G. No. 172/1946 and and Certificate of Consolidated Title No. 5573/1948.

SERVITUDE NOTES :

a. The figure de curved line 9.14 metres above High Water Mark of Indian Ocean fg represents a Parking Area Servitude. Vide diagram S.G. No. 169/1946 and Deed of Servitude No. 121/1948^{8}.
b. The figure mnpqrstuvwxy represents a Road Servitude 7.62 metres wide. Vide diagam S.G. No. 169/1946 and Deed of Servitude No. 121/1948^{8}.
c. The figure Ha1 irregular line b1d1 represents a Sewer and Drain Servitude 3.05 metres wide. Vide diagam S.G. No. 1420/1959 and Deed of Servitude No. 9/1965^{8}.

Reg. Div. FU

The figure Aa Curved Line 9.14m above High Water Mark of Indian Ocean bDEFGHJKLMNPQRSTUVWX including part of the Island and excluding the Lagoon

represents 43,0333 ha of land being

LOT 3485 DURBAN NORTH

(and comprises 1 & 2 as listed above)

Situate in the Durban T.M.C – North Central Substructure
Administrative District of Natal, Province of KwaZulu-Natal

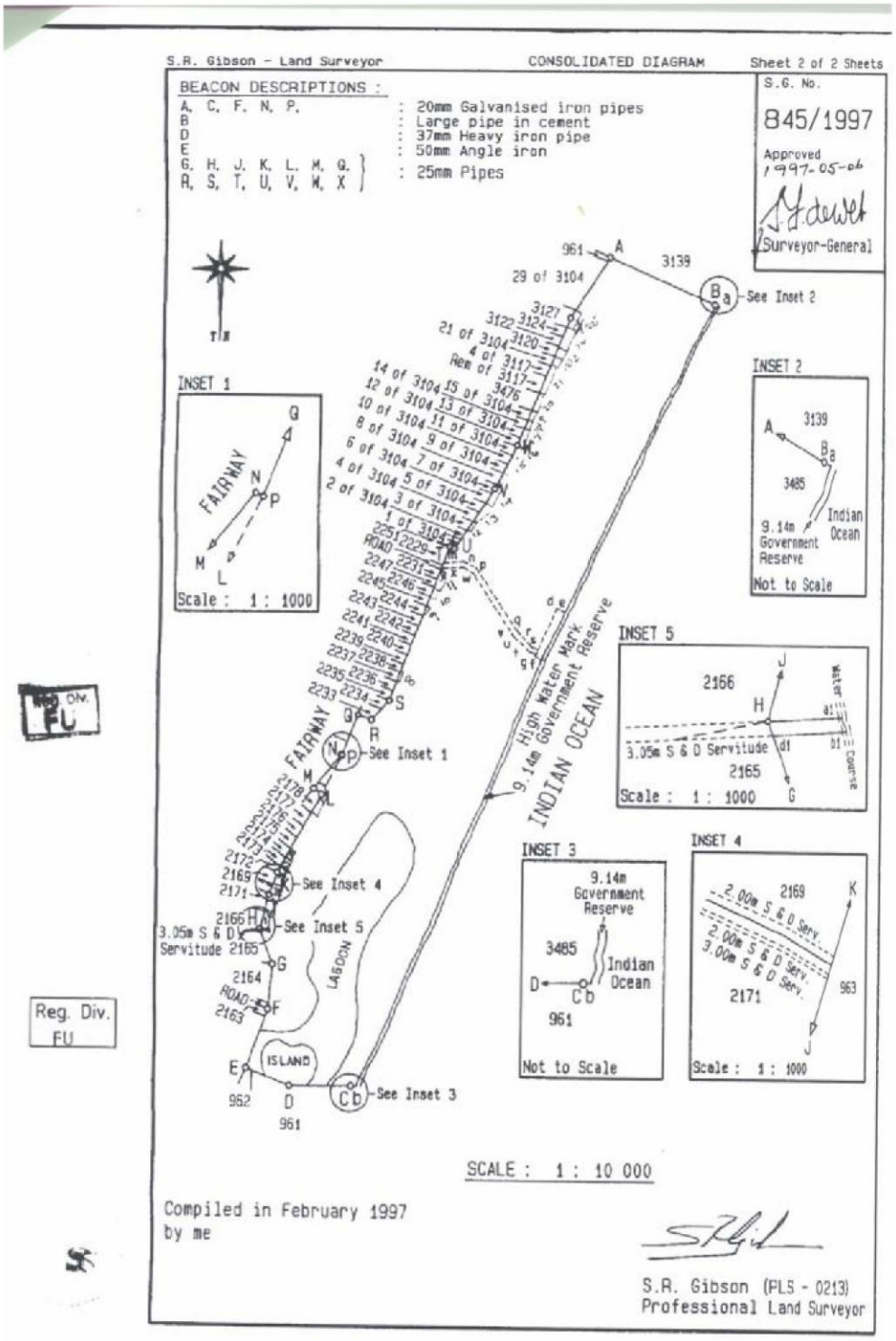
Reg. Div. FU

Compiled in February 1997
by me

S.R. Gibson (PLS – 0213)
Professional Land Surveyor

This Diagram relates to	The original diagrams are as quoted above	File No. /35 (Vol 2)
C.C.T. 17317/1998		S.R. No. FU-7AA FU-7A-6B-8+4
Registrar of Deeds	Transfer No.	Comp. FU-7A-6D-2 FU-7A-7A-3+1

FOR ENDORSEMENTS, etc., SEE BACK



Provisional Endorsements / Notes

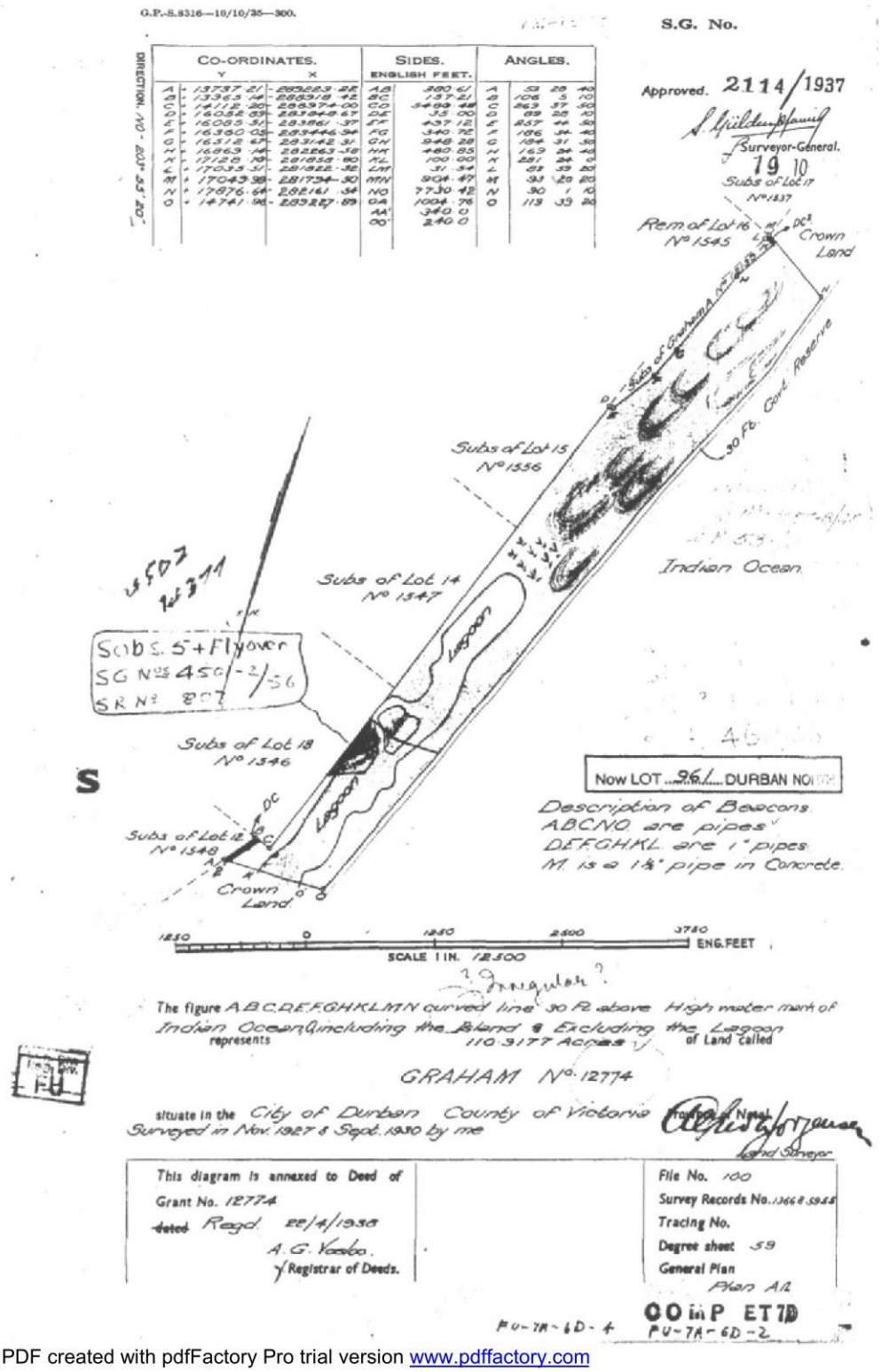
S.G.No 845/1997

Scanned page number 3

Designation: ERF 3485 Durban North

Reservations: Consecutive Numbering:

Ptn 1-25 OF ERF 3485 Vide SG No 874-898/SR 294/2006



THE FOLLOWING DEDUCTIONS HAVE BEEN MADE FROM THIS DIAGRAM :— SG 2114/1937

SUB-DIVISION	DIAGRAM NO.	S.R.	EXTENT	REMAINDER	TRANSFER NO.	INTD.	DATE
1	163/1946	46/1946	56.2746 Acs	14.6431 Acs	5572/1948	C.Q.O.	25.6.48
3	3957/1948	533/48	2523 sq. ft.	14.5193 "	9475/1349	G.V.B.	6.12.49
4	3558/1948	46/1948	2872 " "				
2 (Road)	5878/55	1275/55	6333 " "		Grant 102/56	[illegible]	10.12.62
5	4501/56	803/56	1.3910 Ac	12.9829 Ac	" " "		

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DEPARTEMENT VAN NASIONALE OPVOEDING

No. 1461 18 Julie 1980

WET OP NASIONALE GEDENKWAARDIGHEDE, No. 28 VAN 1969

VERKLARING VAN DIE BEACHWOOD-MANGLIETMOERAS, DURBAN

Kragtens die bevoegdheid my verleen by artikel 10 (1) van die Wet op Nasionale Gedenkwaardighede, 1969 (Wet 28 van 1969), verklaar ek, Teunis Nicolaas Hendrik Janson, Minister van Nasionale Opvoeding, hierby die Beachwood-manglietmoeras, by Durban, tot nasionale gedenkwaardigheid.

Beskrywing

Die manglietbome geleë op die volgende eiendomme noord van die Umgeniriviermonding:

1. Die restant van Graham 12774 volgens Kaart LG 2114/1937 en Transportakte 3145/1954. Geleë in die stad Durban, county Victoria, provinsie Natal.

2. Die hele gebied, synde onvervreemde Staatsgrond, aangedui as "Lagoon" op die kaart van Graham 12774, Kaart LG 2114/1937, maar uitsluitende daardie gedeelte van die lagune bekend as Lot Flyover 14377 en aangetoon op Kaart LG 4502/1956. Geleë in die stad Durban, county Victoria, provinsie Natal.

3. Die gedeelte onvervreemde Staatsgrond as volg begrens: Vanaf die kruising van die ooswaartse verlenging van die suidelike grens van Graham 12774 met die hoogwatermerk van die Indiese Oseaan langs; daarvandaan suidwaarts met die hoogwatermerk van die Indiese Oseaan langs tot by die punt waar dit gekruis word deur die middellyn van die Umgenirivier; daarvandaan weswaarts met die middellyn van die Umgenirivier langs, tot by die kruising daarvan met die oostelike rand van die Ellis Brown-viaduk; daarvandaan noordwaarts met die oostelike rand van genoemde viaduk en sy brughoofde langs, tot by die snypunt daarvan met die hoogwatermerk van die linkeroewer van die Umgenirivier; daarvandaan ooswaarts met die hoogwatermerk van die linkeroewer van die Umgenirivier langs, tot by die kruising daarvan met die oostelike grens van Lot Boyd 14173; daarvandaan noordwaarts agtereenvolgens met die grense van die volgende eiendomme langs, sodat hulle uit die gebied uitgesluit word: Lot Boyd 14173 en Lot 12 No. 1548, tot by de punt geletter A op die kaart van Graham 12774, daarvandaan ooswaarts met die suidelike grens van Graham 12774 en die verlenging van hierdie grens langs, tot by die punt wat eerste genoem is. Geleë in die county Victoria, provinsie Natal.

Kulturele en omgewingsbelang

Manglietmoerasse is een van die seldsaamste en wetenskaplik belangwekkendste ekosisteme en word in die hoogs gespesialiseerde getygebiede aangetref. Die Beachwood-manglietbome is van besondere plantkundige, opvoedkundige en historiese waarde omdat dit digby een van ons land se grootste stede met 'n verskeidenheid belangrike opvoedkundige instansies geleë is. 10/2/782.

T. N. H. JANSON, Minister van Nasionale Opvoeding.

DEPARTMENT OF NATIONAL EDUCATION

No. 1461 18 July 1980

NATIONAL MONUMENTS ACT, No. 28 OF 1969

DECLARATION OF THE BEACHWOOD MANGROVE SWAMP, DURBAN

By virtue of the powers vested in me by section 10 (1) of the National Monuments Act, 1969 (Act 28 of 1969), I, Teunis Nicolaas Hendrik Janson, Minister of National Education, hereby declare the Beachwood Mangrove Swamp at Durban, to be a national monument.

Description

The mangrove trees situated on the following properties north of the Umgeni River Estuary:

1. The remainder of Graham 12774, according to Diagram SG 2114/1937, and Deed of Transfer 3145/1954. Situate in the City of Durban, County of Victoria, Province of Natal.

2. The whole of the area being unalienated State land, shown as "Lagoon" on the map of Graham 12774, Diagram SG 2114/1937, but excluding that portion known as Lot Flyover 14377 and shown on Map SG 4502/1956. Situate in the City of Durban, County of Victoria, Province of Natal.

3. That portion of unalienated State land bordered as follows: From the crossing of the eastern extension of the southern boundary of Graham 12774 along the high-water mark of the Indian Ocean; thence southwards along the high-water mark of the Indian Ocean to the point where it is crossed by the middle line of the Umgeni River; thence westwards along the middle line of the Umgeni River to the crossing thereof with the eastern edge of the Ellis Brown viaduct; thence northwards along the eastern edge of the said viaduct and its bridgeheads to the cutoff thereof with the high-water mark of the left bank of the Umgeni River; thence eastwards along the high-water mark of the left bank of the Umgeni River to the crossing thereof with the eastern boundary of Lot Boyd 14173; thence northwards consecutively along the borders of the following properties, so as to exclude them from the area: Lot Boyd 14173 and Lot 12 No. 1548, to the point lettered A on the map of Graham 12774; thence eastwards along the southern boundary of Graham 12774 and this extension of the boundary to the point of beginning. Situate in the County of Victoria, Province of Natal.

Cultural and natural interest

Mangrove swamps are one of the rarest and most scientifically interesting ecosystems that occur in the highly specialised tidal environment. The Beachwood Mangroves are of significant botanical, educational and historical value because they are situated close to one of our country's largest cities with a variety of important educational institutions. 10/2/782.

T. N. H. JANSON, Minister of National Education.

THE DECLARATION OF NATIONAL MONUMENTS

(a) The most important aspect of proclamation is that a piece of land, a house, a building or any relic which has been proclaimed a monument is protected and will remain protected for posterity by virtue of the proclamation. It is for this reason that no monument may be damaged, removed, demolished or structurally altered without the prior written consent of the National Monuments Council.

(b) A proclaimed monument obviously remains the property of the owner and he retains, as before proclamation, his full ownership rights thereto.

(c) Proclamation of a property need not affect the privacy of the owner. An owner is under no obligation to allow visitors entry to a proclaimed monument. He is however obliged to admit at reasonable hours a member or a representative of the Council on official business.

(d) The National Monuments Council can even, at the owner's request, erect a notice on or near a proclaimed property, whereby visitors are informed that the property is privately owned, or that admission can only be granted in special circumstances, etc.

(e) An owner may sell or let his proclaimed property, but if he sells it he is obliged to inform the Council of the sale and the name of the new owner so that the Council will know with whom to deal in respect of any possible future negotiations. All responsibilities connected with a proclaimed monument devolve on a buyer of such monument.

(f) It is understood that an owner will be responsible for the maintenance of a proclaimed property as he was before proclamation, and that he will not allow the property to be neglected. If an owner is not in a financial position to maintain the property the Council may with the approval of the Minister, contribute towards such maintenance as and when the Council's finances permit.

(g) The National Monuments Council will, when application is made for approval of alterations to a monument, consider such application with due regard for the preservation of the monument. On the whole the Council considers such applications sympathetically and will not stand in the way of necessary and unavoidable alteration.

(h) The Council will be pleased to give advice to owners in regard to the maintenance and/or restoration of their property and alternatively will provide owners with a list of experts in this field.

(i) The National Monuments Council provides its bronze badge for erection on or at a proclaimed monument. If possible the Council will also erect a bronze plaque giving an explanation of the importance of the monument.

(j) If a survey proves to be necessary for the correct definition of a monument the Council will arrange for such a survey at its own expense.

Ref: H 25/13/2

B E A C H W O O D M A N G R O V E S

DRAFT REGULATIONS GOVERNING THE MANAGEMENT AND DEVELOPMENT OF THE BEACHWOOD MANGROVE AREA DECLARED AS A NATIONAL MONUMENT

NOTE

The enforcement of these regulations shall be in the hands of the Natal Parks Game and Fish Preservation Board hereinafter referred to as the Natal Parks Board.

REGULATIONS

1. **The public shall have use of the waters of the Umgeni River lying within the proclaimed area for such activities as fishing and boating with access from the South Bank only providing there shall be no access from the North Bank and providing that no person or boat approach the North Bank nearer than the middle line of the river as indicated by a series of buoys to be placed in position by the City Council of the City of Durban (hereinafter referred to as the City of Durban) with the approval of the National Monuments Council and the Natal Parks Board and providing that no craft travel at more than 15 k.p.h. while in the declared area i.e. East of the Ellis Brown Viaduct and between the South Bank and the line of buoys.**

2. **The City of Durban subject to the Water Act No 54 of 1956 and the Seashore Act No 21 of 1935 as amended and any other relevant legislation will have the right to manage the bed of the Umgeni River within the proclaimed area which lies East of the Ellis Brown Viaduct and South of the line of buoys referred to in para 1 above for the purpose of maintaining adequate depth and flow of water.**

3. **The City of Durban shall have the right to erect pillars and access embankments and to construct a service road bridge over the Umgeni River within the proclaimed area as shown in Diagram ST 2279.**

4. **The City of Durban shall have the right to widen the Ellis Brown Bridge by means of a cantilever construction as indicated in Diagram ST 2279.**

5. **The City of Durban shall continue to operate and maintain the toilets already situated within the proclaimed area and shall continue to perform its functions in connection with the control of the malaria within the proclaimed area providing that if any difference of opinion regarding the exercise of these functions should arise between any of the parties on the management committee and the City of Durban the State Department of Health shall be empowered to act as arbitrator.**

6. **The proclaimed area of the Beachwood Mangroves shall be managed by a management committee consisting of at least one nominee of each of the following bodies**
   Natal Parks Board
   Wild Life Society
   University of Westville Durban/Westville
   University of Natal
   Natal Command
   Botanic Gardens
   Beachwood Golf Club
   City Engineer's Department

2/.....

delete

and ~~shall meet at least once per quarter~~. The Natal Parks Board to which management functions shall be delegated shall act as convenor and shall give at least 14 days written notice of meetings and keep proper minutes.

Revised Regulations governing the management and development of the Beachwood Mangrove Area declared as a National Monument.

The enforcement of these regulations shall be in the hands of the Natal Parks, Game and Fish Preservation Board, hereinafter referred to as the Natal Parks Board.

Regulations:

1. "The public shall have the use of the waters of the Umgeni River lying within the proclaimed area for such activities as fishing and boating with access from the South Bank only providing there shall be no access from the North Bank and providing that no person or boat approach the North Bank nearer than the middle line of the river as indicated by a series of buoys to be placed in position by the City Council of the City of Durban (herein \after referred to as the City of Durban) with the approval of the National Monuments Council and that Natal Parks Board and providing that no craft travel at more than 15 k.p.h. while in the declared area i.e., East of the Ellis Brown Viaduct and between the South Bank and the line of buoys."
2. The City of Durban subject to the Water Act No 54 of 1956 and the Seashore Act No 21 of 1935 (refer to appendix, pg. 79) as amended and any other relevant legislation will have the right to manage the bed of the Umgeni River within the proclaimed area which lies East of the Ellis Brown Viaduct and South of the line of buoys referred to in para. 1. Above for the purpose of maintaining adequate depth and flow of water.
3. The City of Durban shall have the right to erect pillars and accesses embankments and to construct a service road bridge over the Umgeni River within the proclaimed area.
4. The City of Durban shall have the right to widen the Ellis Brown Bridge by means of a cantilever construction.
5. The City of Durban shall continue to operate and maintain the toilets already situated within the proclaimed area and shall continue to perform its functions connection with the control of the malaria within the proclaimed area providing that if any difference of opinion regarding the exercise of these functions should arise between any of the parties on the management committee and the City of Durban the State Department of Health shall be empowered to act as arbitrator.
6. The proclaimed area of the Beachwood Mangroves shall be managed by a management committee consisting of at least one nominee of the following bodies:

- Natal Parks Board (now Ezemvelo KZN Wildlife)
- City of Durban
- National Monuments Council

7. And shall meet at least once per year. The Natal parks Board to which management functions shall be delegated shall act as convenor and shall give at least 14 days written notice of meetings and keep proper minutes.

Appendix C3 – Beachwood Mangroves Nature Reserve Public Participation Report, June 2013

This document is available as a separate report.

Appendix D – Listed activities requiring environmental authorisation in terms of Regulation R.546, Listing Notice No.3

If any of the following activities are proposed in a protected area, proclaimed in terms of the Protected Areas Act, or within five kilometres of one, they will be subject to either a basic assessment or full scoping and environmental impact assessment process:

- The construction of billboards exceeding 18 square metres in size.
- The construction of reservoirs for bulk water supply with a capacity of more than 250m^3.
- The construction of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast:
    - Is to be placed on a site not previously used for this purpose.
    - Will exceed 15 metres in height but excluding attachments to existing buildings and masts on rooftops.
- The construction of a road wider than four metres with a reserve less than 13.5 metres.
- The construction of resorts, lodges or other tourism accommodation facilities.
- The conversion of existing structures to resorts, lodges or tourism accommodation facilities that sleep 15 people or more.
- The construction of aircraft landing strips and runways.
- The construction of above ground cableways and funiculars.
- The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good.
- The construction of tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles excluding conversion of existing tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles.
- The clearance of an area of 1ha or more of vegetation where 75% of the vegetative cover constitutes indigenous vegetation, except where such removal is required for:
    - The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list.
    - The undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No.544 of 2010

The construction of facilities and infrastructure or structures of any size for any form of aquaculture *(this applies only inside a protected area, not within five kilometres of it)*.

- The construction of:
    - Jetties exceeding $10m^2$ in size.
    - Slipways exceeding $10m^2$ in size.
    - Buildings with a footprint exceeding $10m^2$ in size.
    - Infrastructure covering $10m^2$ or more.

    Where such construction occurs within a watercourse or within 32 metres of watercourse, measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line.
- The expansion of reservoirs for bulk water supply where the capacity will be increased by more than $250m^3$.
- The expansion of a resort, lodge, hotel and tourism or hospitality facilities where the development footprint will be expanded.
- The widening of a road by more than four metres or the lengthening of a road by more than one kilometre.
- The expansion of runways or aircraft landing strips where the expanded runways or aircraft landing strips will be longer than 1.4 kilometres in length.
- The expansion of above ground cableways and funiculars where the development footprint will be increased.
- The expansions of tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles excluding conversion of existing tracks or routes for the testing, recreational use or outdoor racing of motor powered vehicles, where the development footprint will be expanded.
- The expansions of facilities or infrastructure for the storage, or storage and handling of a dangerous good.
- The expansion of:
    - Jetties where the jetty will be expanded by $10m^2$ in size or more.
    - Slipways where the slipway will be expanded by $10m^2$ or more.
    - Buildings where the buildings will be expanded by $10m^2$ or more in size.
    - Infrastructure where the infrastructure will be expanded by $10m^2$ or more.

    Where such construction occurs within a watercourse or within 32 metres of watercourse, measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line.
- The expansion of facilities, infrastructure or structures of any size for any form of aquaculture *(this applies only inside a protected area, not within five kilometres of it)*.
- Phased activities for all activities listed in the Schedule and as it applies to a specific geographical area, which commenced on or after the effective date of the Schedule, where any phase off the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.

Appendix E – Species lists

The following species lists were derived from the Ezemvelo KZN Wildlife database, previous Management Plans, the KwaZulu-Natal Museum Services, Begg (1983), Edwards and Moll (1971) and directly from Roddy Ward.

Plant Species List

Class DICOTYLEDONAE(MAGNOLIIOPSIDA)	
Family ANACARDIACEAE	
Searsia (Rhus) nebulosa var. *forma nebulosa*	Coast Current
Family APIACEAE	
*Hydrocotyle bonariensis**	Perdekloutjies
Family ASTERACEAE	
*Ageratum houstonianum**	Blue Weed
Chrysanthemoides monilifera	Bush Tick-Berry
*Tridax procumbens**	Tridax Daisy
Family AVICENNIACEAE	
Avicennia marina	White Mangrove
Family CASUARINACEAE	
*Casuarina equisetifolia**	Horsetail Tree
Family Chenopodiaceae	
Sarcocornia natalensis var. *Affinis*	(succulent herbaceous halophyte)
Family COMBRETACEAE	
Lumnitzera racemosa	Tonga Mangrove
Family CONVOLVULACEAE	
*Ipomoea alba**	Moonflower
Ipomoea cairica	Common Ipomoea
DICOTYLEDONAE(MAGNOLIIOPSIDA)	
Family MALVACEAE	
Hibiscus tiliaceus tiliaceus	Lagoon Hibiscus
Family PASSIFLORACEAE	
*Passiflora foetida**	Wild Granadilla
Family RHIZOPHORACEA	
Bruguiera gymnorrhiza	Black Mangrove
Rhizophora mucronata	Red Mangrove
Ceriops tagal	Tagal/Indian Mangrove
Family SAPOTACEAE	
Mimusops caffra	Coastal Red Milkwood
Class MONOCOTYLEDONAE(LILIOPSIDA)	(Liliopsida)
Family *Cyperaceae*	
Mariscus dubius	
Pycreus polystachyos var. Laxiflorus	

Monocotyledonae(Liliopsida) Family JUNCACEAE *Juncus kraussii effusus*	Ncema Grass (*iNcema* [Zulu])
Monocotyledonae(Liliopsida) Family POACEAE *Sporobolus pyramidalis*	Catstail Dropseed

Source Ezemvelo KZN Wildlife Database. Species market with Asterisk (*) are alien species.

Alien plants recorded at Beachwood Mangroves Nature Reserve

Species	Common Name	Species	Common Name
Ageratum houstonianum	Blue Weed	*Nerium oleander*	Oleander
Arundo donax	Spanish Reed	*Passiflora foetida*	Wild Granadilla
Canna indica	Canna	*Pereskia aculeata*	Barbados Gooseberry
Cardiospermum grandiflorum	Balloon Vine	*Persicaria serrulata*	Bistort
Cassia sp.	Cassia	*Phytolacca dioica*	Belhambra
Casuarina equisetifolia	Horsetail Tree	*Psidium guajava*	Guava
Cestrum laevigatum	Ink Berry	*Ricinus communis*	Castor Oil
Chromolaena odorata	Triffid Weed	*Sagittaria latifolia*	Broad-leaf Arrowhead
Clerodendrum thomsonii	Bleeding Heart vine	*Schinus terebinthifolius*	Brazilian Pepper
Colocasia esculenta	Madumbi	*Senna didymobotrya*	Peanut Butter Cassia
Eugenia uniflora	Surinam Cherry	*Sesbania punicea*	Sesbania
Hydrocotyle bonariensis	Perdekloutjies	*Solanum mauritianum*	Bugweed
Ipomoea alba	Moonflower		
Ipomoea purpura	Morning Glory	*Syzygium cuminii*	Jambolan
Lantana camara	Tick Berry	*Tecoma stans*	Yellow Bells
Leucaena leucocephala	Giant Wattle	*Thevetia peruviana*	Yellow Oleander
Melia azedarach	Syringa	*Tithonia diversifolia*	Mexican Sunflower
Musa sp.	Banana	*Tridax procumbens*	Tridax Daisy

Other alien/exotic plant species do escape from the Japanese Gardens, and other nearby domestic gardens, from time to time and these include difficult species, such as *Canna indica.*

Epiphytic algae found in Beachwood Mangroves (Steinke *et al*., 1995)

CYANOPHYCAEA (Blue-green Algae)	RHODOPHYCAEA (Red Algae)	CHLOROPHYCEAE (Green Algae)
Chroococcus hangsgirgii	*Bostrychia moritziana*	*Enteromorpha sp.*
Chroococcus turgidus	*Bostrychia radicans*	*Rhizoclonium riparium*
Hydrococcus rivularis	*Caloglossa leprieurii*	*Rhizoclonium implexum*
Xenococcus acervatus	*Phylosiphonia subtilissima*	
Xenococcus kerneri		
Lyngbya cinerascens		
Lyngbya confervoides		
Lyngbya lutea		
Microcoleus chthonoplastes		
Oscillatoria nigroviridus		
Oscillatoria subbrevis		
Spirulina subsalata		
Scytonema hoffmannii		

Mammals recorded in the Beachwood Mangroves Nature Reserve

Family CERCOPITHECIDAE	
Vervet monkey	*Cercopithecus pygerythrus*
Family VIVERRIDAE	
Water mongoose	*Atilax paludinosus*
Banded mongoose	*Mungos mungo*
Slender Mongoose	*Galerella sanguinea*
Family MUSTELIDAE	
Clawless otter	*Aonyx capensis*
Family BOVIDAE	
Blue Duiker	*Philantomba monticola*
Grey duiker	*Sylvicapra grimmia* (In KZN Wildlife database, but not presently there)
Family THRYONOMYIDAE	
Greater Canerat	*Thryonomys swinderianus*
Order EULIPOTYPHLA (Shrews, Moles and Hedghogs)	
Family SORICIDAE	
Greater Red Musk Shrew	*Crocidura flavescens*
Order RODENTIA (Rodents)	
Family MURIDAE	
Angoni Vlei Rat	*Otomys angoniensis*
Four Striped Grass Mouse	*Rhabdomys pumilio*
Order CHIROPTERA (Bats)	
Family MOLOSIDAE (Free-tailed Bats)	
Egyptian Free-tailed Bat	*Tadarida aegyptiaca*
Little Free-Tailed Bat	*Chaerephon pumilus*
Family VESPERTILIONIDAE (Vesper bats)	
Anchieta's Pipistrelle	*Hypsugo achietae*
Rufous Myotis	*Myotis bocagii*
Cape serotine Bat	*Neuromicia capensis*
Banana Bat	*Neuromicia nana*
Dusky Pipistrelle	*Pipistellus hesperidus*
Yellow-bellied House Bat	*Scotophilus dinganii*
Greenish House Bat	*Scotophilus cf viridis*

Sources:
1986 Beachwood Mangroves Management Plan; Ezemvelo KZN Wildlife Database; Rowe-Rowe, 1992. Rodents – Leigh Richards, Curator of Mammals Durban Museum, Pers. Comm. 2013; Bats – Moonsamy, 2013.

Birds recorded in the Beachwood Mangroves Nature Reserve

Rob	Common Name	Scientific Name
11	Shy Albatross	*Thalassarche cauta*
14	Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*
21	Pintado Petrel	*Daption capense*
24	Soft-plumaged Petrel	*Pterodroma mollis*
32	White-chinned Petrel	*Procellaria aequinoctialis*
42	European Storm-Petrel	*Hydrobates pelagicus*
44	Wilson's Storm-Petrel	*Oceanites oceanicus*
49	Great White Pelican	*Pelecanus onocrotalus*
50	Pink-backed Pelican	*Pelecanus rufescens*
53	Cape Gannet	*Morus capensis*
55	White-breasted Cormorant	*Phalacrocorax lucidus*
56	Cape Cormorant	*Phalacrocorax capensis*
58	Reed Cormorant	*Phalacrocorax africanus*
60	African Darter, Darter	*Anhinga rufa*
61	Greater Frigatebird	*Fregata minor*
62	Grey Heron	*Ardea cinerea*
63	Black-headed Heron	*Ardea melanocephala*
64	Goliath Heron	*Ardea goliath*
65	Purple Heron	*Ardea purpurea*
66	Great Egret, Great White Egret	*Egretta alba*
67	Little Egret	*Egretta garzetta*
69	Black Heron, Black Egret	*Egretta ardesiaca*
71	Cattle Egret	*Bubulcus ibis*
72	Squacco Heron	*Ardeola ralloides*
74	Green-backed Heron	*Butorides striata*
76	Black-crowned Night-Heron	*Nycticorax nycticorax*
81	Hamerkop	*Scopus umbretta*
84	Black Stork	*Ciconia nigra*
86	Woolly-necked stork	*Ciconia episcopus*
91	African Sacred Ibis, Sacred Ibis	*Threskiornis aethiopicus*
94	Hadeda Ibis	*Bostrychia hagedash*
95	African Spoonbill	*Platalea alba*
96	**Greater Flamingo**	***Phoenicopterus ruber***
99	White-faced Duck	*Dendrocygna viduata*
102	Egyptian Goose	*Alopochen aegyptiaca*
104	Yellow-billed Duck	*Anas undulata*
108	**Red-billed Teal**	***Anas erythroihyncha***
126	Black Kite,Yellow-billed Kite	*Milvus migrans*
148	African Fish-Eagle	*Haliaeetus vocifer*
157	Little Sparrowhawk	*Accipiter minullus*
158	Black sparrowhawk	*Accipiter melanoleucus*
160	African Goshawk	*Accipiter tachiro*
170	Osprey	*Pandion haliaetus*
172	Lanner falcon	*Falco biarmicus*
175	Sooty Falcon	*Falco concolor*
199	Swainson's Spurfowl, Swainson's Francolin	*Pternistis swainsonii*
200	Common Quail	*Coturnix coturnix*
207	Wattled Starling	*Creatophora cinerea*
223	African Purple Swamphen, Purple Gallinule	*Porphyrio madagascariensis*
226	Common Moorhen	*Gallinula chloropus*
229	African Finfoot	*Podica senegalensis*
240	African Jacana	*Actophilornis africanus*

Rob	Common Name	Scientific Name
242	Greater Painted-snipe, Painted Snipe	*Rostratula benghalensis*
244	African Black Oystercatcher	*Haematopus moquini*
245	Common Ringed Plover, Ringed Plover	*Charadrius hiaticula*
246	White-fronted Plover	*Charadrius marginatus*
247	Chestnut-banded Plover	*Charadrius pallidus*
248	Kittlitz's Plover	*Charadrius pecuarius*
249	Three-banded Plover	*Charadrius tricollaris*
251	Greater Sand Plover, Sand Plover	*Charadrius leschenaultii*
252	**Caspian Plover**	***Charadrius asiaticus***
254	Grey Plover	*Pluvialis squatarola*
258	Blacksmith Lapwing, Blacksmith Plover	*Vanellus armatus*
260	**Common Quail**	***Coturnix coturnix***
262	Ruddy Turnstone, Turnstone	*Arenaria interpres*
263	Terek Sandpiper	*Xenus cinereus*
264	Common Sandpiper	*Actitis hypoleucos*
265	Green Sandpiper	*Tringa ochropus*
266	Wood Sandpiper	*Tringa glareola*
269	Marsh Sandpiper	*Tringa stagnatilis*
270	Common Greenshank, Greenshank	*Tringa nebularia*
271	Red Knot, Knot	*Calidris canutus*
272	Curlew Sandpiper	*Calidris ferruginea*
274	Little Stint	*Calidris minuta*
281	Sanderling	*Calidris alba*
284	Ruff	*Philomachus pugnax*
288	Bartailed Godwit	*Limosa lapponica*
289	Eurasian Curlew, Curlew	*Numenius arquata*
290	Common Whimbrel, Whimbrel	*Numenius phaeopus*
295	Black-winged Stilt	*Himantopus himantopus*
296	Crab Plover	*Dromas ardeola*
298	Water Thick-knee, Water Dikkop	*Burhinus vermiculatus*
307	Parasitic Jaeger, Arctic Skua	*Stercorarius parasiticus*
308	Long-tailed Jaeger, Long-tailed Skua	*Stercorarius longicaudus*
309	Pomarine Jaeger, Pomarine Skua	*Stercorarius pomarinus*
310	Subantarctic Skua	*Catharacta antarctica*
312	Kelp Gull	*Larus dominicanus*
313	Lesser Black-backed Gull	*Larus fuscus*
314	Herring Gull	*Larus argentatus*
315	Grey-headed Gull	*Larus cirrocephalus*
316	Hartlaub's Gull	*Larus hartlaubii*
317	Franklin's Gull	*Larus pipixcan*
318	Sabine's Gull	*Larus sabini*
322	Caspian Tern	*Sterna caspia*
324	Swift Tern	*Sterna bergii*
325	Lesser Crested Tern	*Sterna bengalensis*
326	Sandwich Tern	*Sterna sandvicensis*
327	Common Tern	*Sterna hirundo*
328	Arctic Tern	*Sterna paradisaea*
329	Antarctic Tern	*Sterna vittata*
330	Roseate Tern	*Sterna dougallii*
332	Sooty Tern	*Sterna fuscata*
333	Bridled Tern	*Sterna anaethetus*
335	Little Tern	*Sterna albifrons*
337	Black Tern	*Chlidonias niger*
338	Whiskered Tern	*Chlidonias hybrida*

Rob	Common Name	Scientific Name
339	White-winged Tern	*Chlidonias leucopterus*
340	Brown Noddy, Common Noddy	*Anous stolidus*
341	Lesser Noddy	*Anous tenuirostris*
348	Rock dove, Feral Pigeon	*Columba livia*
352	Red-eyed Dove	*Streptopelia semitorquata*
355	Laughing Dove	*Streptopelia senegalensis*
359	Tambourine Dove	*Turtur tympanistria*
371	Purple-crested Turaco, Purple-crested Lourie	*Gallirex porphyreolophus*
385	Klaas's Cuckoo	*Chrysococcyx klaas*
386	Diederick Cuckoo, Diederik Cuckoo	*Chrysococcyx caprius*
391	Burchell's Coucal	*Centropus burchellii*
392	Barn Owl	*Tyto alba*
401	Spotted Eagle-Owl	*Bubo africanus*
404	European Nightjar	*Caprimulgus europaeus*
405	Fiery-necked Nightjar	*Caprimulgus pectoralis*
407	**Swamp Nightjar, Natal Nightjar**	***Caprimulgus natalensis***
409	Square-tailed Nightjar, Mozambique Nightjar	*Caprimulgus fossii*
412	African Black Swift, Black Swift	*Apus barbatus*
415	White-rumped Swift	*Apus caffer*
417	Little Swift	*Apus affinis*
418	Alpine Swift	*Tachymarptis melba*
421	African Palm-Swift, Palm Swift	*Cypsiurus parvus*
424	Speckled Mousebird	*Colius striatus*
426	Red-faced Mousebird	*Urocolius indicus*
428	Pied Kingfisher	*Ceryle rudis*
429	Giant Kingfisher	*Megaceryle maximus*
430	Half-collared Kingfisher	*Alcedo semitorquata*
431	Malachite Kingfisher	*Alcedo cristata*
432	African Pygmy-Kingfisher, Pygmy Kingfisher	*Ispidina picta*
434	Mangrove Kingfisher	*Halcyon senegaloides*
435	Brown-hooded Kingfisher	*Halcyon albiventris*
444	Little Bee-eater	*Merops pusillus*
451	African Hoopoe, Hoopoe	*Upupa africana*
464	Black-collared Barbet	*Lybius torquatus*
469	Red-fronted Tinkerbird, Red-fronted Tinker Barbet	*Pogoniulus pusillus*
471	Yellow-rumped Tinkerbird, Golden-rumped Tinker Barbet	*Pogoniulus bilineatus*
478	Brown-backed Honeybird, Sharp-billed Honeyguide	*Prodotiscus regulus*
483	Golden-tailed Woodpecker	*Campethera abingoni*
486	Cardinal Woodpecker	*Dendropicos fuscescens*
518	Barn Swallow, European Swallow	*Hirundo rustica*
520	White-throated Swallow	*Hirundo albigularis*
522	Wire-tailed Swallow	*Hirundo smithii*
527	Lesser Striped Swallow	*Hirundo abyssinica*
529	Rock Martin	*Hirundo fuligula*
532	Sand Martin	*Riparia riparia*
533	Brown-throated Martin	*Riparia paludicola*
536	Black Saw-wing, Black Saw-wing Swallow	*Psalidoprocne holomelaena*
541	Fork-tailed Drongo	*Dicrurus adsimilis*
542	Square-tailed Drongo	*Dicrurus ludwigii*
548	Pied Crow	*Corvus albus*
549	House Crow	*Corvus splendens*
554	Southern Black Tit	*Parus niger*
568	Dark-capped Bulbul, Black-eyed Bulbul	*Pycnonotus tricolor*
569	Terrestrial Brownbul, Terrestrial Bulbul	*Phyllastrephus terrestris*

Rob	Common Name	Scientific Name
572	Sombre Greenbul, Sombre Bulbul	*Andropadus importunus*
574	Yellow-bellied Greenbul, Yellow-bellied Bulbul	*Chlorocichla flaviventris*
576	Kurrichane Thrush	*Turdus libonyanus*
577	Olive Thrush	*Turdus olivaceus*
578	Spotted Ground-Thrush, Spotted Thrush	*Zoothera guttata*
589	Familiar Chat	*Cercomela familiaris*
596	African Stonechat, Stonechat	*Saxicola torquatus*
600	Red-capped Robin-Chat, Natal Robin	*Cossypha natalensis*
601	Cape Robin-Chat, Cape Robin	*Cossypha caffra*
613	White-browed Scrub-Robin, White-browed Robin	*Cercotrichas leucophrys*
628	Great Reed-Warbler	*Acrocephalus arundinaceus*
631	African Reed-Warbler, African Marsh Warbler	*Acrocephalus baeticatus*
633	Marsh Warbler, European Marsh Warbler	*Acrocephalus palustris*
634	Sedge Warbler, European Sedge Warbler	*Acrocephalus schoenobaenus*
635	Lesser Swamp-Warbler, Cape Reed Warbler	*Acrocephalus gracilirostris*
637	Dark-capped Yellow Warbler, Yellow Warbler	*Chloropeta natalensis*
638	Little Rush-Warbler, African Sedge Warbler	*Bradypterus baboecala*
643	Willow Warbler	*Phylloscopus trochilus*
645	Bar-throated Apalis	*Apalis thoracica*
648	Yellow-breasted Apalis	*Apalis flavida*
651	Long-billed Crombec	*Sylvietta rufescens*
657	Green-backed Camaroptera, Bleating Warbler	*Camaroptera brachyura*
664	Zitting Cisticola, Fan-tailed Cisticola	*Cisticola juncidis*
672	Rattling Cisticola	*Cisticola chiniana*
674	Red-faced Cisticola	*Cisticola erythrops*
675	Rufous-winged Cisticola, Black-backed Cisticola	*Cisticola galactotes*
677	Levaillant's Cisticola	*Cisticola tinniens*
681	Neddicky	*Cisticola fulvicapilla*
683	Tawny-flanked Prinia	*Prinia subflava*
690	African Dusky Flycatcher, Dusky Flycatcher	*Muscicapa adusta*
694	Southern Black Flycatcher, Black Flycatcher	*Melaenornis pammelaina*
698	Fiscal Flycatcher	*Sigelus silens*
700	Cape Batis	*Batis capensis*
701	Chinspot Batis	*Batis molitor*
705	Black-throated Wattle-eye, Wattle-eyed Flycatcher	*Platysteira peltata*
708	Blue-mantled Crested-Flycatcher, Blue-mantled Flycatcher	*Trochocercus cyanomelas*
710	African Paradise-Flycatcher, Paradise Flycatcher	*Terpsiphone viridis*
711	African Pied Wagtail	*Motacilla aguimp*
713	Cape Wagtail	*Motacilla capensis*
714	Yellow Wagtail	*Motacilla flava*
716	African Pipit, Grassveld Pipit	*Anthus cinnamomeus*
728	Yellow-throated Longclaw	*Macronyx croceus*
732	Common Fiscal, Fiscal Shrike	*Lanius collaris*
733	Red-backed Shrike	*Lanius collurio*
736	Southern Boubou	*Laniarius ferrugineus*
740	Black-backed Puffback, Puffback	*Dryoscopus cubla*
741	Brubru	*Nilaus afer*
742	Southern Tchagra	*Tchagra tchagra*
758	Common Myna, Indian Myna	*Acridotheres tristis*
760	**Wattled Starling**	***Creatophora cinerea***
761	Violet-backed Starling, Plum-coloured Starling	*Cinnyricinclus leucogaster*
768	Black-bellied Starling	*Lamprotornis corruscus*
769	Red-winged Starling	*Onychognathus morio*
780	Purple-banded Sunbird	*Cinnyris bifasciatus*

Rob	Common Name	Scientific Name
787	White-bellied Sunbird	*Cinnyris talatala*
789	Grey Sunbird	*Cyanomitra veroxii*
790	Olive Sunbird	*Cyanomitra olivacea*
791	Scarlet-chested Sunbird	*Chalcomitra senegalensis*
792	Amethyst Sunbird, Black Sunbird	*Chalcomitra amethystina*
793	Collared Sunbird	*Hedydipna collaris*
796	Cape White-eye	*Zosterops virens*
801	House Sparrow	*Passer domesticus*
807	Thick-billed Weaver	*Amblyospiza albifrons*
810	Spectacled Weaver	*Ploceus ocularis*
811	Village Weaver, Spotted-backed Weaver	*Ploceus cucullatus*
817	Yellow Weaver	*Ploceus subaureus*
824	Southern Red Bishop, Red Bishop	*Euplectes orix*
828	Fan-tailed Widowbird, Red-shouldered Widow	*Euplectes axillaris*
831	Red-collared Widowbird, Red-Collared Widow	*Euplectes ardens*
835	Green Twinspot	*Mandingoa nitidula*
840	African Firefinch, Blue-billed Firefinch	*Lagonosticta rubricata*
846	Common Waxbill	*Estrilda astrild*
848	Grey Waxbill	*Estrilda perreini*
857	Bronze Mannikin	*Spermestes cucullatus*
858	Red-backed Mannikin	*Spermestes bicolor*
860	Pin-tailed Whydah	*Vidua macroura*
869	Yellow-fronted Canary, Yellow-eyed Canary	*Crithagra mozambicus*
877	Brimstone Canary, Bully Canary	*Crithagra sulpuratus*

Source:
Ezemvelo KZN Wildlife Database; Extra species in **bold** obtained from old Natal Parks Board Management Plan.

Fish species found in Mgeni Estuary and Beachwood Mangroves

FRESHWATER SPECIES

Family CICHLIDAE (Cichlids)
Anguilla mossambica — Mozambique tilapia (Blue Kurper)

Family CLARIIDAE (Airbreathing Catfish)
Clarias gariepinus — Sharptooth catfish

Family POECILIIDAE (Alien live-bearing Aquarium fish released for mosquito control)
Poecilia reticulata — Guppy

ESTUARINE SPECIES

Family AMBASSIDAE (Glassfish)
Ambassis ambassis — Bald Glassy
Ambassis natalensis — Smooth Glassy

Family ATHERINIDAE (Silversides)
Atherina breviceps — Cape Silverside

Family ANTENNARIIDAE (Anglerfish [Frogfish])
Antennarius maculatus — Warty Frogfish

Family BOTHIDAE (Lefteye Flounders)
Bothus pantherinus — Leopard Flounder

Family CALLIONYMIDAE
Callionymus martleyi — Sand Dragonet

Family CARANGIDAE (Kingfish, Leervis, Queenfish, etc)
Caranx sexfasciatus — Bigeye Trevally
Scomberoides tala — Barred Queenfish

Family CLUPEIDAE (Herring, Sardine & Pilchards)
Gilchristella aetuarius — Estuarine Roundherring

Family DREPANEIDAE (Concertinafish/Sicklefish)
Drepane longimana — Concertina fish
(recorded by Begg as *D. punctata,* which occurs in Red Sea, Gulf of Arabia and central pacific)

Family ELEOTRIDAE (Sleeper Gobies)
*Butis butis** — Duckbill Sleeper
Eleotris fusca — Dusky Sleeper

Family ELOPIDAE (Ladyfish)
Megalops cyprinoides — Oxeye Tarpon

Family ENGRAULIDAE (Anchovies)
Stolephorus holodon (commersonii) — Thorny Anchovy

Family FISTULARIDAE (Flutemouths)
Fistularia petimba — Serrate Flutemouth

Family GERREIDAE (Pursemouths)	
Gerres methueni (rappi)	Evenfin Pursemouth
Family GOBIIDAE (Gobies, Mudskippers & Gliders)	
Caffrogobius natalensis	Baldy
Favonigobius melanobranchus	Blackthroat Goby
Favonigobius reichei	Tropical sand Goby
Glossogobius biocellatus	Sleepy Goby
Glossogobius giurus	Bar-Eyed Goby
Hypseleotris dayi	Golden sleeper
Mugilogobius (Gobius) durbanensis	Durban Goby
Oligolepis acutipennis	Sharptail Goby
Periopthalmus kalolo (cantonensis)	Common Mudskipper
Psammogobius knysnaensis	Knysna Sandgoby
Family HAEMULIDAE (Rubberlips & Grunters)	
Plectorhinchus nigrus	Harry Hotlips
Pomadasys commersonnii	Spotted Grunter
Pomadasys hasta	Spotted Javelinfish
Pomadasys maculates	Saddle Grunter
Pomadasys multimaculatus	Cock Grunter
Family LEIOGNATHIDAE (Ponyfish/Soapies)	
Leiognathus equula	Common Ponyfish
Secutor insidiator	Slender Ponyfish
Family LOBITIDAE (Tripletails)	
Lobotes surinamensis	Triple Tail
Family LUTJANIDAE (Jobfish & Snappers)	
Lutjanus argentimaculatus	River Snapper
Lutjanus fulviflamma	Dory Snapper
Family MONODACTYLIDAE (Moonies)	
Monodactylus argenteus	Round Moony
Monodactylus falciformis	Oval Mooney
Family MUGILIDAE (Mullets)	
Liza richardsonii	Southern Mullet
Liza dumerili	Groovy Mullet
Liza macrolepis	Large Scale Mullet
Mugil cephalus	Flathead/Grey Mullet
Myxus capensis	Freshwater Mullet
Valamugal buchanani	Bluetail Mullet
Valamugil cunnesius	Longarm Mullet
Family OPHICHTHIDAE (Snake Eels)	
Strophidon sathete (Thyrsoidea macrura)	Slender Giant Moray
Family PLATYCEPHALIDAE (Flatheads)	
Platycephalus indices	Bartailed Flathead
Family SCIAENIDAE (Kob, Geelbek & Baardman)	
Argyrosomus hololepidotus	Kob
Johnius belangeri	Mini Knob

Family SCORPAENIDAE (Scorpionfish, Firefish & Stonefish)
Taenioides jacksonii

Family SERRANIDAE (Rockcods, Goldies, Seabasses & Soapfish)

Epinephelus andersonii	Catface Rockcod

Family SILLAGINIDAE (Sillagos/Whitings)

Sillago sihama	Silver Sillago

Family SOLEIDAE (Soles)

Solea bleekeri	Blackhand Sole

Family SPARIDAE (Seabream)

Acanthopagrus berda	Mudbream
*Rhabdosargus holubi**	Cape Stumpnose
Rhabdosargus sarba	Tropical Stumpnose

Family SYNGNATHIDAE (Seahorses & Pipefish)

Hippichthys heptagonus	Belly Pipefish

Family TERAPONIDAE (Thornfish)

Terapon jarbua	Thornfish

Family TETRAODONTIDAE (Puffers [Blaasops], Tobies & Blowfish)

Amblyrhynchotes honckenii	Evileye Puffer
Arothron immaculatus	Blackedged Puffer

Source:
Begg, 1983; Edwards and Moll, 1971. Checked names against Heemstra & Heemstra, 2005 and www.fishwise.co.za. Only two species (*) are listed in KZN Wildlife Database.

Note: All are estuarine species, unless otherwise indicated.

Reptiles recorded in the Beachwood Mangroves Nature Reserve

Scientific Name	EnglishName
Bradypodion melanocephalum	KwaZulu (Black-Headed) Dwarf Chameleon
Hemidactylus mabouia	Moreau's tropical house gecko
Causus rhombeatus	Night Adder
Crotaphopeltis hotamboeia	Red Lipped Herald
Philothamnus angolensis	Green Water Snake
Philothamnus natalensis	Natal Green Snake
Lamprophis fuliginosus	Brown House Snake

There are also references to various skink species and monitors in old Beachwood Mangroves management plans, but the actual species are not recorded.

Source: Ezemvelo KZN Wildlife database.

Amphibians recorded in the Beachwood Mangroves Nature Reserve

Scientific Name	EnglishName
Arthroleptis wahlbergi	Bush Squeaker
Afrixalus fornasinii	Greater Leaf-folding Frog
Hyperolius marmoratus	Painted Reed Frog
Hyperolius pusillus	Water Lily Frog
Hyperolius tuberilinguis	Tinker Reed Frog
Breviceps verrucosus	Plaintive Rain Frog
Phrynobatrachus natalensis	Snoring Puddle Frog

Source:
Ezemvelo KZN Wildlife database. Species not in database, but in historical reports are indicated with *.

Invertebrates recorded in the Beachwood Mangroves Nature Reserve

INSECTS

Order COLEOPTERA
Family SCARABAEIDAE (Fruit chafers)
Cyrtothyrea marginalis Marginal fruit chafer

Order HYMENOPTERA
Family ANTHOPHORIDAE (Anthophorid bees)
Xylocopa flavorufa

Family MEGACHILIDAE (Megachilid bees)
Megachilus sp.

Order LEPIDOPTERA (Heterocera)
Family SESIIDAE (Moths)
Melittia sp.

Source:
Ezemvelo KZN Wildlife Database

GASTROPODS

Assiminea bifasciata	
Assiminea ovata	
Auriculastra radiolata	White Coffee-bean Snail
Cassidula labrella	Keeled Coffee-bean Snail
Cerithidea decollate	Truncated Mangrove Snail
Littoraria (Littorina) scabra	Scabra Periwinkle
Melampus semiaratus	Half-grooved Coffee Bean Snail
Melampus spp. x 2	Unidentified Coffee Bean Snails
Neritina auriculata	Eared Nerite
Neritina gagates	Jet Nerite
Neritina natalensis	Natal Nerite

Source:
D.S. Brown, 1971; Herbert and Kilburn, 2004; and D. Herbert (Pers. Comm., 2012 – KwaZulu Natal Museum Database)

Ten out of 13 species listed as occurring in South African Mangroves, i.e. the richest assemblage known at any one locality (Begg 1978).

PRAWNS AND SHRIMPS

Acetes natalensis†	
*Alpheus lobidens**	Orange-claw snapping shrimp
Caridina nilotica†	Common Caridina
Caridina types†	
Harpilius depresses†	
Macrobrachium equidens†	River Prawn
Marsupenaeus japonicus	*Ginger Prawn*
*Metapenaeus monoceros†**	Speckled Prawn
Palaemon concinnus†	Mangrove Prawn
Palaemon pacificus†	Sand Prawn
Fenneropenaeus (Penaeu†) índicus*	White Prawn

Marsupenaeus (Penaeus†) japonicus*	Ginger Prawn
Penaeu semisulcatus†	Green Prawn
*Penaeus monodon†**	Tiger Prawn
*Upogebia africana†**	Mud Prawn

CRABS

Cardiosoma carniflex[+]	Tangoman Crab
Chiromantes (Sesarma†) eulimene*	
Dehaanius dentatus†	Seaweed Crab
Dehaanius quadridentatus †	
Hymenosoma orbiculare†	Membrane Bodied Crab
Leucisca squalina†	
Macrophthalmus grandidi†	
Monomia argentata†	
Neosarmatium (Sesarma†) meinhartii*	Red Mangrove Crab
Parasesarma catenatum (Sesarma catenates†)*	Marsh Crab
*Scylla serrata†**	Giant Mud Crab
Thalamita admete†	
Paratylodiplex (Tylodiplax) blephariskios†	
*Uca annulipes†**	Ring-legged Fiddler Crab
Uca gaimardi†	Fiddler Crab
*Uca inversa**	Inversed Fiddler Crab
*Uca chloropthalmus**	Common Fiddler Crab
*Uca urvillei†**	Fiddler Crab
*Uca hesperiae (vocans) †**	Fiddler Crab
Varuna litterata†	Green Tidal Crab

Sources: †Forbes (Pers. Comm. - From old Beachwood Management Plan); *Berjak *et al.*, 2011; Ezemvelo KZN Wildlife Database[+].

Appendix F – Pro forma annual plan of operation

Notes of a management meeting for Beachwood Mangroves Nature Reserve held at office on …

Present:

Apologies:

CC:

Management Target	2011/12 Progress	2012/13 Goals	Completion Date	Responsibility	Action
LEGAL COMPLIANCE AND ENFORCEMENT					
▪ Minutes of the annual management meeting indicating security targets.					
▪ Regular patrols covering the full extent of the protected area. ▪ Prosecution of offender caught committing an offence.					
STAKEHOLDER ENGAGEMENT					
▪ Maintain relationships with various stakeholder groups, such as Umgeni Conservancy, DUCT, Honorary Officers, eThekwini Biodiversity Forum, Beachwood Golf Course. ▪ Reserve plans and management information presented to the stakeholders as they are developed					
LOCAL AND REGIONAL PLANNING					
Report presented and negotiated with the municipalities for inclusion in their IDP's and SDF's and schemes.					

VISITOR MANAGEMENT					
Annual report of visitor information.					
ENVIRONMENTAL INTERPRETATION AND AWARENESS					
▪ Education material in education centre. ▪ Adequate signage on trails.					
INVASIVE SPECIES CONTROL					
▪ Continue alien species control efforts. ▪ Compliance with the Biodiversity Act. ▪ Minutes of the annual management meeting containing the annual plan of operation and targets for alien species control.					
SOIL EROSION AND SEDIMENTATION CONTROL					
▪ Erosion problems identified. ▪ Implementation of accelerated soil erosion control measures in areas identified. ▪ Coordinated, ongoing communication and timeous clearing of silt coordinated with Municipality.					

COLLECTION OF BIOLOGICAL MATERIAL					
Ensure that all collecting is done under permit.					
CONSERVATION TARGETS					
▪ All subsidiary plans must reflect critical ecological processes. ▪ All subsidiary plans must include a biological monitoring programme. ▪ Surveillance and monitoring plans for key threatened processes are required ▪ Monitoring plans for key rare and endangered species to be developed.					
FINANCIAL RESOURCES					
Adequate funding to achieve the objectives of the nature reserve.					
HUMAN RESOURCES					
▪ Sufficient staff to achieve nature reserve objectives ▪ Clean bill of health.					

FACILITIES AND INFRASTRUCTURE					
▪ Infrastructure maintenance plan developed. ▪ Regular scheduled maintenance of all facilities and infrastructure. ▪ Regular scheduled maintenance of all facilities and infrastructure. ▪ Targets set in annual plan of operation through the management meeting ▪ Appropriately functioning service infrastructure and systems that do not cause harm to the environment.					