

# C.A.P.E. Estuaries Programme



## Estuary Management Plan for the Diep Estuary



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**Prepared by  
Coastal & Environmental Consulting**



***Acknowledgements***

The original edition of this plan was completed under the auspices of Peak Practice. The proposals made therein were based on a series of discussions and workshops involving numerous individuals and organizations from relevant government agencies, to research institutions, non-governmental organizations and representatives of the local resident's associations. The proposals in this second edition of the plan have similarly involved many stakeholders through bilateral discussions and participation in the meetings of the EMP Forum (Rietvlei Management Working Group).

The active and enthusiastic participation in the process augurs well for the successful implementation of this plan and the rehabilitation of the estuary and we would like to express our appreciation to everyone who has contributed.

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### **1. INTRODUCTION**

#### **The management of estuaries in South Africa**

The term estuary refers to the body of water which forms the interface between a river and the sea into which it flows. Estuaries may be permanently or periodically open to the sea. When open, they are characterized by fluctuations in water levels related to the tides, and by salinities which are measurably higher than freshwater as a result of seawater intrusion.

Estuaries are generally highly productive ecosystems, and provide a range of goods and services ranging from nursery areas for juvenile fish, to stopovers for migrant birds, and recreational opportunities for local inhabitants. Their productivity, combined with their natural beauty and the shelter they provide also means that they are highly sensitive and vulnerable to development, with many towns and cities, ports and harbours being deliberately located in and around them. As a result, many estuaries have been seriously degraded.

South Africa has approximately 260 estuaries, of which 62 are located within the Cape Floristic Region. Despite the fact that their value – particularly from a biodiversity perspective – has long been recognized, there has been a lack of effective management, largely due to the fact that they did not fit clearly within the mandate of any one government Department. This was highlighted during the recent development of a National Biodiversity Strategy and Action Plan, and has been addressed through the inclusion of relevant provisions in the National Environmental Management: Integrated Coastal Management Act, 2008. Amongst other things, the Integrated Coastal Management Act introduces a requirement for Estuary Management Plans.

In parallel with the development of the legislation, the C.A.P.E. Estuaries Programme has provided funding for the development of Estuary Management Plans for a number of priority estuaries in the Cape Floristic Region, including the Diep.

#### **The management of the Diep Estuary**

The Diep River has its origins in the Riebeeck Kasteel Mountains north-east of Malmesbury, and flows for about 65 kilometres south-west towards Cape Town, before entering the sea at Milnerton, some 5 kms north of the Port of Cape Town. It has one major tributary – the Mosselbank – which drains the northern slopes of the Durbanville Hills. Other tributaries include the Swart, Groen, Klein, and Riebeeck, with the Klapmuts being a tributary of the Mosselbank. The total size of the catchment is 1,495 km<sup>2</sup> or 154,347 ha.

Before entering the sea, the Diep River flows through the Rietvlei wetland and the Milnerton Lagoon, which together cover an area of approximately 900 hectares. These two features together have generally been considered to comprise the “estuary”. More specifically, for purposes of the Estuary Management Plan, the estuary is defined as the area from the estuary mouth, to the Blaauwberg Bridge at

## Estuary Management Plan: Diep Estuary

the upper end of Rietvlei, with the lateral boundaries being the 5 metre mean sea level contour. These boundaries, as well as the 1:100 year floodline are shown in Figure 1. below.

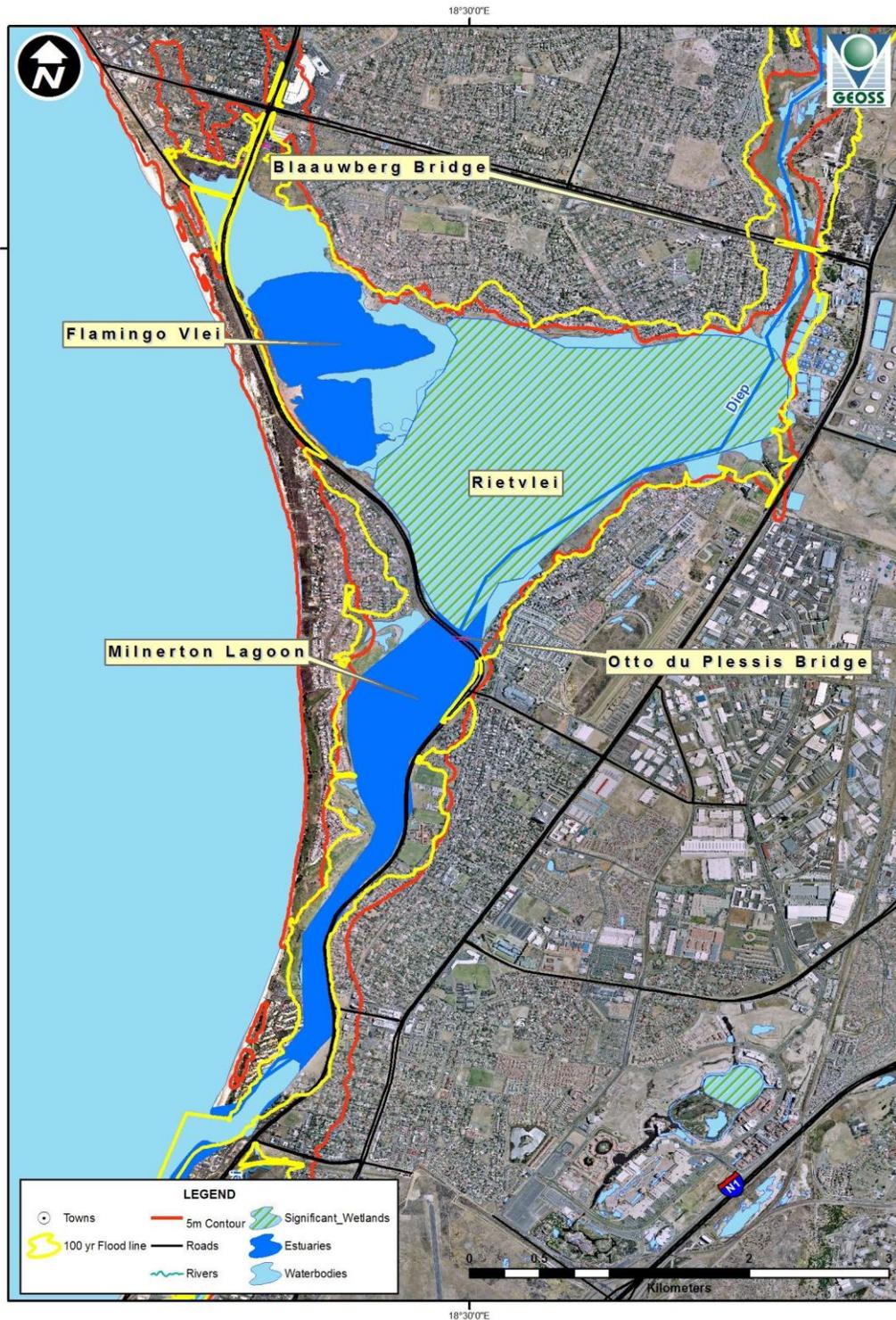


Figure 1: The Diep Estuary comprising Rietvlei and the Milnerton Lagoon.

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The catchment of the Diep River has a relatively flat topography, making it suitable for both agriculture and urban development. This, together with its proximity to Cape Town has meant that it has become highly developed, with agricultural activities going back to van Riebeeck's time, and the establishment of an outpost by the Dutch East India Company. Urbanisation around the estuary began in earnest following the founding of Milnerton Estates Limited in 1897, and has continued to gain momentum, with the area to the north of Rietvlei today being the fastest growing in Cape Town. The Diep River, and particularly its lower reaches, has therefore been significantly modified over the past few centuries.

Rietvlei is considered as the most important area for waterbirds in the region and is recognized as an Important Bird Area by Birdlife International. Official recognition of its importance to biodiversity by the South African government was first afforded in 1984, when a Nature Reserve was established. This was followed by its declaration as a Protected Natural Environment in 1989, and the establishment of the Rietvlei Wetland Reserve in 1993. The first formal Management Plan for the reserve was developed in 1994, and this served to guide management activities until the publication of the first edition of this plan in 2008.

Despite these initiatives, development has continued to encroach into the margins of the estuary, the hydrodynamics of the system has been altered, water quality has seriously deteriorated, and the area has been invaded by a number of alien and indigenous species. A fish kill in December, 2006 highlighted these problems, and led to the inclusion of the Diep Estuary in the C.A.P.E. Estuaries Programme.

### **1.3 The Diep Estuary Management Plan and Action Plan**

As per the requirements of the C.A.P.E. Estuaries Programme, the original edition of this management plan was developed in two phases: i) a Situation Assessment; and ii) the Estuary Management Plan (EMP) and Action Plan. The latter was developed through a consultative process including public meetings, the development of a Vision and Strategic Objectives, and the establishment of Technical Working Groups comprising experts and public representatives.

This updated version of the EMP and Action Plan was produced in consultation with the EMP Forum and should be read in conjunction with the Situation Assessment. It takes into account the progress that has been made in implementation of the Action Plan over the past two years, and now covers the period 2011 – 2015.

## 2. VISION AND STRATEGIC OBJECTIVES

The Vision for the C.A.P.E. Estuaries Programme as a whole is: “***Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits.***”

In this context, the following more specific Vision and Strategic Objectives for the Diep Estuary were adopted at a public meeting in September, 2008.

***Vision: The Diep River, Rietvlei and Milnerton Lagoon are natural assets, beautiful and rich in biodiversity, and a part of our heritage. They should be restored, enhanced and protected for sustainable use and appreciation by current and future generations.***

### ***Management Objectives***

Overall Objective: “*To manage the Diep River, Rietvlei, the Milnerton Lagoon and their environs in a manner that is sustainable, and compatible with the conservation of an ecosystem of international significance for biological diversity*”.

### Key management objectives:

- *To develop a mechanism to manage the hydrodynamics of the system in a manner which simulates as far as possible the natural condition and which:
  - alleviates the dust problem
  - protects property against flooding
  - reduces siltation
  - optimises flows from and through the various components of the system
  - establishes optimum conditions at the estuary mouth.*
- *To prevent, reduce or minimise pollution from all sources so as to be able to restore the water quality to a standard suitable for supporting natural resources and human recreation.*
- *To ensure that any relevant future planning and development decisions acknowledge the socio-economic value and conservation significance of the estuary.*
- *To promote and manage recreation, education and eco-tourism in the estuary in a manner compatible with its conservation status.*
- *To create conditions suitable for the restoration and ongoing protection of the Diep Estuary ecosystem and its biodiversity, including:
  - creating an appropriate buffer between the estuary and the surrounding urban areas;
  - controlling and removing key invasive alien species;
  - improving water quality;
  - promoting sustainable use of natural resources.*

### 3. OPERATIONAL OBJECTIVES

#### 3.1 Long-term objectives:

- 3.1.1 Rietvlei should function optimally as a wetland with the pans undergoing seasonal cycles, and the lagoon should have appropriate tidal flows and salinity levels.
- 3.1.2 Water quantity and quality should meet Resource Quality Objectives to be developed through a reserve determination, with water quality standards being based on the guidelines for recreation and freshwater and marine ecosystems as appropriate.
- 3.1.3 Biological communities should be restored to as close to natural species composition and structure as possible.
- 3.1.4 There should be an appropriate balance between conservation and sustainable use of the system.
- 3.1.5 The system should comply with South Africa's obligations under relevant international agreements such as the Ramsar Convention, the Convention on Migratory Species (Bonn Convention) and the associated Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

#### 3.2 Objectives for Action Plan: 2011 - 2015

This management plan includes an Action Plan for the period 2011 – 2015 (see section 7). Since a number of the long-term objectives will not necessarily be achievable within this period, more detailed specific objectives which are intended to be met by 2015, if not before, are set out below.

##### 3.2.1 *Land-use and Infrastructure Development*

For purposes of this plan, the Diep Estuary is defined as including the river from the mouth to the Blaauwberg Bridge, with the lateral boundaries being the 5 meter contour above sea level. While the majority of this falls within the Rietvlei Nature Reserve, there are, unfortunately some areas within the 5m contour which have already been developed. On the other hand, there are still some undeveloped portions of land – many of which are currently considered as Public Open Space – lying between the Reserve boundaries and the 5 m contour. These, as well as the Dolphin Beach ponds and a stretch of coastline between Dolphin Beach and Sunset Beach, should be formally included into the Reserve to ensure the best possible protection for the estuary in future. See Fig. 2 below.

Furthermore, subject to discussions with the City's Roads Planning Department, it is proposed to incorporate all City-owned land between Blaauwberg Bridge and the railway bridge into the reserve, with a view to establishing a corridor between the Blaauwberg Conservation Area and Rietvlei/Milnerton Lagoon.

## Estuary Management Plan: Diep Estuary

In addition:

- The wetland should be delineated using the guidelines developed for South African wetlands;
- There should be no further developments within the boundaries of the reserve or the estuary [apart from approved conservation-related structures].
- Facilities within the reserve must be designed to promote conservation objectives, including effective management of the reserve, education, awareness-raising and non-consumptive uses.
- There must be secure boundary conditions around the entire reserve, and where appropriate, between different zones within the reserve.
- Stringent environmental conditions should be included in approvals for rezoning and future development in areas nearby the reserve and with potential to impact on the estuary (eg. on water quality).

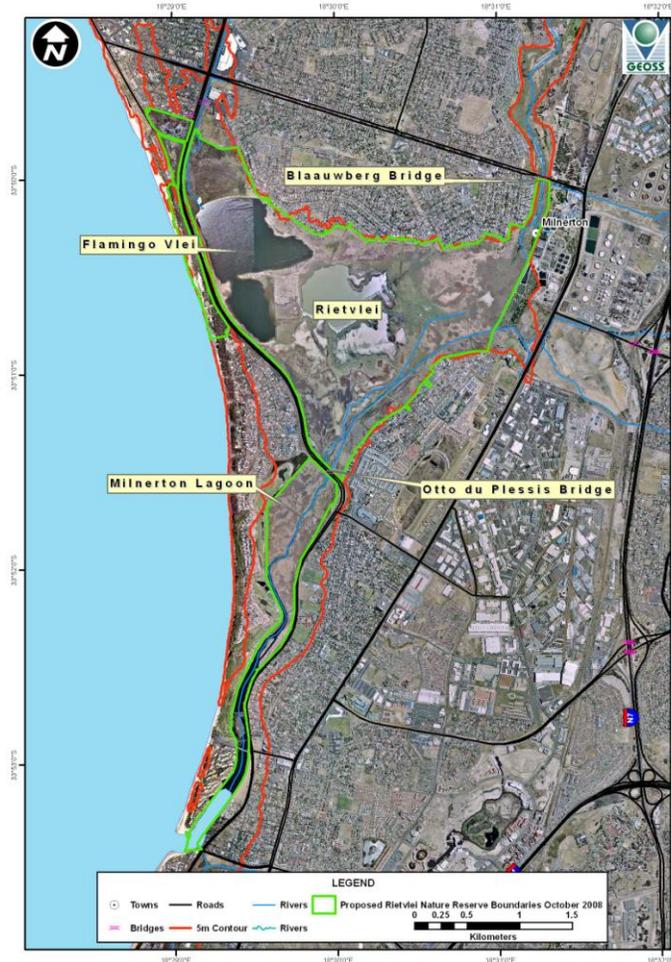


Fig. 2. Proposed new boundaries for the Rietvlei Nature Reserve (excluding area upstream of Blaauberg Bidge).

### 3.2.2 *Water Quantity and Quality*

Over the years, there have been significant changes to the volumes and quality of water and associated sediments flowing into the Diep Estuary. In combination with physical developments (such as roads and bridges) these changes mean that the system will never function as a completely natural system again and, at present is seriously degraded. At the same time, the estuary remains highly valuable from both a conservation and socio-economic perspective. The primary objective is therefore to develop a management regime which will restore the flows to, from and within the system and the water quality to the extent possible, with a view to maintaining and enhancing its current value.

#### Water Quantity and Circulation

At present there is insufficient information available to set specific objectives in relation to the management of water quantity. The initial objective must therefore be to obtain a better understanding of the water requirements, hydrodynamics and other aspects of the system. Nevertheless, in the interim, there are a number of more general objectives which can be used as a guide to begin the process of rehabilitation over the next few years.

These interim objectives include:

#### *Salinity*

As a consequence of the various changes to the system, the estuary is currently fresh-water dominated. A salinity regime more typical of an estuarine system, with tidal effects and saline penetration up to at least the Otto du Plessis Bridge needs to be re-established. From a biological perspective, the salinity regime should be such that it facilitates the rehabilitation of estuarine communities - such as *Callianassa* - in those areas which they previously occupied.

#### *Mouth conditions*

Historically the mouth closed periodically during the summer months of low-rainfall years. More recently, the discharge of sewage effluent into the system has maintained flows at levels which have precluded the closing of the mouth with a variety of consequences (including the drop in salinity). Optimum conditions should therefore be re-established at the estuary mouth. In the longer term, this would imply the mouth closing in late summer at least in some years, and then opening again after a few months. It is noted that in the short-term – until water quality conditions have been improved – it is probably preferable that the mouth does not close, or that it closes for very short periods only.

#### *Water levels*

The water levels in the vlei should be managed such that they fluctuate on a seasonal basis, thereby allowing the pans to maintain the ecological characteristics which make them attractive to wading birds. At the same time, the period during which they are allowed to dry out completely should be limited to the shortest time

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possible with a view to alleviating the dust problem. (It is noted that there will need to be expert consultations, and possibly even a study, to determine this).

Water levels should not be allowed under normal conditions to rise to a point where residential areas are under immediate threat of flooding - noting that some areas have already been constructed within areas already prone to flooding (see Fig. 3 below). Residents of such areas must be made aware of this threat, and a Disaster Management Plan should be put in place for such eventualities. It is further noted that the extent of areas under threat of flooding may increase as a consequence of climate change.

### *Sedimentation*

At present there is a lack of understanding of the rates and patterns of sedimentation in the system, and the impacts thereof on channel depth, drying of seasonal pans, circulation, mouth conditions etc. The initial objective should therefore be to generate the required information and, if necessary, sediment inputs and deposits should then be managed so as to limit impacts on the system.

### *Circulation*

Flows of water and stratification within the system are not clearly understood. Relevant data needs to be generated so that flows can be optimised so as to, for example, reduce the potential for development of anoxic conditions.



Fig.3 Floodprone areas around the Diep Estuary (based on the 1:100 -year floodline).

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### Water quality

The long term objective should be for the water quality to meet Resource Quality Objectives to be developed in terms of the National Water Act (1998) specifically for the Diep Estuary and covering i) the freshwater inflow from the river; and ii) the estuary itself. These will be based on socio-economic requirements and existing guidelines for freshwater or marine ecosystems and/or full contact recreation as appropriate. Interim targets for parameters of particular concern are outlined below. These will be reviewed halfway through the 5-year period of the Action Plan.

Supplementary objectives are:

- that the number of accidental discharges of wastewater per year (i.e. sewage overflows from sewerage bockages and sewage pump stations) should be reduced through monitoring, maintenance and appropriate capital investment;
- to obtain a better understanding of the relative contributions of the different sources of pollution, in particular the stormwater drains.

### *Bacteriological targets*

- The Resource Quality Objectives for bacteriological parameters should be based on those for full contact recreation (especially given the high prevalence of HIV in the country, and the consequential lowered immune system of a substantial proportion of the population). The most important of these is *E.coli*, with others being Faecal coliforms and *Enterococci* as follows:
  - *E. coli* – which are more specific to warm-bodied animals and show a high correlation with swimming-related gastric illness - with a target range of 0 – 130 counts (based on the DWAF South African Water Quality Guidelines: Recreational Use (2<sup>nd</sup> Edition, 1996)). To meet the target, the range should not be exceeded by the geometric mean of fortnightly samples over a three-month period.
  - Faecal coliforms (including *E.coli*) – which are used as an indicator of general faecal contamination - for which the target range should be between 0 – 100 counts per 100 ml (based on the 1995 South African Water Quality Guidelines for Coastal Marine Waters). To meet this target, 80% of samples taken from the water body should fall within this range (i.e. less than 100 counts); and 95% of samples should be below 2,000 counts.
  - *Enterococci* – there are currently no guidelines for South Africa, but guidance is obtainable from the Blue Flag Programme and/or World Health Organisation recommendations.
- The bacteriological standards should be met in the northern section of Flamingo Vlei (which is zoned for recreational use) within 3 years (i.e. by the end of 2011).
- There should be an improvement in the bacteriological quality of the water in the Milnerton Lagoon (also zoned for recreational use) over the next 3 years (to end of 2013) as follows: At present, only around 10% of the faecal coliform samples are < 100 counts/ 100 ml, while about 60% of the samples are < 2,000 counts/ 100ml. By 2013, 95% of the samples should be < 2,000 counts/100ml; and 50% of the samples should be < 100 counts/ 100ml.

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### *Nutrient targets*

Target values need to be established for the Diep Estuary as part of the reserve determination process, and once there is greater clarity on the discrepancy between target and current actual values, a time-frame can be developed for the achievement of the target values. In the interim, the following targets are proposed:

- The current guideline on dissolved inorganic nutrients for marine aquatic ecosystems is: “Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing oxygen concentrations below the target range..”(see below).
- The Coastal Water Quality Guidelines provide a more specific guideline for Total Ammonia-N – namely 600  $\mu\text{g/l}$  - while the freshwater guideline for unionized ammonia ( $\text{NH}_3$ ) is < 7  $\mu\text{g/l}$  (DWAF, 1996). More recent guidelines developed through the Reserve Determination methodology suggest that values of 0.015 – 0.058 mg/l (or 15 – 58  $\mu\text{g/l}$ ) are good.<sup>1</sup> It is therefore proposed that this be adopted as the target range for the Diep Estuary.
- The DWAF Water Quality Guidelines: Aquatic Ecosystems provide a guideline for inorganic nitrogen ( $\text{NH}_3 + \text{NH}_4 + \text{NO}_2 + \text{NO}_3$ ) which states that i) concentrations should not deviate by more than 15% from that of the local water body; ii) the trophic status of the water body should not be increased; and iii) that the amplitude and frequency of natural cycles should not be changed. The Guidelines also state that concentrations below 0.5 mg/l are indicative of oligotrophic conditions, 0.5 – 2.5 mg/l mesotrophic, and 2.5 – 10 mg/l, eutrophic. However, according to Taljaard (pers. comm.) although only limited data is available for estuaries in South Africa, concentrations of 1 – 2 mg/l were sufficient to stimulate dense macrophyte growth in the Sundays River. Moreover, recent guidelines developed through the Reserve Determination methodology equate values of 0.25 – 1 mg/l with good conditions, and it is proposed that this be adopted as the target range for the Diep Estuary.
- Phosphorus occurs in a number of forms, of which Soluble Reactive Phosphate (SRP) or orthophosphate is immediately available to aquatic biota. The recent guidelines developed through the Reserve Determination methodology suggest that values of between 0.005 – 0.025 mg/l (or 5 – 25  $\mu\text{g/l}$ ) indicate good conditions, and it is proposed that these be adopted as the target value for the Diep Estuary.

### *Dissolved oxygen*

The current guideline on dissolved oxygen for marine aquatic ecosystems is: “For the east coast, the dissolved oxygen level should not fall below 10% of the established natural variation. For the south and east coasts the dissolved oxygen should not fall below 5 mg/l 99% of the time, and below 6 mg/l 95% of the time.” The recent guidelines developed through the Reserve Determination methodology suggest that

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<sup>1</sup> Information on the guidelines from the Reserve Determination process provided by Candice Haskins.

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values of between 6 – 8 mg/l are good, and it is proposed that these be used as the general target range for the Diep Estuary.

For the north and south lakes (Flamingo Vlei), which reach a depth of around 10 metres in places, and where there is likely to be stratification in the water body, it is recommended that a target of 6 mg/l to a depth of 2 metres for 100% of the time be adopted.

### *Salinity*

Target values for salinity also need to be determined for critical species. For example, *Callianassa* requires a salinity of at least 17 ppt to breed successfully. Soil salinities, together with inundation, are also important for macrophyte growth. *Sarcocornia perennis*, for example, has been found to grow best in water-saturated soil at salinities between 0 and 15 ppt (Adams and Bate, 1994).

### *Biological criteria*

In general, the water quality should be sufficient to support all biological communities. More specifically, it should allow for:

- The re-establishment of primary producers (such as *Zostera*) and benthic invertebrates such as *Callianassa* in the lagoon;
- Improved water quality and the recovery of the benthos (which are a food source for fish) should also see the juveniles of species such as the White steenbras and Cape stumpnose re-entering the estuary.
- In the south lake, water quality should be sufficient to support *Galaxius zebratus*.

At the same time <sup>2</sup>:

- Chlorophyll *a* levels (which are a measure of phytoplankton growth/eutrophication) should not create nuisance conditions or produce surface scums. Mean annual concentrations should be < 15 ug/l (DWA Water Quality Guidelines).
- Cyanobacteria (toxic blue-green algae) should be at levels < 6 blue-green units<sup>3</sup> (DWA WQ Guidelines), and < 10 ug/l of cyanobacterial toxins (microcystin toxin) (WHO recreational guidelines).

### 3.2.3 **Sediment quality**

A number of previous reports have referred to erosion in the catchment and siltation in the lagoon and other parts of the system. More recently there have also been reports of significant accumulations of organic material on or near the bottom. Apart from possible impacts on circulation, mouth conditions etc, sediments tend to be a

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<sup>2</sup> Candice Haskins and Robert Siebritz – pers. comm..

<sup>3</sup> This refers to the number of blue-green units (colonies and filaments) counted in a two-minute scan of 0.5 mL of water at x 200 magnification.

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sink for contaminants with consequential impacts on bottom-dwelling organisms. It is therefore also important to quantify and manage sediment quality.

The following objectives are proposed for sediment quality:

- Sediment quality objectives should be developed and implemented. These should be based on current international practice (see guidelines developed under BCLME), and should include bacteriological parameters.
- The sediments should be restored as far as possible to their original condition (eg. particle size distribution, organic content etc).
- Bacteriological loads in the sediments should not pose a threat to human health.
- From a biological perspective, the sediment quality in the lagoon should be sufficient to allow the re-establishment of benthic invertebrates such as *Callianassa*.

In the interim, the following guidelines are proposed for trace metals (based on the DEA guidelines)<sup>4</sup>:

Trace Metal	Target (mg/kg dry weight)
Arsenic	< 30
Cadmium	< 1.5
Chromium	< 50
Copper	< 50
Lead	< 100
Mercury	< 0.5
Nickel	< 50
Zinc	< 150
Combined levels of Cd & Hg	< 1.0
Combined levels of As, Cr, Cu, Pb, Ni & Zn	< 50

### 3.2.4 **Conservation and sustainable use**

#### Conservation and rehabilitation

Although there were some relatively thorough studies of the biodiversity of the estuary some years back, there are a number of taxonomic groups for which there is fairly limited information. Moreover, there has not been regular monitoring of the biodiversity. Nevertheless, a comparison of some of the reports completed over the years – in particular those on the vegetation – suggests that there have been significant changes to the biodiversity. These are probably a consequence of changes to the habitat, a deterioration in water quality, and the introduction of a variety of invasive species. General objectives therefore are that a more complete understanding of the biota of the estuary needs to be obtained, and that biological

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<sup>4</sup> The values given are those which trigger precautionary measures when dumping dredged materials. Updated guidelines are in the process of development.

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communities should be restored to as close to original species composition and structure as possible, noting that this may not always i) be possible to determine (given that the system has been compromised over a period of > 300 years); and ii) be practical in the current urban context.

More specific objectives include:

- The restoration of Strandveld in relevant parts of the reserve.
- The stabilization of the shorelines of the central pans and the north lake.
- Restoration of primary producers, benthic invertebrates (*Callianassa* communities) and fish in the lagoon.
- The development and implementation of an invasive species management plan for the reserve covering the eradication of alien species where possible, and where this is not possible, their control. The plan should also include provisions for the control of invasive indigenous species as appropriate.

### Human use of the estuary/ reserve

The Diep Estuary is important from both conservation and socio-economic perspectives, the latter primarily due its aesthetic value and the recreational opportunities it affords in an area close to the City centre. Management initiatives must take account of both aspects, with objectives being:

- An appropriate balance between conservation and sustainable use of the system.
- Use of the estuary and adjacent terrestrial areas within the reserve for non-consumptive purposes such as recreation should not further compromise the biological integrity of the system, and should be limited to specific zones.

### Resource exploitation

Consumptive use of resources within the estuary is relatively limited. Nevertheless, the exploitation of natural resources that does occur – for example, fishing and bait collection – should be limited to specific zones and seasons to ensure that such exploitation is sustainable.

### Education and awareness-raising

Public awareness is essential for the effective implementation of environmental programmes, and the Rietvlei Education Centre offers an ideal opportunity to build awareness of a variety of environmental issues, in particular, the role of wetlands and estuaries. Existing programmes should be expanded and facilities upgraded.

## 4 ZONATION IN THE RIETVLEI WETLANDS RESERVE

Rietvlei was first designated as a Nature Area in 1984, later becoming a Protected Natural Environment under the Environment Conservation Act (1989) and then the NEM: Protected Areas Act (2003). This was largely on the strength of its regional importance as a habitat for waterbirds ranking in the top ten of South Africa's largest estuaries. It is listed as an Important Bird Area by Birdlife International, and consideration has been given to applying for Ramsar status for the area with the wetland being of international importance for at least four bird species.

At the same time:

- Development of the surrounding areas has continued to encroach into areas which fall within the 100-year floodline of the estuary; and
- historical records show that parts of the estuary have been utilized for recreational purposes for over a century, and today there is a well-established aquatic club on the north lake, as well as a canoeing club on the lagoon. Its establishment as a Nature Reserve, and the construction of an Education Centre and related facilities, has also encouraged walking, bird-watching, picnicking etc. In addition, there is limited bait collection and fishing.

The objectives of this management plan therefore include:

- the prevention of any further inappropriate development/land-use within the reserve; and
- the achievement of an appropriate balance between conservation and sustainable use of the Nature Reserve and estuary.

An important tool in achieving these objectives is zonation. This term can be applied to the designation of particular areas or zones for specific developmental or land-use purposes or to the delineation of different zones for specific visitor uses. Both of these approaches have been applied to the reserve/estuary and are discussed further below.

### 4.1 City of Cape Town Guidelines

The City of Cape Town has recently developed Guidelines for Land Use Zoning for Nature Reserves and Conservation Areas.<sup>5</sup> These guidelines make provision for the following land-use zones and associated conservation objectives:

- Primary Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.
- Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide

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<sup>5</sup> The name of the current Table is actually Guidelines for Visitor Use Zoning, but according to Arne Purves this should be corrected.

## Estuary Management Plan: Diep Estuary

undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.

- Low Intensity Leisure: Although some areas will be impacted by a range of activities and limited infrastructure, most areas should be kept largely intact and ecological processes should remain functioning. Where possible degraded areas should be rehabilitated.
- High Intensity Use: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.
- Utility Zones: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.

Based on these, the City has proposed the following zones for the Rietvlei Wetlands Reserve:

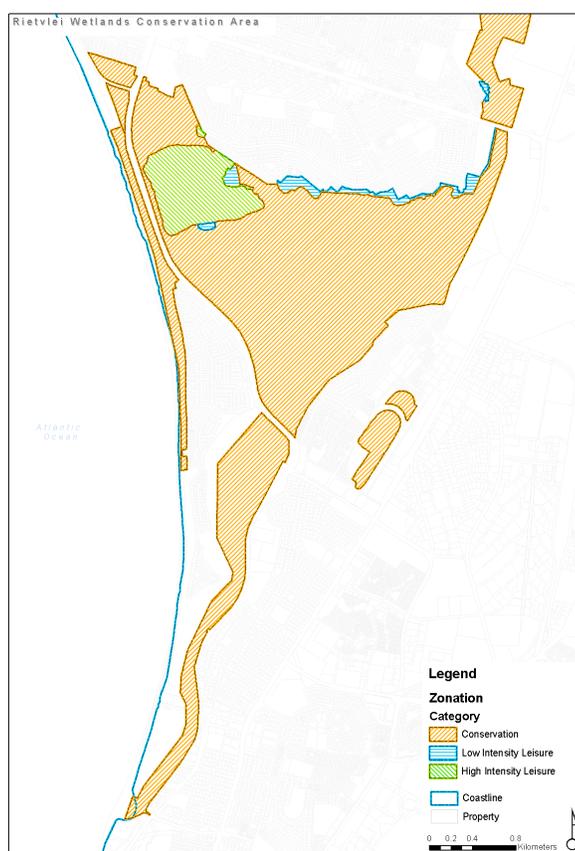


Fig. 4: Developmental/land-use zones in the Rietvlei Wetlands Nature Reserve

## Estuary Management Plan: Diep Estuary

As can be seen from the map, the majority of the area of the reserve is designated for conservation. High intensity use is restricted to the northern part of Flamingo Vlei where there are facilities which support boating, educational and other recreational activities.

### 4.2 Visitor Use Zones in the Rietvlei Wetlands Reserve

The City guidelines make recommendations on the type of activities, frequency of use, group size, sophistication and type of facilities, user movement/transport and roads and footpaths which are considered appropriate to each category. The specific details however, may vary from one reserve to the next, and the activities allowed in the various different parts of the Rietvlei Wetlands Reserve are outlined below and in Fig. 5.

#### 4.2.1 *Closed areas or sanctuaries*

These are areas where no human disturbance is permitted, and includes the southern part of Flamingo Vlei and the seasonal pans, both of which are important as sanctuaries for birds. This area comprises 357.94 ha or 44% of the total area of the estuary.

#### 4.2.2 *Low intensity Use*

In these areas only low impact activities such as bird-watching and walking are allowed. They include the entire upper lagoon, as well as a number of strips bordering the sanctuary thus providing some sort of buffer between parts of the sanctuary and developed areas. This covers 128.69 ha, or 15.9 % of the total area.

#### 4.2.3 *Medium Intensity Use Areas*

Within the reserve, there are 3 different types of low intensity use areas, based on the characteristics of the area and/or use:

- a) The terrestrial areas along the eastern bank of north lake, and the western bank of the river just below Blaauberg Bridge. Activities in these areas include picnicking, bird-watching, walking and fishing.
- b) The lower lagoon (below the wooden bridge), where canoeing, bait collection and swimming are allowed – the latter only when water quality permits.
- c) The area within the Sanctuary just to the east of Otto du Plessis Drive (and adjacent to Sunset Beach) which is used for model aircraft flying. It is noted that this zone is temporary, and will be discontinued in 2014 when the permit expires, at which time this will be incorporated into the sanctuary area.

Together these make up 30.97 ha or 3.8% of the total.

## Estuary Management Plan: Diep Estuary

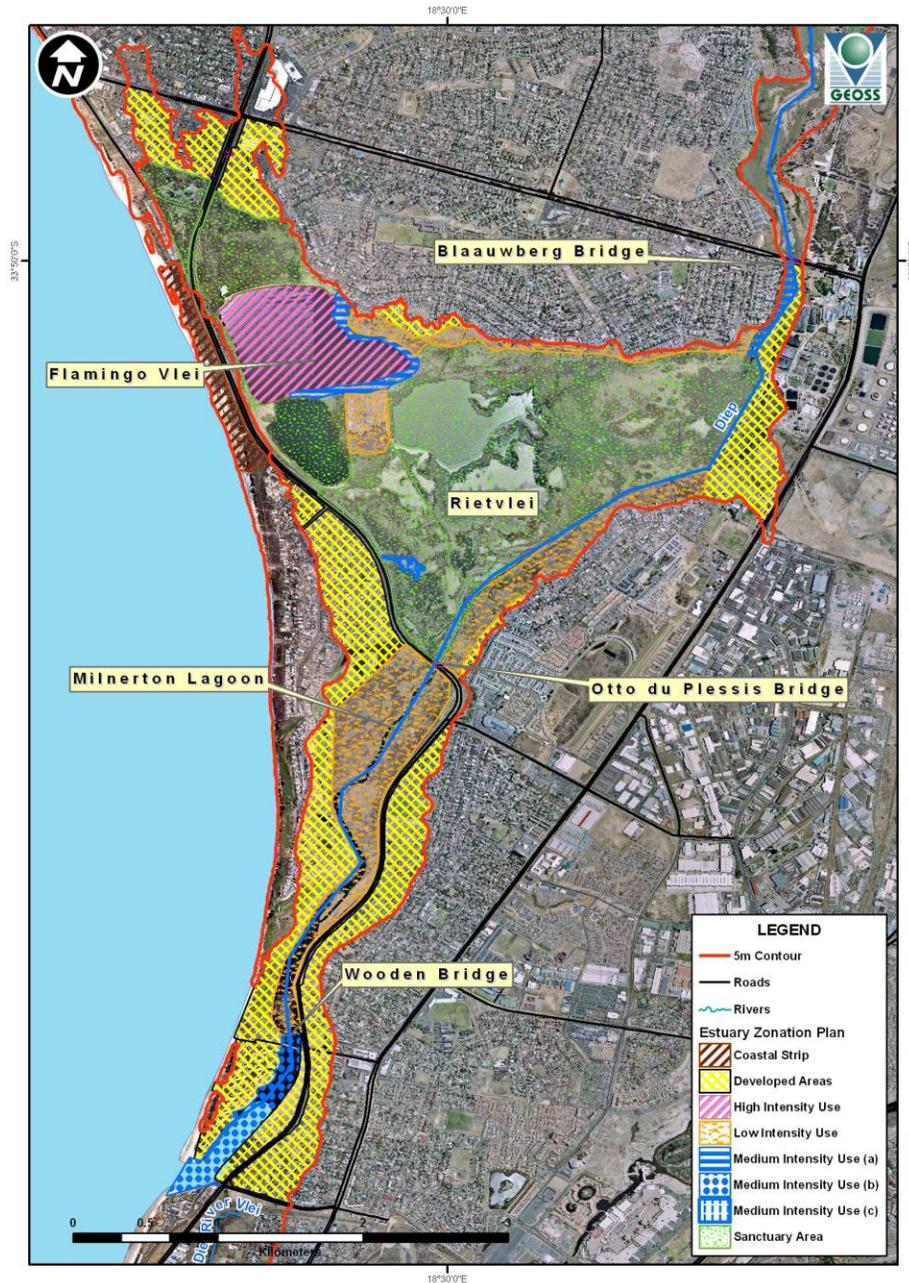


Fig. 5. Visitor Use Plan for the Diep Estuary.

### 4.2.4 High Intensity Use areas

High intensity use is limited to the north lake of Flamingo Vlei, where power-boating, water-skiing, and sailing are allowed. Limited fishing is also allowed on specifically designated open days. The lake covers 54.51 ha, or 6.73 of the total area.

## 5 MANAGEMENT STRATEGIES

### 5.1 Management of water quantity and quality

The prevailing national strategy for managing the water quantity and quality requirements of aquatic ecosystems is through the determination of Reserves and Resource Quality Objectives. These are provided for in the National Water Act (Act 36 of 1998) and the National Water Resource Strategy, and are intended to be implemented through Catchment Management Strategies and Agencies. However, neither the Reserve, nor Resource Quality Objectives have as yet been determined for the Diep River or Estuary. Nor has a Catchment Management Strategy been developed.

National policies on pollution and waste management are also pertinent to water quality. The policies of both DEA and DWA are intended to promote the precautionary approach and a hierarchy of management steps starting from pollution prevention and minimisation. Moreover, the operational policy for the disposal of wastewater derived from land (adopted by DWAF in 2004) espouses a Receiving Water Quality Objectives Approach rather than one based on effluent standards. The policy further states that:

- i) the disposal of wastewater into sensitive areas (such as estuaries) will not be considered, except in exceptional circumstances;
- ii) wastewater discharges that were existing on 31 May, 2004 (when the policy was adopted) should be re-evaluated during a 5-yearly licence-review process;
- iii) revisions can also be motivated on the grounds of negative impact on the environment and non-compliance with licence conditions.

These policies have not yet been applied to the management of water quality in the Diep Estuary. In fact, despite the serious deterioration of water quality in the system, the Western Cape Department of Environmental Affairs and Development Planning (DEA & DP) on the 3<sup>rd</sup> August, 2010 issued a Record of Decision giving their approval for the further expansion of the Potsdam Wastewater Treatment Works without placing any specific restrictions on disposal of the effluent. While disposal of the effluent would be regulated by a permit from DWA, this raises an urgent need to investigate alternative options for such disposal (other than discharge into the estuary).

#### 5.1.1 *Water quantity*

There is general consensus that given the history of changes to and around the Diep Estuary caused by historical and ongoing urbanization, the system will never be able to function naturally and there is therefore a need for management interventions to ensure that there is an appropriate balance between runoff from the catchment, inflow from other sources, drainage from the system, and evaporation. There is also general agreement that increasing the salinity in the system – which is now freshwater dominated as a consequence of the changes - could have a number of benefits, and that this must be taken into account in developing a management regime. At the same time, the information available on the system is insufficient to develop a comprehensive and effective water quantity management strategy. There

## Estuary Management Plan: Diep Estuary

is therefore an urgent need for a number of studies to, amongst other things, properly quantify the inputs and losses to and from the system, and to determine the ecological reserve for the estuary.

### *Information requirements*

Of the studies proposed, only the topographic survey and development of a Digital Elevation Model (DEM) have been completed, with the following still being required:

- i) A study of the hydrology of the estuary needs to be undertaken in order to get a clear understanding of the water balance in the system, including any seasonal variations therein. This will require an accurate determination of all flows into (from the river, groundwater, stormwater and effluent) and out of the system. The data will be obtained from:
  - o Existing DWA flow stations;
  - o Planned and completed studies on stormwater which include an assessment of flows;
  - o A determination of the groundwater contribution to the river base flow;
  - o Water level and salinity recorders in the lagoon (at the Woodbridge Island Bridge), to supplement the existing ones in Rietvlei and at the Otto du Plessis Bridge.All recorders must be properly maintained, and data downloaded on a regular basis. Once complete, the study should be able to recommend an optimal water balance.
- ii) A study of the geohydrology of the estuary is required to determine groundwater flow directions, groundwater gradients, groundwater depths and seasonal fluctuation, as well as groundwater quality variation. The groundwater underpins the surface hydrology dynamics and plays a crucial role in the management of the desiccation of the central pans in summer. The geohydrological study will require the installation of at least 8 piezometers throughout the study area. The piezometers should be equipped with water level and water quality data loggers which then need to be read at regular intervals. The piezometer water level data will also provide valuable input into assisting with the understanding of surface water dynamics. (At certain times of the year the piezometers may well be flooded).
- iii) A study of the patterns of stratification in the deep water lakes needs to be undertaken so as to have a better understanding of their contribution to the development of anoxic conditions.
- iv) A study of the quantity and quality of sediments and the rate of sedimentation needs to be undertaken (including core sampling of sediments) with a view to determining their impact on drainage patterns and the dust problem, as well as on the environmental health of the system. Sediments act as a sink for pollutants which can be re-released into the water column under certain conditions.
- v) GIS based mapping of all historical aerial photos to measure possible changes in the extent and duration of the drying of the seasonal pans.
- vi) A study on the ecology of the central pans – and especially those species which are the main food sources of the wading birds – to determine

## Estuary Management Plan: Diep Estuary

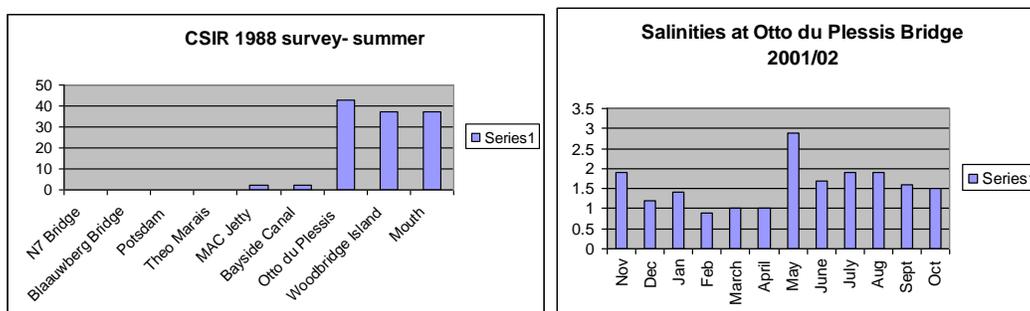
- optimal seasonal cycles from an ecological perspective. In particular, the requirements of the Palearctic waders must be taken into account.
- vii) Ultimately, a comprehensive reserve determination in terms of Chapter 3, Parts 2 and 3 of the National Water Act (1998) needs to be undertaken, noting that some of the above studies will contribute to this process.
  - viii) The above data needs to be compiled and collated so that a hydrodynamics model can be established to optimize the various management options available.

### *Interim management measures*

In parallel with the above-mentioned studies, it is proposed to implement some interim measures to alleviate current problems until longer-term solutions can be found. These include:

#### Reduction/manipulation of flows from Potsdam

Since the establishment of the channel along the east bank of Rietvlei(1991/92), the estuary has become increasingly freshwater dominated, as can be seen by comparing the salinities at Otto du Plessis Bridge in 1988 and 2001/02 (Fig. 6 below). In summer, with the river effectively drying up, the flow is made up predominantly of the effluent from Potsdam. Amongst other things, this has to a large extent eliminated the seasonal fluctuations in flow into the lagoon, and as a result, the mouth no longer closes. This is probably exacerbated by the increased sedimentation in the lower lagoon which further limits tidal penetration.



Figs 6 a and b: (a) Salinities in the Diep Estuary during a CSIR survey in the summer of 1988; and (b) Salinities at Otto du Plessis Bridge in 2001/02.

The capacity of Potsdam has recently been increased from 32 to 47 MI/day and would be further increased to 100 MI/day should the most recent proposal go ahead. At the same time, an increasing amount of the effluent is now being re-used – up to 20 MI/day over the summer months since January 2006 (see Fig. 7 below). During those periods, the effluent discharge to the estuary is at times reduced to around 15 MI/day. However, a monitoring programme undertaken between January and March, 2010 – which looked at the correlation between daily volumes of effluent discharged, salinity at two points in the estuary, and tidal height – suggested that discharges would need to be reduced to at least 10 MI/day in order to achieve a significant increase in salinity in the estuary. Even then, the ingress of salt water is only likely to reach the Otto du Plessis Bridge at high spring tides. While the monitoring

## Estuary Management Plan: Diep Estuary

programme was of limited duration, the conclusions are supported by the study done by WAM Technology in 2004, which suggested that flows from Potsdam could be reduced to 8 MI/day before the mouth would be affected.

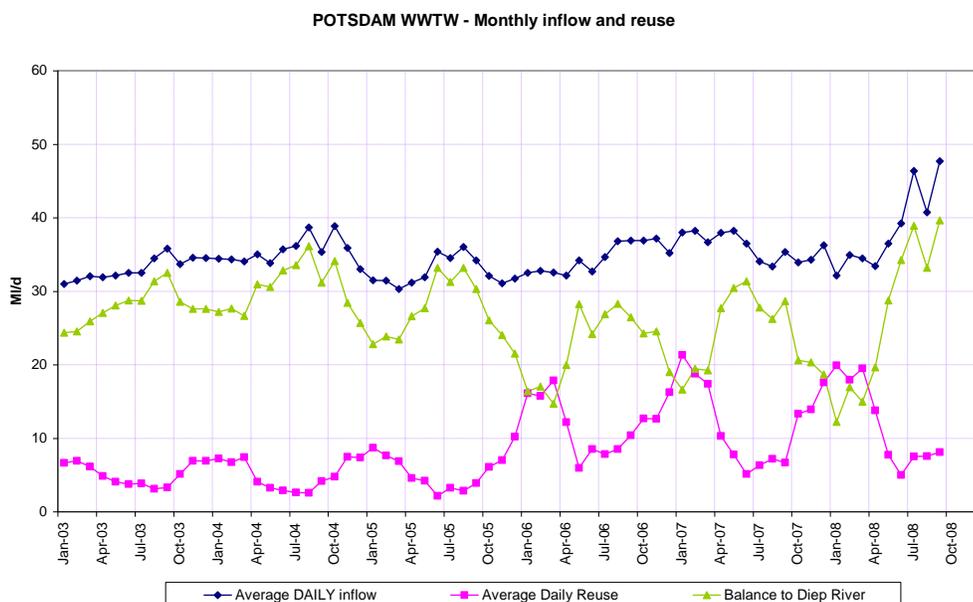


Fig. 7. Average daily flows of effluent from the Potsdam WWTW.

It is therefore proposed that a programme for the further reduction of effluent discharges from Potsdam be developed in collaboration with Water and Sanitation Services. Initially this should focus on trying to achieve such reductions on dates coinciding with high spring tides of the summer months.

The necessity for these measures may fall away should an alternative disposal option be identified and implemented.

### Flows from the catchment

The flow-gauging station at Vissershok, which was operational between May 1967 and May 1982 recorded a Mean Annual Runoff of 44.4 million m<sup>3</sup>. This was replaced by the gauge at Adderley, which has been operational since 1998, and has recorded a Mean Annual Runoff of 40.17 million m<sup>3</sup>. Both show significant variations from year to year, as well as between seasons (see Figure 8 below). Of significance for the estuary, and the proposed management of flows, is that flows from the river during the summer months are effectively zero.

## Estuary Management Plan: Diep Estuary

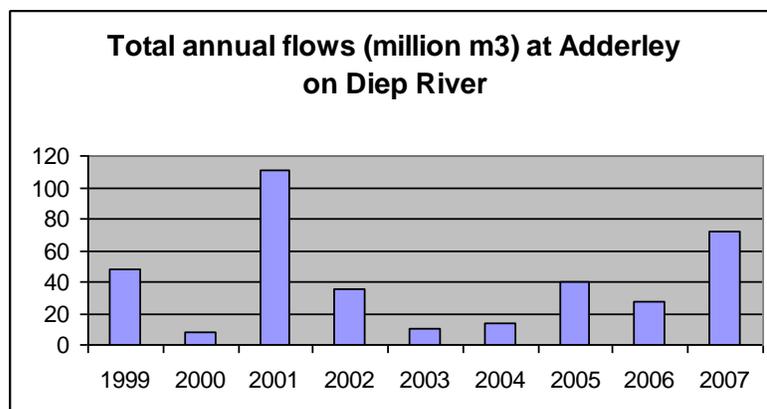


Fig. 8 (a) Variations in annual flow from the Diep River.

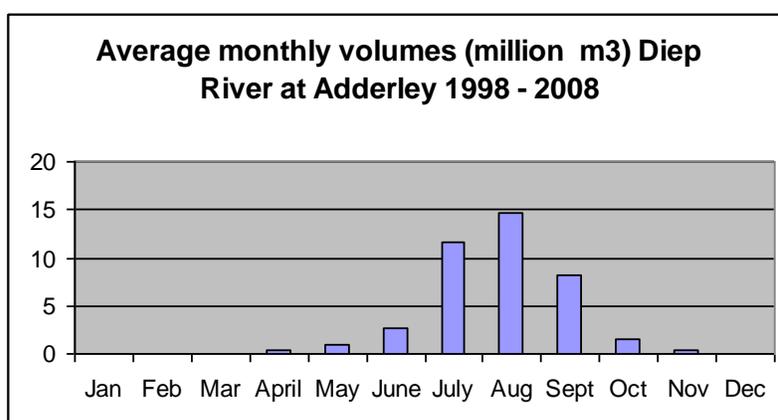


Fig. 8 (b) Seasonal fluctuations in the flow in the Diep River.

Although not immediately apparent from the above graphs, there have been suggestions that the runoff from the catchment has been reduced in recent years as a result of an increasing number of farm dams amongst others. The capacity of such dams, and their impact on flows, needs to be investigated as part of a Catchment Management Strategy. Other measures to be included in such a strategy include:

- Clearing of alien plants along the river channel, especially gum trees
- The promotion of appropriate agricultural practices to reduce infestation of invasive alien species.

### Stormwater flows

The Stormwater Master Plan for the areas north of Rietvlei is in line with the City's Policy on Minimising the Impact of Stormwater from Urban Development on Receiving Waters, and promotes measures which facilitate the retention and infiltration of stormwater close to source. This should be implemented with a view to reducing stormwater flows into the estuary.

## Estuary Management Plan: Diep Estuary

### Management of water levels

#### *Dust problem*

While there is insufficient data at this stage to prove it, there have been suggestions from a variety of sources (including a specialist study conducted during the development of the 1994 Rietvlei Management Plan) that the construction and ongoing maintenance of the bypass channel along the east bank in 1991/92 has increased the rate of drainage of Rietvlei during the dry summer months by lowering the water table. This is further exacerbated by the channels which have been dug at a number of the stormwater discharge points along the boundaries of the vlei. And although the central pans have always dried out – and indeed need to go through seasonal changes in water levels to maintain their ecological function – the extent of this phenomenon may have been altered. Whether this is true or not, the dust emanating from the dry pans is a problem to residents in the area.

It is therefore proposed that measures be introduced to manage the water table with a view to limiting the rate and extent of drainage from the vlei, BUT within the constraints of the ecological requirements of the wetland (which still need to be determined). Once the ecological requirements have been established, a mechanism which will allow management of the water table will be developed and implemented. As far as possible, this should be based on natural, sustainable solutions (i.e. costly engineering solutions to be avoided), and may include the partial or complete filling in of the Potsdam bypass and stormwater channels.

In the interim, it is proposed:

- i) that the maintenance excavations of these channels be discontinued, at least in certain sections; and
- ii) the pumping of water from the northern lake onto the pans when they start to dry out in January should continue until a more permanent solution is found.

#### *Flooding*

Residents in areas which fall within the 1:100 -year floodline must be made aware of this fact, and a Disaster Management Plan must be put in place to facilitate response during a major storm event.

### **5.1.2 Water quality**

The data from the City's water quality monitoring programme shows that the water quality for most of the system – with the possible exception of the Flamingo Vlei area – is unacceptably poor in comparison with existing guidelines, particularly with regards to bacteriological contamination and nutrients. Fig. 9 below for example, shows that the water in Milnerton Lagoon has not been suitable for contact recreation since at least 2001, while Fig. 10 shows that the majority of Total Nitrogen samples at the Otto du Plessis Bridge are at levels indicative of eutrophic or hypertrophic conditions. This suggests that current management efforts are ineffective.

## Estuary Management Plan: Diep Estuary

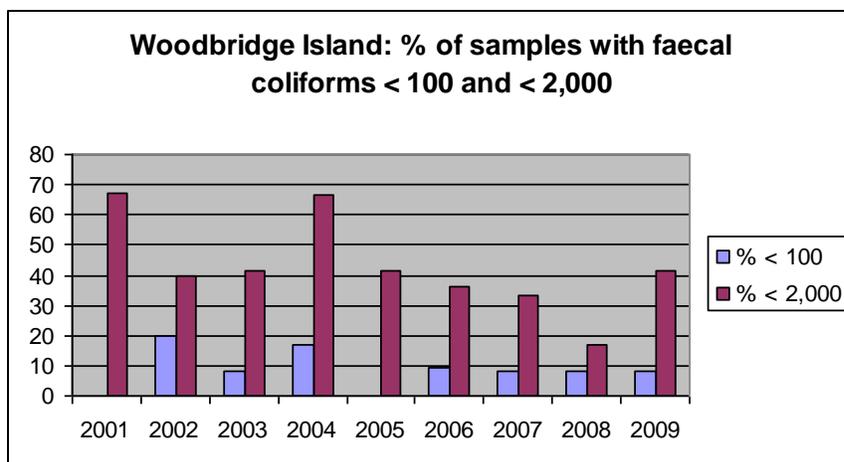


Fig. 9. Bacteriological quality of water at Woodbridge Island.

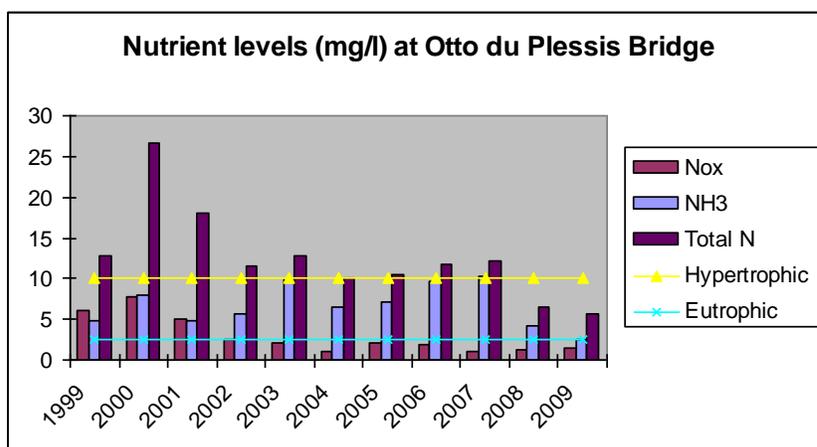


Fig. 10. Levels of nitrates and nitrites (Nox), Ammonia (NH<sup>3</sup>) and Total Nitrogen in mg/l at Otto du Plessis Bridge. Values for Total Nitrogen > 2.5 are indicative of eutrophic conditions, and > 10 are indicative of hypertrophic conditions.

This situation needs to be addressed by the development of Resource Quality Objectives specific to the system, and the application of pollution prevention/minimisation measures to each of the sources of pollution with a view to achieving these objectives. The sources include:

- Inflow from the river (which carries pollution from a variety of sources in the catchment)
- Potsdam and related infrastructure
- Stormwater
- Informal settlements and low-cost housing areas

The relative contribution of each of these sources also needs to be determined so that prevention efforts can be prioritized.

### Setting of Resource Quality Objectives

The development of Resource Quality Objectives is provided for in Chapter 3, Parts 2 and 3 of the National Water Act (1998). The RQO should include target values for i) the freshwater inflow from the river; and ii) the estuary itself. These will be based

## Estuary Management Plan: Diep Estuary

on existing guidelines for natural environments and/or recreation and, where appropriate, should elaborate interim targets for parameters of particular concern and a timeline for their achievement.

### *Pollution Prevention/ minimisation*

Although the monitoring programme being undertaken by the City has provided an insight into the water quality of the estuary, many of the various sources of pollution still need to be properly quantified so as to obtain a better understanding of their relative contributions to the overall pollution load. This requires expanding and improving data collection on flows and contaminant levels, especially for stormwater drains. To date, the only in depth study which has been conducted on stormwater has been on the Bayside Canal, although a study of those on the East Bank was initiated in 2009 and is nearing completion.

In the interim, steps should also be taken to start reducing or, where possible, preventing the pollution at source.

#### i) Potsdam

During the summer months, when there is little or no flow from the river or stormwater drains, Potsdam is the primary source of water in the estuary. Thus the quality of the Potsdam effluent has a significant influence on water quality in the estuary during summer, if not the whole year round.

The effluent standards for Potsdam are set out in a permit issued by the Department of Water Affairs and Forestry in 2000 (and which effectively expired in 2004). A new permit is currently being processed by DWA as part of the current Potsdam expansion from a capacity of 32 Ml/day to 47 Ml/day, and could include a tightening of standards, although according to the DWA operational policy, they should, in fact, be moving to a management regime based on Receiving Water Quality Objectives. The latter have, however, yet to be determined for the Diep Estuary, although interim objectives have been proposed in this document (see Section 3.2.2).

The current permit requires the effluent to meet the General Standard for most parameters. It is also required to meet the Special Standard for Phosphate (Section 21 (1)(a) of the National Water Act. Exceptions are made for Nitrate/Nitrite as Nitrogen, which is set at 10 mg/l, and Faecal coliforms, which are set at 1000 counts/100 ml. Given that during the summer months there is effectively no dilution of the effluent, and the permitted levels exceed the water quality guidelines, any improvement in the situation would require a significant reduction in the permitted levels in the new permit.

On top of this, over the past few years – during the expansion process – Potsdam has not been able to meet many of these standards. For *E. coli*, for example, although the situation appeared to improve considerably in the latter half of 2008 and 2009, the effluent still regularly exceeds the standard and is, in fact, again showing an upward trend (see Figs 11(a) and (b) below).

## Estuary Management Plan: Diep Estuary

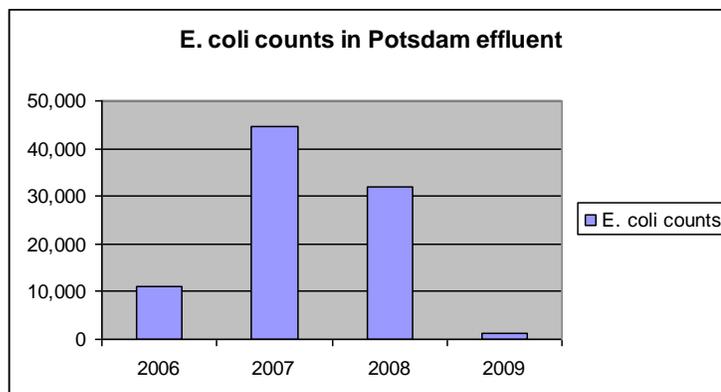


Fig. 11 (a) Average annual E.coli counts in Potsdam effluent.

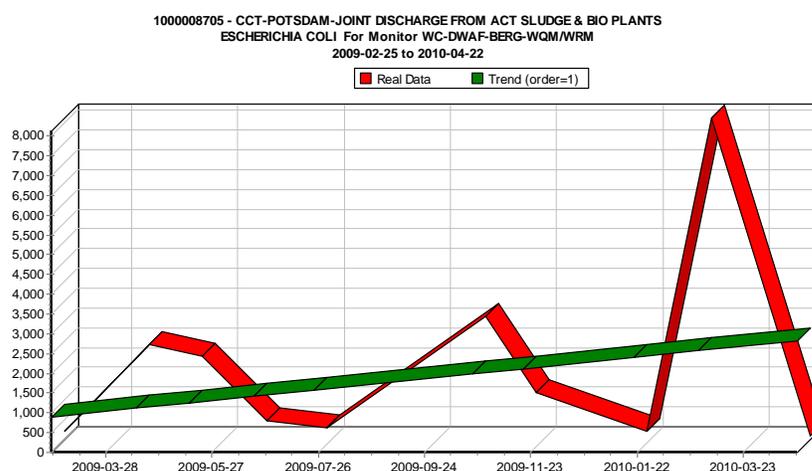


Fig. 11 (b) E.coli counts in Potsdam effluent for 2009/10 (provided by DWA).

This is of particular concern given the recent developments in relation to the investigation into WW Treatment expansion options for the broader Blaauwberg area, namely the Record of Decision issued by DEA & DP to further increase the capacity of Potsdam to 100 Ml/day. Such an expansion, with an associated increase in the volumes of effluent being discharged into Rietvlei, would lead to a further significant deterioration in the water quality. On the other hand, such an expansion combined with an alternative disposal system (i.e. one which does not involve discharging the Potsdam effluent into Rietvlei), could ultimately see a significant improvement in the water quality of the estuary. It is therefore critical, since this was not addressed in the EIA, that alternative disposal options for the effluent from Potsdam be investigated before any final decisions are taken.

### ii) Sewerage infrastructure in the Milnerton/ Blaauwberg area.

There have been a number of accidental spills of sewage into the estuary via the stormwater system which have had serious consequences for the biodiversity (and have health implications). These are the result of either blockages in the sewerage infrastructure in the catchment area or

## Estuary Management Plan: Diep Estuary

malfunction of the sewage pump stations. The following actions are proposed to address these problems:

- Sewerage blockages

The causes of these blockages are varied but in many cases are illegal discharges into the sewerage system. A system of recording and managing these blockages is being developed with a view to instituting preemptive maintenance and thereby a reduction of sewerage blockages.

- Pump stations

All pump stations are monitored via a telemetry system and pump station malfunctions are generally expeditiously attended to without significant spillages. However, there have been significant spillages when telemetry systems fail and power outages occur. All the major pump stations adjacent to the estuary have therefore been equipped with standby generator sets. Minor pump stations will be serviced by mobile generators.

- Reporting and response to spillages

Any significant spillages from either blockages or pump station malfunctions should immediately be reported to the Reserve Manager. They should then be treated and cleaned up using appropriate methodologies in consultation with Reserve staff.

iii) Stormwater drains.

The City's policy on minimizing impacts of stormwater on receiving waters – based on the concepts of Water Sensitive Urban Design and Sustainable Urban Drainage Systems - needs to be implemented. This includes the development of structural and non-structural best management practices for stormwater – such as retention ponds, vegetated swales, infiltration basins, bioretention cells, education, stormwater master planning etc, which are implemented at site or regional level as appropriate.

In addition, the flows and pollution loads of all existing stormwater discharges into the estuary need to be quantified and those having the greatest impact should be addressed. As mentioned above, the study on the stormwater drains along the eastern bank of the estuary is nearing completion, following which the recommended solutions should be implemented.

Following an earlier study, a number of proposals were made for managing the stormwater in the Bayside Canal – including the construction of an off-channel riparian reedbed for the treatment of stormwater low flows (chiefly suspended solids and attached pollutants) in undeveloped land immediately south of Parklands Main (Link) Road,

## Estuary Management Plan: Diep Estuary

structural changes to increase the capacity of the canal and the introduction of litter management structures and practices. While implementation of these proposals was initiated during 2009/10, as of September 2010, these had not yet been completed. This needs to happen as soon as possible, following which they should be properly maintained.

Stormwater management systems on sites supporting industrial activities need to be inspected on a regular basis, and the policing of illegal discharges into stormwater drains needs to be improved.

Litter traps need to be placed on all stormwater discharges unless there is a strong chance of serious backflooding. They should then be properly maintained to prevent litter, especially plastics, from entering the system.

### iv) Informal settlements and low-cost housing areas

There are a number of informal settlements and low-cost housing areas in the area – some between the Blaauberg and N7 bridges – which have a significant impact on water quality via stormwater or direct runoff. These include Doornbach, Du Noon, Joe Slovo and Phoenix. The problem in low-cost housing areas is a consequence of both malfunctioning plumbing and the presence of backyard shacks without plumbing.

Doornbach is near Killarney and is right on the bank of the river. There are some chemical toilets on the edge of the area, but they are seldom used. Moreover, there are no roads and so it would not be possible to service toilets further into the settlement. Pressure needs to be put on relevant authorities to upgrade the area to a formal settlement – and in doing so, create a buffer zone along the river bank.

Stormwater from the Du Noon area discharges to the river above the Blaauberg Bridge, while Joe Slovo and Phoenix drain via the Erica Road stormwater drain, reaching the estuary opposite the tennis courts at Milnerton High. These have been addressed as part of the project on stormwater drains along the east bank.

It is also proposed to have an education/awareness-raising campaign emphasizing the health related problems around water and sanitation. This will be implemented in collaboration with the Department of Water Affairs, which has significant experience in this area.

### v) Pollution sources in the river catchment

There are a variety of sources of pollution in the catchment, including:

- Waste-water treatment works (eg. Fisantekraal, Malmesbury) – and it is noted that the Malmesbury WWTW is currently not meeting the required standards.

## Estuary Management Plan: Diep Estuary

- Stormwater from urban areas (formal and informal – eg. on the Mosselbank)
- Agriculture ( runoff of fertilizers, pesticides etc, as well as discharges and runoff from eg. dairy farms). Many farms allow cattle to drink from the river which results in significant trampling, erosion and also contributes to pollution due to fouling of the water by cattle manure.
- Mining.

These all affect the water quality of the inflow from the river to the estuary, and need to be addressed as part of a Catchment Management Plan.

### *Mitigation measures*

Reed beds act as sinks, and can be used to reduce nutrients in flows entering aquatic environments. However, this is not necessarily true for all situations. Moreover, their effectiveness tends to reduce over time, and the reedbeds therefore need to be managed – eg. harvested and removed for composting, burned etc. The reedbeds in the Diep Estuary have expanded significantly in recent years, and are a nuisance in some areas. A proper plan for their management needs to be developed and implemented.

Aerators could be used in emergency situations to prevent anoxic conditions from developing. They would need to be used in combination with an appropriate monitoring system which would provide early warning of such conditions.

### **5.1.3 Sediment quantity and quality**

While it is generally agreed that there have been and are considerable amounts of sediment entering the estuary from the catchment and other sources, this has not been quantified. It is therefore proposed that a series of sediment cores across the system should be taken to determine rates and quantities of sediment input from the catchment and other sources. These could also be used to determine historical patterns of salinity in the system.

In the interim, some preliminary work has been done in the catchment on guidelines for setback distances/conservation corridors with a view to reducing the silt load entering the estuary as a result of poor agricultural practices. These guidelines need to be further developed and implemented as part of a Catchment Management Strategy.

Until relatively recently there had also not been any studies on the quality of the sediments or levels of bioaccumulation into the biota in the estuary since the work by Taljaard et al in 1992. However, in 2009, Jackson *et al* published a report on an investigation into levels of a range of metals in water and sediment samples from the Plankenburg and Diep Rivers which indicated high levels in both, with those for water exceeding the DWAF Water Quality Guidelines. In 2009/2010, DEA & DP funded a survey of heavy metal concentrations in the sediments and biota of the Diep and Berg estuaries, with biota including fish and invertebrate species. The results

## Estuary Management Plan: Diep Estuary

indicated that trace metal concentrations in sediments from both the Diep and Berg estuaries exceeded relevant South African and international sediment quality guidelines at many stations – a significant increase over the levels found by Taljaard et al (1992). The concentrations of trace metals in biota (fish and invertebrates) were also high in most of the samples analysed and exceeded the South African legal limits for foodstuffs for a number of species commonly consumed by locals, including mullet (*Liza richardsonii*), Mozambique Tilapia (*Oreochromis mossambicus*), Banded Tilapia (*Tilapia sparrmanii*) and carp (*Cyprinus carpio*).

Some 8 tonnes of fish are estimated to be harvested from the Rietvlei/Diep system annually, and it is important that those communities who might be consuming this fish are made aware of the potential health impacts. It is also recommended that surveys of heavy metals – and other potential contaminants – in the sediments and biota are conducted on a regular basis.

### 5.1.4 *Monitoring*

The City's water quality monitoring programme – funded by the Catchment, Stormwater and River Management Branch - should be supplemented with annual surveys (or at least, every second year) of heavy metal levels in sediments and biota. If possible, these surveys should include a broader array of toxic constituents as well as bacteriology. The biological monitoring should include indicator species such as the sandprawn, other invertebrates, fish and wading birds. This would provide a good measure of overall ecosystem health, and help track the recovery of the system and progress towards the achievement of the Water Quality Objectives.

It is noted that the analytical techniques which are currently being utilized by Scientific Services, and which are suitable for freshwater, will need to be re-evaluated once tidal ingress to the estuary increases.

In addition, some of the more variable and key parameters need to be measured more regularly (eg. oxygen, ammonia, temperature and salinity). This should preferably be done on site from a small lab to be included in the new building. Amongst other things, it should be designed to provide an early warning system for anoxic conditions which could then trigger appropriate management interventions – for example, deployment of aerators during low oxygen conditions. Current monitoring is limited to surface samples, but when these samples show a drop in oxygen of below the target value (6 mg/l), additional samples should be taken lower down in the water column to determine the extent of the problem and need for intervention.

## 5.2 **Conservation, Planning and Sustainable Use**

### 5.2.1 *Legal status of the Reserve*

The overarching management strategy for the area to date has been its declaration as a protected area since 1984 – initially as a Nature Area, and then as a Protected Natural Environment in terms of the Environment Conservation Act (1989) and then the NEM: Protected Areas Act (2003). This was successful in as much as it led to

## **Estuary Management Plan: Diep Estuary**

the acquisition of the land (with WWF as the landowner), the establishment of an Advisory/Management Committee, and the development of a Management Plan in 1994.

Currently, however, the proclaimed boundaries of the reserve are not in line with the area which is currently being managed. This is being addressed as part of a new application to CapeNature by the City to have the reserve declared a Contract Nature Reserve. The formal submission of this application should be completed as soon as possible.

### **5.2.2 *Urban Development and Planning***

While there are no further opportunities for significant developments along the boundaries of the estuary itself, the west coast area to the north of Rietvlei is amongst the fastest growing in the City. The Integrated Zoning Scheme and the Spatial Development Plan for the City – currently under development – must ensure that any further rezoning for urban development in areas upstream and/or likely to impact on the estuary must be subject to stringent environmental conditions. These should include:

- the establishment of biodiversity corridors and buffer zones;
- installation of stormwater drainage in line with the Policy on Minimising the Impact of Stormwater from Urban Development on Receiving Waters;
- retention of existing natural wetlands on the site and incorporation into the development;
- restrictions on the construction of overhead transmission lines in the vicinity of the estuary;
- establishment of Environmental Liaison Committees to oversee compliance with the environmental conditions of the approvals.

### **5.2.3 *Conservation and ecotourism development***

A conservation development framework needs to be developed for the Northern District – which includes the Diep Estuary (cf that developed for the Southern District). Issues to be addressed include:

- The development of an on-site management facility, including office space for reserve staff and a small laboratory to facilitate the management of water quality;
- The erection of fencing or construction of berm and channel boundaries around the entire reserve.
- The establishment and/or upgrading of links to the Blaauberg Conservation Area, Potsdam Outspan, and Zoarvlei;
- Additional bird hides and other bird viewing facilities should be erected, and screened walkways for the existing ones constructed, possibly using reeds;
- Breeding features for birds should be established, particularly in and around the south lake (for example, an island at the tip of the Peninsula);
- Walking trails to be developed;

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- Plans to relocate the model aircraft site in 2014 (when their permit expires) need to be finalized.
- A corridor between Vissershok and Atlantis needs to be provided for in the Catchment Management Strategy.

### 5.2.4 *Biological research and monitoring*

Despite the fact that the area has been a Nature Reserve since 1984, there are a number of taxonomic groups which have not been studied in any detail. At the same time, as a consequence of the physical and chemical changes to the system, there have been changes to the biodiversity. It is therefore recommended that a structured programme be put in place to fill these gaps in knowledge through projects undertaken by the Nature Conservation students, and in collaboration with tertiary institutions<sup>6</sup>. This should include the identification of any threatened species present within the area.

Biological monitoring using indicator species should also be put in place, and a photographic record of changes to the reserve vegetation should be kept based on aerial photos (especially for historical changes) and fixed-point photography (cf. the MCA system).

### 5.2.5 *Rehabilitation and habitat restoration*

Rehabilitation of the estuary must necessarily include issues of water quantity and quality. However, since these have already been addressed in earlier sections of this plan, this section is focused primarily on the biological aspects.

A rehabilitation plan covering both aquatic and terrestrial areas needs to be developed. This should include:

- The re-introduction of primary producers (such as *Zostera*) and benthic invertebrates, such as sandprawns into the lagoon<sup>7</sup>. However, these should not be attempted until the water and sediment quality have improved to suitable levels;
- Salt marsh vegetation (*Sarcocornia*) – although there is not much experience in propagating this.
- The establishment of sand plain fynbos in the Milnerton Ridge area..

Prior to this, there needs to be groundtruthing of the terrestrial vegetation which was originally low-lying strandveld and sand plain fynbos. It is noted that the shoreline areas around parts of the vlei have been transformed, and the substrate is no longer the same. In these areas, therefore, consideration could be given to bringing in plants which would specifically enhance bird habitat – for example, to promote the establishment of a heronry. Although there was not a heronry historically, this issue should be looked at in regional terms. For example, since the number of breeding

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<sup>6</sup> It is noted that during 2010, a student project was completed on frogs in the reserve.

<sup>7</sup> It is noted that sandprawns have now returned to the lower lagoon, although it is not certain in what quantities.

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pairs of herons at Century City has been reduced from 1,200 to 250 pairs, Rietvlei could provide opportunities to increase numbers in the region.

There was also a suggestion that consideration be given to “shallowing” the edges of the south lake to recreate pans, and possibly even to construct an island, to provide additional habitat for wading birds. However, there was concern over the possible impacts on indigenous fish species in the lake (eg. *Galaxius zebratus*) which require a minimum average depth of 50 cm. This proposal therefore needs further discussion.

Another area which needs attention is the erosion on the shores of north lake. These need to be stabilized.

### 5.2.6 *Invasive species*

Initial work on an invasive alien species management plan for the Nature Reserve has consolidated existing information on invasive species, including:

- Aquatic and semi-aquatic plants – at least 9 species reported although some of these have yet to be verified;
- Grasses – at least 5 species reported, with *Paspalum* and *Pennisetum* (Kikuyu) being of greatest concern. *Paspalum* or vleigrass, was recorded as far back as 1985, and was reported by Withers et al (2002) to cover an area of some 78.54 ha (27% of the area studied – essentially Rietvlei). It is outcompeting the indigenous sedgeland species and is encroaching onto the Open Pans – the primary habitat for wading birds (see Fig. below).
- Other terrestrial plants – these have been the focus of initial work on invasive species in the area and the woody species at least are now largely under control;
- A variety of alien fish, mostly deliberately introduced;
- Mallard ducks – mainly in the lagoon area;
- Indigenous invasives such as *Typha* and *Phragmites* which only occurred in localized areas prior to 1967, but which have expanded their distribution significantly as a result of the increased nutrient levels.



Fig. 12 *Paspalum vaginatum* encroaching onto the pans at Rietvlei

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A comprehensive invasive alien species management plan for the reserve needs to be completed as soon as possible. This should be in line with relevant national, provincial and city-wide policies and strategies with first steps including:

- The identification and GIS mapping of invasive species from all taxa;
- Assessment of the impacts of the IAS on conservation goals and management objectives;
- The identification of pathways/vectors for their introduction and dispersal;
- Prioritisation of species and pathways;
- Development and implementation of species-specific management strategies for priority species;
- Development and implementation of management strategies for priority pathways;
- Establishment of an early detection and rapid response strategy and an ongoing monitoring and evaluation system to determine the effectiveness of management interventions;
- Identification of needs and gaps in information and management capacity.

A plan to manage the reedbeds (*Phragmites* and *Typha*) also needs to be developed. In developing the plan, consideration needs to be given to the various management options which are available, including:

- Mechanical harvesting
- The manipulation of salinity to manage, for example, the *Typha capensis* problem in the Dolphin Beach ponds
- Herbicides
- Burning.

### 5.2.7 Resource Utilisation

Fishing in the reserve is limited to recreational fishermen with appropriate permits and even then, only on specific days and/or sites, although there is thought to be a significant amount of illegal fishing. The exploitation of bait organisms is, however, allowed and catches have historically included mainly the sandprawn (*Callinassa*), harder and springer.

However, the *Callinassa* population has suffered a significant reduction in recent years as a result of water quality problems, and even though they appear to be returning now it is suggested that future exploitation should be controlled through the introduction of closed areas and seasons.

### 5.3 Education and awareness

Public awareness around the role and importance of estuaries and wetlands is crucial for the effective implementation of management programmes. Some specific proposals for improving the education and awareness activities around the Diep Estuary include:

- In the longer term, there should be a bigger public education and information centre, and consideration should be given to expanding the existing one.

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- There should be displays on wetlands function and other interpretive material, including signage and a brochure on the rehabilitation programme.
- The information should include a component on water quality.
- The programme with school groups should be expanded and consideration should be given to having trained Xhosa-speaking bird-guides (cf. Intaka).
- Links should be established with the Two Oceans, the Wetland Forum and WESSA, especially in relation to opportunities for teacher training.
- A DVD documenting the rehabilitation of the Diep Estuary system should be produced. The Film Academy should be approached to do this as a student project/s. Another option would be to approach 50/50.
- A Catchment-to-Coast brochure highlighting the importance of landcare in protecting the Diep Estuary should be developed and distributed, especially to farmers in the catchment.
- There should be a specific initiative to make all relevant departments within the City aware of the current efforts to rehabilitate the Diep Estuary so as to ensure that decisions of such departments do not undermine the rehabilitation programme.

## 6 RESOURCE REQUIREMENTS

### 6.1 Staffing

The current level of staffing at the Nature Reserve is insufficient to cope with the additional work which will be required for full implementation of this Action Plan. Since the City does not have any additional posts available, other options for boosting the human resource capacity therefore need to be investigated. These include raising funds and appointing staff in partnership with relevant NGO's and other organizations.

In addition, there should be two students and an intern.

### 6.2 Finances

Many of the proposed actions can be undertaken by existing staff in the relevant organizations, and within existing budgets – for example, costs associated with the ongoing water quality monitoring programme and the pumping of water during the summer from the north lake onto the central pans. However, there are a number of new activities which have been proposed and for which funding has not yet been secured. These include:

- A number of projects which fall clearly within the mandate of the competent authorities, but for which funds have not as yet been secured because of competing priorities (eg. the Reserve Determination/s which is estimated to require R 1.2 million);
- Projects which have been recommended by studies funded by the City, but for which funds have not yet been secured (eg. the recommendations on source reduction measures arising from the study on the East Bank stormwater drains).<sup>8</sup>
- Project proposals which have arisen during the EMP development process and which at present are not covered by the budget of any particular department and for which funds have not been forthcoming despite the fact that some of them are critical to the effective management of the estuary.

The costs for the latter category of projects are estimated to be in the order of R 1.5 million. These could be covered by the Rietvlei Trust Fund which currently stands at around R 5 million. It is therefore recommended that the issues around accessing these funds be resolved as soon as possible so that at least some of the priority projects can be implemented.

Other potential sources of funds should also be investigated.

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<sup>8</sup> It is understood that these are likely to amount to several hundred million rand, and it is unclear as to whether/when they will be implemented.

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### 7 ACTION PLAN

The Situation Assessment (2008) highlighted significant problems in the Diep Estuary, with the following being identified as priorities:

- Water quantity and hydrodynamics
- Water quality
- Changes to biodiversity
- Conservation and legal status.

During the development of the Estuary Management Plan (EMP) a large number of proposals aimed at addressing these issues emerged. These were captured in the Action Plan 2009 – 2013 set out in Section 7 of the first edition of the Estuary Management Plan (2008). Since then, some of the proposed actions have been completed, while new proposals have emerged. This second edition of the EMP therefore includes a revised version of the Action Plan covering the period 2011 – 2015 in Section 7.2 below. There is also an updated list of those considered the highest priority in 7.1 below.

#### 7.1 Revised List of Priority Actions

The status of the initial list of priorities is summarized in the table below, while a list of the acronyms used here and in subsequent tables can be found in Annex I:

	<b>Action</b>	<b>Status</b>	<b>Constraints</b>
1	Preliminary Determination of Ecological Reserve & Resource Quality Objectives	Some low confidence reserve determinations have been completed for parts of the catchment.	This is a DWA responsibility, & the Diep is not high priority at the national level of the Department, so funding has not been available.
2	Studies on the hydrology & geohydrology of the estuary	TOR in place but study not initiated. Partial funding available from TMF.	There have been difficulties in accessing the Rietvlei Trust Fund.
3	Topographic survey & DEM	Completed	
4	Study on East bank stormwater	In progress but behind schedule	
5	Field trials around salinity regime/ effluent management	Modified study implemented and completed	Infrastructural limitations prevented further reduction of Potsdam effluent within the time-frame.
6	Expansion of water quality monitoring programme to include sediments & biota	Once-off survey of heavy metals in sediments & biota funded by DEA & DP	Insufficient capacity at the City's Scientific Services & existing Service Contract.
7	On-site water quality monitoring capacity	Incorporated into plans for on-site office block	Building plans on track for completion in 2011.
8	IAS management plan	Preliminary draft completed, new proposals tabled.	Insufficient funds for work required (comprehensive assessment of
9	Formalisation of new reserve boundaries	In progress	Coordination with submissions for other reserves.
10	Assistant Reserve Manager		No posts available.

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During the first two years of the implementation of the EMP, a Record of Decision (ROD) was issued giving initial approval for the expansion of Potsdam from 47 to 100 MgL/day. Since the EIA did not investigate alternative disposal options for the effluent, this appears to assume that the additional effluent will be discharged into Rietvlei. This will undermine the achievement of many of the operational objectives of this plan and alternatives need to be investigated as a matter of urgency.

Based on the above, the updated list of priorities is as follows:

- i) Investigation into alternative options for the disposal of effluent from Potsdam, including recycling, re-use and disposal to sea;
- ii) Sourcing of funding for a Comprehensive Determination of the Ecological Water Requirements and Resource Quality Objectives for the Estuary;
- iii) Sourcing of funding for studies on the hydrology and geohydrology of the estuary possibly by resolving the issues around the use of funds from the Rietvlei Trust Fund;<sup>9</sup>
- iv) Installation of a permanent salinity recorder/s;
- v) Implementation of source reduction measures for the stormwater inputs along the East Bank of the estuary as per recommendations of the study underway;
- vi) Institution of regular (at least every 5 years, and preferably every two years) surveys of heavy metals and other toxic contaminants in sediments and biota;
- vii) Compilation of leaflet/brochure on potential health impacts of consumption of fish for distribution in surrounding communities;
- viii) Construction of the on-site administrative block, including facilities for on-site monitoring capacity for key water quality parameters;
- ix) Completion and implementation of the invasive species management plan;
- x) Conclusion of an MoU with the Department of Agriculture Forestry and Fisheries (DAFF) regarding fish surveys.

In addition, while the catchment is beyond the scope of this plan, it is recommended that riverine buffer zones be implemented on a pilot basis in the catchment as per the study undertaken by GEOSS.<sup>10</sup>

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<sup>9</sup> The results of this study would contribute to the reserve determination. Moreover, if it is implemented, it will include the installation of salinity recorders, in which case the next point will fall away.

<sup>10</sup> Conrad, J. and Carstens, M (2010) A methodology and guideline for improved hydrological functioning due to poor agricultural practices in the Diep River catchment, Western Cape. GEOSS Report No: G2010/08-06

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### 7.2 Detailed Action Plan: 2011 - 2015

<b>WATER QUANTITY MANAGEMENT</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective A: Re-establishment of a regime more typical of an estuarine system</b>				
1. Comprehensive Ecological Reserve Determination for the estuary.	2011- 2013	DWA + Manager ERMD	R 1.2 million (including det. of resource quality objectives)	Target value for water quantity in place.
2. Investigation into alternative options for the disposal of Potsdam effluent	2011	Manager: WSS	TBD	Alternative options identified, assessed & costed, but implementation likely to be beyond the time-frame of this Action Plan.
3. Development & implementation of a programme for the reduction of discharges from Potsdam during the summer months to 10 MgL/day or below (at least at high spring tides).	2011 - 2015	Manager: WSS (Potsdam, Water Demand Management Committee, Reticulation) + Manager: ERMD	TBD	Achievement of optimal salinity regime and mouth conditions (closes late summer for a short period).
<b>Objective B : Management of water levels, flood risk and seasonal drying</b>				
1. Pumping of water from north lake onto the central pans during summer months as required (until an alternative solution has been determined).	January- April annually	Manager: ERMD (BM and E & H) + Manager: Roads & Stormwater (Operational Division)	R 200,000/ year	Reduction in complaints about dust.
2. Maintenance excavations of the bypass channel from below the Potsdam outlet to be discontinued.	Ongoing	Manager: ERMD + Manager: Roads & Stormwater, (Operational Division)	N/A <sup>11</sup>	Channel depth reduced.
3. Sourcing of funds to undertake study of hydrology & geohydrology of the estuary + execution of study.	2011/2013	Manager: ERMD: BM & Chair: Rietvlei MWG	R 375,000	Improved understanding of water balance in the system, and therefore capacity to manage it.

<sup>11</sup> N/A in relation to budget implies that the work will be done in-house and can be accomplished by existing staff and within normal running costs.

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4. Development of a hydro-dynamics model based on the above data to support management decisions.	2013/14	ERMD: Manager: BM & Chair: Rietvlei MWG	TBD	Improved capacity to manage hydrodynamics.
5. Based on the hydrodynamics model, implement alternative solution.	2014 onwards	Manager: ERMD (BM and E & H)	TBD	Effective management of water levels, especially in the central pans during summer.
6. Ongoing monitoring of water levels, salinity etc. at stations established during hydrology study. (Could be done in-house, or by consultant).	2013 - 2015	Regional Director: DWA + Manager: Catchment, Stormwater & River Management Branch (CSRM)	R 5,000 per sampling run (if done by consultant).	Database to support management of hydrodynamics.
7. Study of the sediments – rates of sedimentation & source of sediments. Should include a bathymetric survey of the bypass channel every second year to assess fill rates.	2011/2012	Manager: ERMD: BM & Chair: Rietvlei MWG	TBD	Improved understanding of sedimentation + management proposals.
8. Development of a Disaster / Flood Management Plan, including the installation of an early warning system at the mouth.	2011	Manager: CSRM, Head: Disaster Management + Regional Director: DWA	TBD	Plan in place and water level recorder + extras in place.
9. Implement riverine buffer zones/set-back lines in the catchment	2011/12	Department of Agriculture	N/A	Reduction in sediment loads in the estuary

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<b>ESTUARINE ENVIRONMENTAL QUALITY MANAGEMENT</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective C : Establishment of binding Resource Quality Objectives</b>				
1. Determination of Resource Quality Objectives using Rapid Determination methodology	2011	Regional Director: DWA	R 250,000	Resource Quality Objectives in place + requirements for Potsdam.
2. Gazetting of Resource Quality Objectives.	2011	Regional Director: DWA	N/A	Binding Resource Quality Objectives in place.
3. Sediment quality guidelines based on international practice.	2011/2012	DEA (Oceans & Coasts)	N/A	RSA sediment quality guidelines in place.
<b>Objective D : To meet interim and longer-term water quality objectives</b>				
1. Investigation into alternative options for the disposal of Potsdam effluent (see also A2).	2011	Manager: Water and Sanitation Services	TBD	Alternative options identified, assessed and costed, but implementation likely to be beyond the time-frame of this Action Plan.
2. Review of Potsdam permit standards and stormwater quality objectives should water quality in the receiving waters not improve.	January 2013	Manager: ERMD (BM and E & H) Regional Director: DWA, & DEA (Marine Pollution)	N/A	Revised permit conditions for Potsdam effluent and revised stormwater quality objectives.
3. Implementation of source reduction measures for contaminants in stormwater (as recommended in study).	2011 – 2015 & beyond	Manager:CSR	TBD	Stormwater complies with recommended quality objectives.
4. Institution of regular surveys of toxic contaminants in sediments & biota (preferably every second year)	From 2012	Managers: CSR/ ERMD	TBD	Improved information on trends in contamination.
5. Mapping and assessment of stormwater drains along the western and northern banks of the estuary.	2011	Manager: CSR	TBD	Inclusion of all stormwater outlets on GIS map, and report on quantity and quality of flows.
6. Comparative assessment of pollution loads from various sources.	2012	Manager: CSR	TBD	Comprehensive understanding of pollution sources to the estuary.

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Steps	Date	Responsibility	Estimated Budget	Indicator
<b>Objective E : Reduction in accidental discharges to the estuary</b>				
1. Development of system for recording & managing blockages through preemptive maintenance	2011	Manager: Water and Sanitation Services: (Reticulation)	N/A	Reduction in blockages..
2. Install back-up generators (fixed or mobile) to cater for power outages.	2011/2012	Manager: Water and Sanitation Services: (Reticulation)	TBD	Reduction in frequency of accidental discharges as a result of pump station failures.
3. Inclusion of Reserve Management in incident reporting system, & development of a Response Plan.	2011/2012	Manager: Water and Sanitation Services: Reticulation + Manager: ERMD	N/A	Improved communications around and response to accidental spills.
<b>Objective F : To reduce inputs from informal settlements</b>				
1. Development of a community health & sanitation awareness programme	2011 – 2012	Regional Director: DWA + Manager: ERMD	R 50,000	Increased utilization of sanitation facilities.
<b>Objective G : To manage short-term fluctuations in critical water quality parameters</b>				
1. Establish on-site monitoring of key parameters.	2012	Reserve Management	TBD	Early warning of potential water quality problems eg. low oxygen events.
2. Develop response plan in the event of changes to critical parameters eg. aerators in the case of low oxygen.	2012	Reserve Management	TBD	Effective response to low oxygen and pollution events.

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<b>BIODIVERSITY MANAGEMENT</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective H : To improve understanding of the ecological requirements of the central pans (wading birds)</b>				
1. Review of relevant literature & expert consultation.	2011	Manager: ERMD (BM and E & H)	R 20,000	Recommendations on ecological requirements in management of water levels in central pans.
<b>Objective I : To improve knowledge of the biology of the estuary</b>				
1. Identify gaps in the knowledge base and prioritise taxonomic groups, species, habitats etc.	2011	Reserve Manager & Chair: Rietvlei MWG	N/A	List of priority biological studies.
2. Develop a programme to address priorities, through student projects.	2011 – 2015	Reserve Manager & Chair: Rietvlei MWG	N/A	Structured programme in place to address priority knowledge gaps.
3. Approach tertiary institutions for possible involvement in this programme.	2011	Reserve Manager & Chair: Rietvlei MWG	TBD	Externally funded projects involving tertiary institutions.
4. MoU in place with DAFF on fish surveys	2011	CapeNature/DAFF/Reserve Manager	N/A	Improved understanding of the fish populations in the estuary.
<b>Objective J : Invasive species management</b>				
1. Development of an invasive species management plan for the RWNR (terrestrial and aquatic).	2011	Reserve Management + City's Invasive Species Unit (ISU)	R 60,000	Integrated approach to addressing invasive species in the estuary/Nature Reserve.
2. Ongoing maintenance clearing of terrestrial invasives (woody plants) in and near the reserve.	Ongoing	Reserve Management	R 100,000 for 2010/11	Priority areas cleared of woody plants.
3. Development & implementation of plan on invasive grasses (esp. <i>Paspalum</i> )	2011-2013	Reserve Management + City's ISU	TBD	Reduction of extent of invasive grasses
4. Development & implementation of programme on aquatic invasives.	2012- 2014	Reserve Management + City's ISU	TBD	Reduction in aquatic invasives.
5. Annual surveys with EDRR/SANBI for emerging species (eg. <i>Lythrum</i> ) + establishment of volunteer network.	2011 - 2013	Reserve Management + EDRR + ISU	N/A	Early detection & removal of potential invasives

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Steps	Date	Responsibility	Estimated Budget	Indicator
<b>Objective K : Rehabilitation of biodiversity</b>				
1. Rehabilitation of sand plain fynbos in Milnerton Ridge area.	2011 - 2015	Reserve Management	TBD	Sand plain fynbos re-established.
2. Rehabilitation of aquatic areas (once water quality has improved).	2013	Reserve Management	TBD	Aquatic biodiversity restored.
3. Rehabilitation of salt marsh vegetation.	2013	Reserve Management	TBD	Salt marsh vegetation restored.
4. Annual discussions with Working for Wetlands on priorities for wetland rehabilitation.	2011/2015	Reserve Management + Working for Wetlands	TBD	Partnership with Working for Wetlands & funding for agreed priorities.

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<b>CONSERVATION AND PLANNING INITIATIVES</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective L : Development and upgrading of Reserve infrastructure</b>				
1. Appointment of building contractors	2011/12	Reserve Management + City Planners/Works	Approx. R 4 million	Construction of office block completed.
2. Development of a detailed assessment of fencing requirements, including budget and motivation.	February, 2011	Reserve Manager	TBD	Submission of budget request for at least priority fencing requirements.
3. Installation of fencing in priority areas	2012	Reserve Management + City Works	TBD	Priority areas fenced & reduction in wildlife kills.
<b>Objective M : Conservation &amp; ecotourism development</b>				
1. A Conservation Development Framework for the North District – which includes the estuary - should be put in place (links, bird hides, breeding features, walking trails etc).	2011	Manager: ERMD + SDI & GIS + Reserve Manager	N/A	Structured approach to development of appropriate facilities, features etc in the reserve.
2. Implementation of the CDF.	2011 - 2015	Reserve Management	TBD	Facilities, features etc. in place.

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<b>LEGAL/POLICY MEASURES</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective N : to formalize the expanded boundaries of the reserve</b>				
1. Formal submission of application for Contract Nature Reserve status – including expanded reserve boundaries to the Province (has been approved in principle).	2011	Manager: ERMD: BM	N/A	Rietvlei recognized as a Contract Nature Reserve with expanded boundaries.
<b>Objective O : to formalize the Estuary Management Plan</b>				
1. The EMP – including the Zonation Plan – to be formalised according to the National Protocol (to be finalized in March, 2011)	2011	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	Estuary Management Plan formally adopted.
<b>Objective P : to improve protection of the reserve from encroachment of private gardens and invasive plants</b>				
1. Make submission to City's IAS policy process on possible development of an appropriate by-law or other mechanism to facilitate this.	2011	Manager: ERMD: BM, Chair: Rietvlei MWG, City ISU	N/A	By-law approved and implementation initiated.

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<b>EDUCATION AND AWARENESS-RAISING</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective Q : To improve public awareness on the importance of wetlands in general and the Diep Estuary in particular</b>				
1. Update and improve displays, posters brochures etc. To include socio-economic value, link to River Health Programme etc.	2011	Reserve Manager + Environmental Communications + Friends of Rietvlei	R 50,000	Updated material available for distribution.
2. Establish contact with Intaka re Xhosa-speaking guides.	2011	Reserve Manager + Avifauna Advisor	N/A	Xhosa-speaking guides available for school programme
3. Establish links with Two Oceans, the Wetland Forum etc re teacher training opportunities.	2011	Reserve Manager + Friends of Rietvlei	N/A	Teacher training programmes include material on wetlands
4. Develop a Catchment-to-Coast brochure to promote understanding of the links to catchment activities.	2011	Reserve Manager + Department of Agriculture (Landcare)	R 25,000	Brochure available for distribution to farmers, miners etc in the catchment.
<b>Objective R : To promote awareness of and compliance with the Estuary Zonation Plan</b>				
1. Displays, posters and brochures showing the zoning	July, 2012	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	R 25,000	Awareness of Zonation Plan.
<b>Objective S : To document and promote awareness of the rehabilitation initiative</b>				
1. Investigate options for the production of a DVD.	2011	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	TBD	Partnership with relevant institution.
2. Implement	2011 - 2015	Reserve Manager + ERMD (Communications) + Friends of Rietvlei		DVD documenting rehabilitation process, with clips aired on 50/50 & other relevant programmes
<b>Objective T : To promote awareness of health &amp; sanitation issues around the estuary</b>				
1. Develop brochure in relevant languages	2011	Reserve Manager + Environmental Communications + DWA	R 25,000	Brochure available for use in community education programme.
2. Meetings with community leaders	2011-2012	Regional Director: DWA	N/A	Support of community leaders for educational programme.

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3. Compilation of a leaflet/brochure on potential health impacts of consumption of fish from Rietvlei & distribution in surrounding communities	2010/11	DEA & DP	TBD	Community awareness of potential health impacts of fish from Rietvlei.
<b>Objective U : To promote and market the Reserve</b>				
1. Improve signage in line with new policy	2011	Reserve Manager + Roads Department	TBD	Increased number of visitors
2. Brochures provided to Cape Town Tourism	2010 (ongoing)	Reserve Manager	N/A	Increased number of visitors

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<b>RESOURCE REQUIREMENTS</b>				
<b>Steps</b>	<b>Date</b>	<b>Responsibility</b>	<b>Estimated Budget</b>	<b>Indicator</b>
<b>Objective V : To increase capacity of human resources</b>				
1. Training in estuaries management (C.A.P.E. Training)	2011/2012	Manager: ERMD	R 10,000	Staff capacity increased.
<b>Objective W : To improve availability of financial resources to implement the Action Plan</b>				
1. Investigate mechanisms to access the funds from the Rietvlei Trust Fund and/or have the funds transferred to Friends of Rietvlei	2011	Manager: ERMD/ Rietvlei Management WG	N/A	Funds available to implement relevant aspects of the EMP/Action Plan.
2. Identify and target additional potential sources of funding	2011 ongoing	ERMD/ Rietvlei Management WG	N/A	Funds available to implement relevant aspects of the EMP/Action Plan.

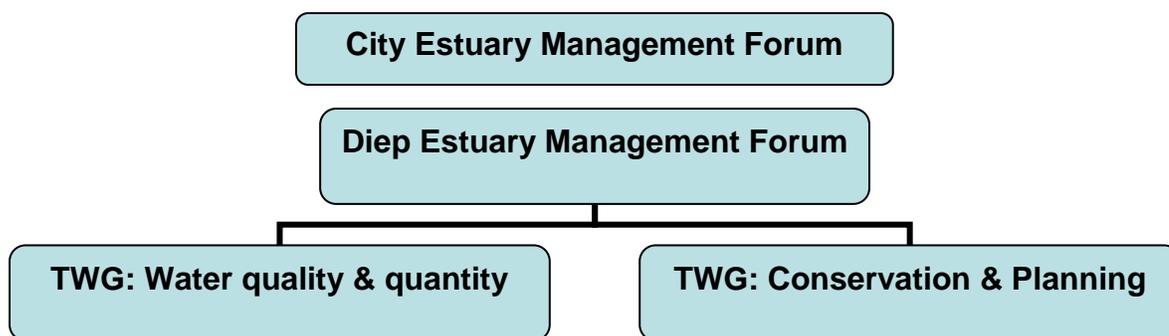
## 8. FRAMEWORK FOR IMPLEMENTATION

A Management Committee for the Rietvlei Nature Reserve has been in existence since the establishment of the reserve, and has taken on the responsibility for overseeing the implementation of the EMP. The original committee has been expanded to include a number of additional members, although it is noted that not all members are active.

Members of the committee include:

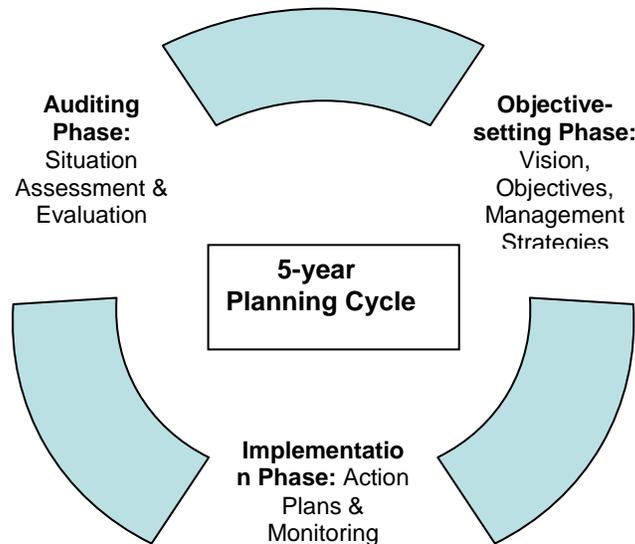
- City of Cape Town (various different divisions)
- Department of Water Affairs
- Cape Nature
- WWF
- Chevron
- Friends of Rietvlei
- Milnerton Aquatic Club
- Bird expert
- Department of Environmental Affairs (DEA – Oceans & Coasts (Estuaries & Pollution Divisions))
- Department of Agriculture (Landcare)
- Department of Environmental Affairs and Development Planning (W.Cape)
- Ratepayers

In addition, there should be two Technical Working Groups to continue providing guidance to the implementation of relevant aspects of the plan.



## 9. AUDITING AND EVALUATION

The Situation Assessment which preceded the development of this Estuary Management Plan should be regarded as the first of 5-yearly Evaluations in an ongoing cycle of planning for the management of the estuary as shown in the diagram below.



However, particularly in the initial 5-year period, it is recommended that progress on the implementation of the EMP is audited on a more regular basis as follows:

- There should be quarterly meetings of the Diep Estuary Management Forum (Rietvlei Management Working Group), with the minutes of these meetings being made available to the City Estuary Management Forum, CapeNature, the Provincial Coastal Committee, and other relevant bodies.
- There should be annual report backs to a open Public Meeting on progress in terms of implementation of the EMP/Action Plan. The report should be made on the basis of an annual “mini-audit” of progress by an external consultant, with the appointment of the consultant being facilitated by the Forum.

In the case of this first 5-year period, where a number of the actions in the second half of the period are dependant on the outcome of studies or other actions scheduled for the first two years, it is also proposed that a more thorough audit take place at the mid-point of the 5-year period, as well as at the end. This would be accompanied by revisions and/or refinements to the current EMP and Action Plan.

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### Annex I: List of Acronyms:

BM	Biodiversity Management Branch (City)	EIA	Environmental Impact Assessment
CSRM	Catchment, Stormwater & River Management Branch (City)	EMP	Estuary Management Plan
DAFF	Department of Agriculture, Forestry and Fisheries	ERMD	Environmental Resource Management Department (City)
DEA	Department of Environment Affairs (National)	IAS	Invasive alien species
DEA & DP	Department of Environmental Affairs & Development Planning ( W.Cape)	TBD	To be determined
DEM	Digital Elevation Model	TMF	Table Mountain Fund
DWA	Department of Water Affairs (National)	WSS	Water & Sanitation Services (City)
E & H	Environment & Heritage Branch (City)		

**Annex II: Catchment Management Strategy for the Diep Estuary**

In order to effectively manage the Diep Estuary, activities in the catchment which affect the estuary must be addressed through a Catchment Management Strategy. Issues to be covered include:

- A more accurate determination of the base flow of the river, and factors impacting the flow such as:
  - the capacity of farm dams (registered and unregistered),
  - clearing of alien plants along the river channel, especially gum trees
  - the promotion of appropriate agricultural practices to reduce infestation of invasive alien species.
  
- Pollution sources in the river catchment including:
  - Waste-water treatment works (eg. Fisantekraal, Malmesbury) – and it is noted that the Malmesbury WWTW is currently not meeting the required standards.
  - Waste disposal sites eg. Vissershok.
  - Stormwater from urban areas (formal and informal – eg. on the Mosselbank)
  - Agriculture (runoff of fertilizers, pesticides etc, as well as discharges and runoff from eg. dairy farms). Many farms allow cattle to drink from the river which results in significant trampling, erosion and also contributes to pollution due to fouling of the water by cattle manure.
  - Mining.
  
- Sources of sediment:
  - Erosion as a result of poor agricultural practices.
  - Mining.