FINAL REPORT

BASELINE ASSESSMENT FOR THE PORT OF RICHARDS BAY EXPANSION PROGRAMME – Selected Aquatic and Terrestrial Habitats

MAY 2013

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GLOSSARY AND ABBREVIATIONS

Anthropogenic	Having to do with people, or caused by humans
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems
Benthic invertebrates	Organisms living in or on sediments of aquatic habitats
Catchment	In relation to a watercourse or watercourses or part of a watercourse, this term means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points
CIC	Co-operative Independent Consultants
Community	Assemblage of organisms characterised by a distinctive combination of species that occupy a common environment and interact with one another
Community composition	All taxa, plants and animals, present in a community
Cumulative impact	Impact on the environment which results from the incremental or combined effects of one or more developmental activities in a specified area over a particular time period, which may occur simultaneously, sequentially, or in an interactive manner.
Dilution	The reduction in concentration of a substance due to mixing with water
DO	Dissolved Oxygen
DWA	Department of Water Affairs (formerly Department of Water Affairs & Forestry)
EHI	Estuarine Health Index
EKZNW	Ezemvelo KwaZulu/Natal Wildlife
ERE	Environmental and Resource Economics
GIS	This abbreviation stands for Geographic Information System. GIS is a combination of computer software and hardware tools used for creating maps and analyzing spatial data. GIS links the map and database information so that questions can be asked and answers given in map or visual form.
Habitat	The natural home of an organism or community of organisms (this also includes the surrounding area)

Intertidal	Area of the shore between the highest and lowest tides.
in toto	in total or completely (in this document referring to the whole estuary)
Invasive species	A species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health.
MAR	Mean Annual Runoff
MER	Marine and Estuarine Research
MSL	Mean Sea Level
NEMA	National Environment Management Act No 107 of 1998
PES	Present Ecological Status
Richards Bay estuary or the Bay	Terms used interchangeably to refer to the estuary of Richards Bay. The Port or harbour is considered to lie within the greater estuary.
RBCT	Richards Bay Coal Terminal
Runoff	Runoff is the water yield from an individual catchment – the subcatchment plus the runoff from all upstream subcatchments. Runoff includes any seepage, environmental flow releases and overflows from the reservoirs in a catchment, if they are present - which is not the case in any of the simulations in this project in which baseline catchment conditions are assumed.
SANBI	South African National Biodiversity Institute
Stormwater run-off	Stormwater run-off from paved areas, including parking lots, streets, residential subdivisions, of buildings, roofs, highways, etc.
Subtidal	the area of the shore that is always covered by water and is never exposed at low tides
Supratidal	the area of the shore that is always dry and above the reach of the highest tides.
TNPA	Transnet National Ports Authority
Wastewater	Water containing solid, suspended or dissolved material (including sediment) in such volumes, composition or manner that, if spilled or deposited in the natural environment, will cause, or is reasonably likely to cause, a negative impact

BASELINE ECOLOGICAL ASSESSMENT OF SELECTED AQUATIC AND TERRESTRIAL HABITATS

for the Port of Richards Bay Expansion Programme

1 INTRODUCTION

1.1 Background

Marine and Estuarine Research (MER) have been appointed by BKS (Pty) Ltd (hereafter referred to as BKS) to undertake a baseline ecological assessment of the estuarine bay and surrounding environments. This is deemed necessary to build an understanding of whether these environments may be impacted by the proposed expansion plans for the Port of Richards Bay, which is managed by Transnet National Ports Authority (herafter referred to as TNPA) on behalf of Transnet SOC Limited (hereafter referred to as Transnet). This allows the "early identification" of potential environmental risks and opportunities prior to any detailed planning.

For the purposes of this report the study boundary included the larger Bay environment and its various linked and adjacent habitats and dealt with these using four broad areas groupings within the Port. These are illustrated graphically in Figure 1—1 and described below:

1. The estuarine bay including the water surface area, intertidal and supratidal habitats.
2. The 500 series berths located to the south west of the existing bay situated approximately at 28˚47'37"S/32˚01' 37"E.
3. The area between the break bulk and repair quay positioned at 28˚47'45"S/32˚47' 06"E.
4. The south dunes development option located on the frontal dune cordon positioned approximately at 28˚49'15"S/32˚04' 26"E.

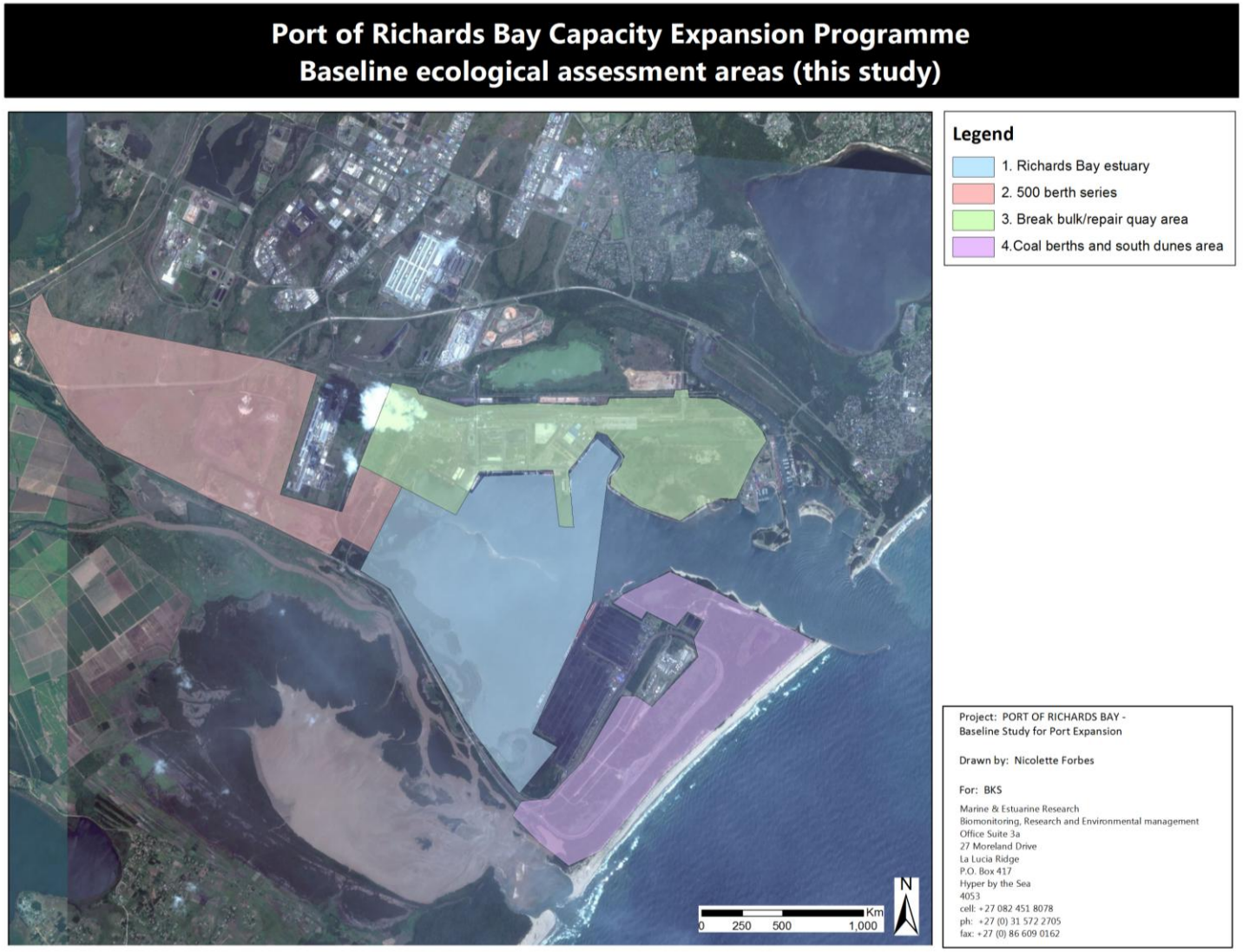

Figure 1—1 Areas assessed as part of this ecological evaluation

This report considers the information available relating to the larger environment and applies information collected during this study to assess the current status of the estuary, wetlands and surrounding terrestrial environments, identify high level issues and risks and provide an indication (gap analysis) of further information requirements to facilitate the environmental assessment task.

1.2 Terms of Reference and scope of study

BKS requested that MER conduct a baseline ecological assessment of_the terrestrial and aquatic habitats that would be directly or indirectly influenced by the development proposals currently mooted for the expansion of the Port of Richards Bay. An agreed Terms of Reference prior to appointment of MER and Phase 1, includes the following components:

- Literature survey
- Present status and condition of the various habitats within the sudy area and/or affected by the proposed development. Terrestrial habitats would be sampled as part of this study but due to time constraints only limited sampling of the estuarine / marine habitats would be undertaken as part of the EIA phase where this is recommended by authorities and / or by specialist studies.
- Existing disturbance within each unit;
- Environmental assessment to identify environmental constraints and opportunities within the study area

MER is in possession of most if not all of the available historical and recent literature on the Richards Bay estuary and has led ecological assessments within the Port during the past ten years. To ensure integration with local, provincial and national conservation policies, information from the conservation plans of South African National Biodiversity Institute

(SANBI)[1], EKZNW and the Mhlathuze Municipality's Environmental Management Framework will also be taken into account. The existing knowledge of the MER specialist team will ensure a robust assessment and will include:

a. Sensitivity and conservation significance of the Richards Bay estuary and

b. the various habitats found therein and adjacent to it taking into account the conservation planning information from SANBI, EKZNW and municipal planning

1.3 Approach and assumptions / limitations for this study

The approach for this study involved the following components:

a) Baseline study (desktop from existing information);
b) Description of the estuary type, delineation of its boundaries and a description of its current status using existing and recent information;
c) Identification and description of the major / key habitat types and their characteristic fauna and flora, along with their conservation value;
d) Potential threats and opportunities linked to terrestrial, wetland and estuarine biodiversity / function as a result of the currently proposed developments; and
e) Identification of further information requirements for Phase 2 which will undertake more detailed investigations and conduct the impact assessment evaluation during the EIA process.

Literature survey

Published papers on the Richards Bay system are relatively scarce but this is compensated for by a plethora of often overlapping contract reports. Those produced over the last decade and which are available, have been used to synthesize an integrated picture and to draw out points relevant to the Terms of Reference for this study.

[1] The South African National Biodiversity Institute (SANBI) is established in terms of the National Environmental Management: Biodiversity Act (Act No 10 of 2004) and reports to the Minister of Water and Environmental Affairs.

More focused consideration was given to ten specific documents for the terrestrial vegetation assessment. These documents were directly relevant to port expansion plans and the consequent environmental changes associated with these. It is evident that most reports and literature associated with the port are more general in focus, identifying specific features or the function of the estuary *in toto*.

Table 1—1 and Table 1—3 below provides a broad overview of these specific reports. It was evident from these reports that limited, site specific information is available for consideration. What is of value, is the apparent conflicting descriptions of habitat within the specific sites, which indicates possible variations in habitat structure over a relatively short period of time and provides some insight into the various drivers affecting the site.

A great number of aquatic and estuarine studies have been completed which provide information regarding the resources and state of the Richards Bay and Mhlathuze estuaries. The list, while fairly comprehensive may not be complete as some reports remain either inaccessible or unknown but those reviewed do bring out some recurring themes.

The methods employed in this approach drew on these sources and included the following:

- Mapping of estuarine boundaries, land use and key habitats using GIS techniques to provide a spatial indication of the habitats and their areas as well as an indication of the scale of the impacts;
- Description of the current state of the estuary using available literature including published papers, contract and other reports and MER data;
- High level broad assessment of the implications of the proposed activities for this particular estuary to identify possible issues and impacts;
- Further information requirements for the more detailed phases.

Site visits

Site visits to selected terrestrial, supratidal and intertidal habitats were conducted on the 6-7th February 2013 and 14-15th March 2013. These site visits allowed the specialists to an up-to-date visual confirmation of the broad habitats and conditions, particularly terrestrial which are described in the report.

Table 1—1 Overview of key reports used in the terrestrial vegetation desktop survey and assessment

Title	Richards Bay Phase 2 Container Terminal Report	Richards Bay Environmental and Resource Economics (ERE) Evaluation report	Port of Richards Bay Development Framework Plan	Basic Assessment Report for Proposed New Infrastructure and Expansion at Richards Bay Coal Terminal (RBCT)
Date	2007	2008	2008	2008
Author	Acer Africa	Cooperative Independent Consultants (CIC) International	Transnet	Cymbian Enviro- Socio Consultants
Report Description	Feasibility report considering a number of layout options for port expansion with consideration of ecological and environmental issues. Environmental authorization processes and the "flagging" of specific environmental issues was undertaken	Enviro-economic report relating to the cost benefit analysis for the proposed expansion of the port facilities at Richards Bay	Preliminary proposals with environmental risks on possible expansion opportunities for the port. Report is a broad spatial plan focusing on available opportunities.	Application for environmental authorization
500 Series Berths	Using CSIR 1996 mapping information and consideration of 2006 mapping information, this site was deemed to constitute "developed area",	No information relating to site	No information relating to site	No information relating to site
South dunes	Using CSIR 1996 information this site was deemed to comprise of "pioneer communities" and "dune scrub". 2006 information did not identify the area in terms of its ecological status or value.	No information relating to site	No information relating to site	No information relating to site
Break bulk to Repair Quay	Using CSIR 1996 information, this area was considered to comprise of a mix of habitat, described as "pre mangrove" with some "mesic woodland". The latter is possibly an incorrect reflection of the status of the site and an improved description would be "Casuarina dominated, stabilized dune form"	No information relating to site	No information relating to site	No information relating to site

Table 1—2 Overview of key reports used in the terrestrial vegetation desktop survey and assessment

Title	ERE Richards Bay Phase 2 and 3 Report	Proposed Container terminal Ph I and Ph II Bayside. – Preliminary Environmental Options	Vegetation of Richards Bay municipal area, Kwazulu Natal, South Africa with specific reference to wetlands	Air Emission Inventory for the Port of Richards Bay
Date	2008	2008	2008	2009
Author	CIC International	Acer Africa	J. Burger	Co Ex Environmental Planners
Report Description	Further review and consideration of the integrated environmental and economic implications of expansion within the Richards Bay Port	This report considered the area adjacent to the Bayside Aluminium smelter as a point of phased expansion.	A vegetation survey was conducted at plant community level within the boundaries of Richards Bay Municipal area during 2001 to 2002. Report describes the vegetation of Richards Bay deteriorating and becoming more disturbed.	Baseline information collation and reporting on dust and other emissions arising from select points within the port as well as traffic, shipping and related activities
500 Series berths	In this report the site is considered to be "developed", in line with the 2007 report and spatial information	This report identifies the area as being a "wetland habitat". Specifically the area under consideration lies landward of the study site. Some woody species requiring legislative permitting for their removal were identified at site. Of significance is the identification of the high level of groundwater pollution that may lie within the site, which by extension may have consequences for any expansion activities envisaged for this area.	No information relating to site	No information relating to site
South Dunes	The bio physical nature and status of this site is not considered in this report.	No information relating to site	No information relating to site	No information relating to site
Break Bulk to Repair Quay	In this report, this area is generally and possibly incorrectly considered to be "tidal flats". While some portions of the area may be considered as such, the earlier description provided under the CSIR 1996 spatial plan is more appropriate	No information relating to site	No information relating to site	No information relating to site

1.4 Estuarine specialist team

The scientists working on this assessment, their expertise and years of experience working in the field are listed in Table 1—3

Table 1—3 Ecologists working on this project

Personnel	Expertise	Years experience
Prof Anthony Forbes (ATF)	Estuarine Ecology	45
Ms Nicolette Forbes (NTF)	Mangroves / Estuarine management	23
Mr Simon Bundy	Coastal vegetation and dune dynamics	20

All three ecologists are independent specialists on this application, have no financial interest in the undertaking of the activity, other than remuneration for specialist work performed in terms of National Environmental Management Act 107 of 1998 (NEMA) and the Environmental Impact Assessment Regulations, 2010 and have no vested interest in the proposed activity.

2 LITERATURE REVIEW AND ASSESSMENT OF CURRENT ECOLOGICAL STATUS

This section integrates the synthesis of information from the literature review with the results of this study. A general historical literature review is used to describe the larger ecological value and issues within the Richards Bay port area. The habitats within and immediately surrounding the Bay, which may be influenced by development proposals are then described in more details within three habitat groupings (Figure 2—1) as described below:

- The estuary with its associated intertidal (mangroves, sand and mudbanks) and upstream river habitats
- Freshwater and estuarine linked wetlands
- Terrestrial habitats immediately adjacent to the estuary (proximity results in the estuary having an influence on these areas and *vice versa* activities in these areas may influence the estuary)

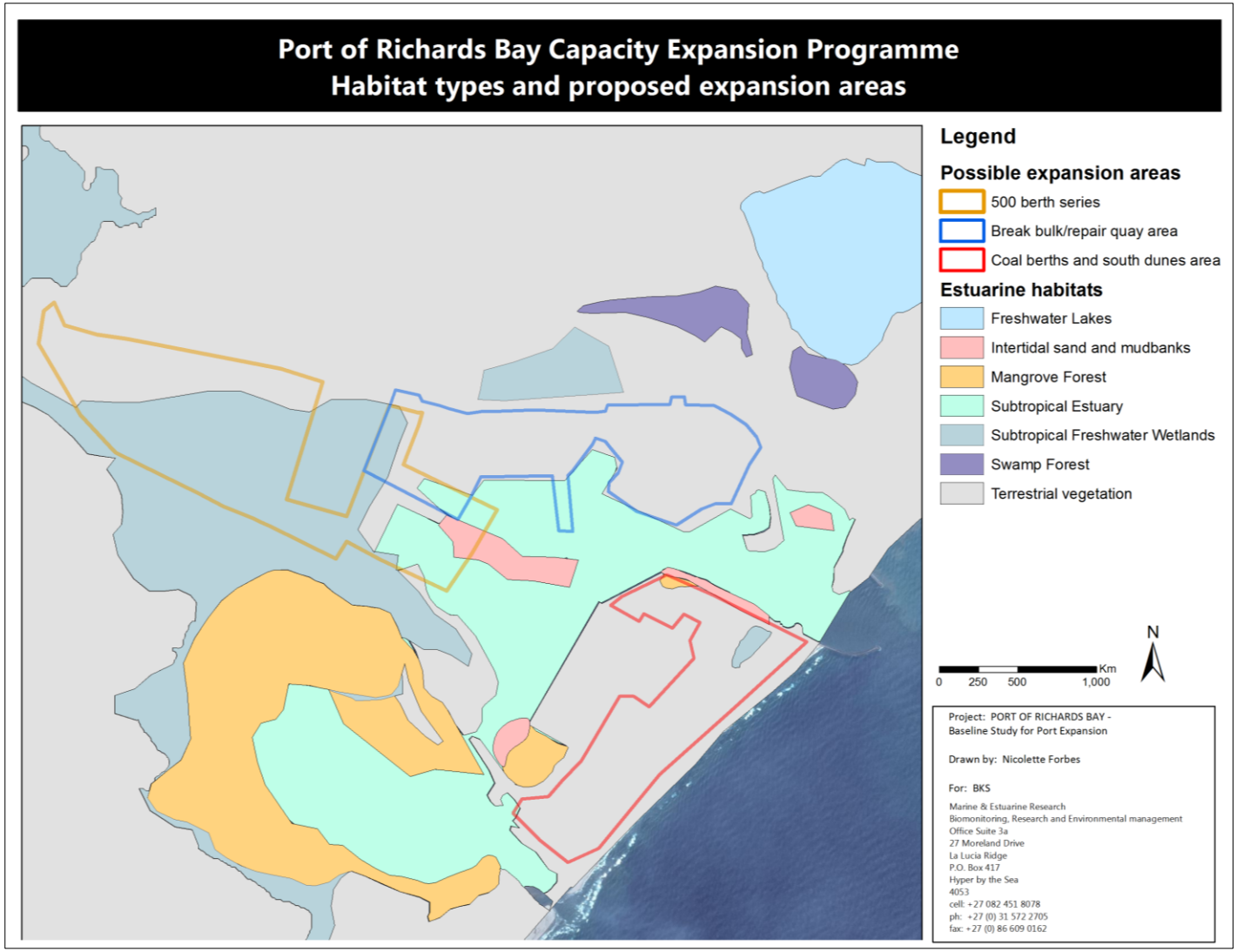

Figure 2—1 Broad habitat groupings within and immediately adjacent to possible expansion areas investigated in this study.

2.1 The Richards Bay Estuary

2.1.1 Literature review of reports dealing with the estuary and adjacent habitats

Based on the accepted South African system of estuarine classification into five types, *viz*. coastal lakes, estuarine bays, river mouths, permanently open and intermittently open estuaries (Whitfield 1992), Richards Bay historically qualified as one of three estuarine bays in the country, along with Durban Bay and the Knysna estuary, on the basis of its size and strong marine influence. The nature of the environment and the biota in the undeveloped state were first described (Millard & Harrison 1954) during the University of Cape Town (UCT) Zoology Department country wide estuarine surveys of the late 40s and early 50s.

Radical transformation of the greater Richards Bay environment began in the 70s with port development, the splitting of the original bay into north and south sections and the re-direction of the Mhlathuze River into the southern Sanctuary area as it was initially known. This was followed by all the activities associated with normal port development in the northern section including *i.a*. dredging, wharf construction, infilling, mouth widening and stabilisation, breakwater construction and terrestrial infrastructure, all of which have resulted in an environment different from that which existed previously.

A scoping report for a Strategic Environmental Assessment (SEA) was produced in 2002 (CSIR 2002). The report provided a brief overview of the then existing environment, including the Sanctuary (Mhlathuze estuary) and identified "*strategic environmental issues*" including the "*maintenance of ecosystem functions and habitats*". The scoping report was followed by a full SEA (CSIR 2005) where the strategic issues identified for sustainable port development were grouped into the following categories:

- Maintenance of ecosystem functions and habitats;
- Hydrodynamic functioning of the Port of Richards Bay;
- Beach erosion;
- Disposal of dredge spoil;
- Port-City land use planning issues;
- Institutional arrangements;
- Socio-economic issues; and
- Consideration of local, provincial and national policies for port planning and economic impact of port development and operations.

Of relevance in the present context, is the portion of the SEA report that dealt with environmental issues, and some of the following paragraphs and phrases have been extracted *verbatim*. It is the considered assessment of the authors of this report that the statements made within the SEA report remain true and accurate and in fact have strengthened in significance with the decline in condition of estuarine systems along the KZN coastline.

"*The port and its surrounds also include habitats of conservation significance. The system sustains considerable diversities of crustaceans and mostly juvenile fishes, and functions ecologically as an estuarine system. The large size of this system relative to the majority of estuaries in KZN (many of which are in degraded ecological states) therefore renders Richards Bay important to the conservation of estuarine flora and fauna along the South African coast. The port has direct and indirect importance to several fisheries. These include subsistence, recreational and commercial operations harvesting fish and crustacean stocks, locally within the confines of the port, as well as along the greater length of KZN coastline in the surf zone and on offshore banks. The importance of the Bay as a bird (including many rare species) habitat has been documented.*"

The Richards Bay Port, was developed more recently in the mid 1970s and unlike some of the other South African Ports, it still retains significant areas of natural habitat. These habitats are modified from those of the original system prior to port development, but ecological succession has seen most of them regain importance as functioning ecosystem components. Available information suggests that pollution and poor water quality are presently not limiting to biotic communities. The proximal threat to the port's continued ecological function therefore appears to be habitat degradation and habitat loss with port growth. Increasing industrial development and expanding port facilities and operations are, however, anticipated to result in increased pollution levels in port waters (CSIR 2005). Longer retention times and reduced flushing, due to a changed bathymetry, may result in water quality becoming an increasingly significant factor in the ecological state of the port waters.

Landward of the Port, swamps and terrestrial environments have been significantly transformed by urban and agricultural developments again indicating that habitat loss and fragmentation has lead to the present state or conditions of these habitats. Significant impacts have been: degradation of habitats and alien species invasion. Nonetheless several habitats of significant conservation importance have been identified.

The "Environmental-and-Resource-Economics" (ERE) report (2008) initiated by Co-operative Independent Consultants (CIC) International represented a move towards an attempt to value those ecological goods and services provided by the natural Richards Bay estuarine system. This report provided precursor work to a comparative environmental-and-resource-economics (ERE) evaluation of the ecosystem services of Richards Bay. It describes the systems exposed to the environmental effects of the development, the development itself, and the environmental assets and contingent services at risk to these environmental effects. The report provided in some detail the broad biophysical features of the Richards Bay estuarine system, the possible short and long term impacts of port development and possible mitigatory measures, but does not seem to have been carried through to resource economics.

ACER (2009) produced a report assessing potential feasible and sustainable layouts for the Phases 2 and 3+ container terminals. Infrastructure impact was considered in terms of:

- Success (risks) of mitigation.
- Absolute environmental impact.
- Land and property impact.
- Integrated planning.
- Schedule.
- Cost.
- Operability.
- National economic benefit.
- Local economic benefit.

Among many important issues associated with the criteria mentioned above, the following can be highlighted as having a key influence on the assessment and screening processes of the past two years and these are still considered relevant:

- An improved understanding of the ecological value of the intertidal sand and mudflats on the western boundary of the port known locally as the 'Kabeljou flats'.
- Describing and quantifying if possible the potential importance of maintaining the ecological link between the 'Kabeljou Flats' and the Manzamnyama/Bhizolo Canals.
- Uncertainty regarding offset mitigation, particularly whether successful recreation of destroyed habitats and the restoration of successful ecological functioning are achievable.
- Land availability and space requirements.

The 2009 ACER Africa Report also clearly stated the *"important realisation that once the Kabeljou Flats are affected, the link to the canals is lost or altered, and* [once] *a shipping channel is created in the south and the Kabeljou Flats and their functioning are lost, it becomes somewhat meaningless to try to conserve remnants."*

It was also noted that "*the level of understanding of the possibility for and success of offset mitigation is unknown, with professional opinions ranging from "easy" to "impossible". Added to this, there is a need to better understand the ecological connectivity between the Canals (Manzamnyama and Bhizolo) and the Kabeljou Flats*. This was described as extremely necessary because in each development layout assessed, the canal link to the Kabeljou Flats would be disrupted potentially negatively affecting the Kabeljou Flats. In the absence of this linkage the report queries whether this would possibly render the conservation of the Kabeljou Flats meaningless. The implications of rerouting the Mhlathuze and Nseleni Rivers as well as understanding the ease or not with which mangrove forests and papyrus swamps can be artificially established were also considered to be worthy of further investigation.

Some physico-chemical and selected biotic conditions in the Port in recent years have been monitored by the CSIR. One of these reports (CSIR 2011) covered determinations of bacterial, hydrocarbon and heavy metal contaminants as well as the macrobenthic fauna*, i.e.* the smaller animals living either on or in the bottom sediments.

In terms of the wording used in the report "*Water and sediment quality in the Port of Richards Bay at the time of summer and winter surveys in 2011 can be described as a 'mixed bag'*. With relatively few exceptions physical, chemical and biological parameter values and concentrations in water samples were below or within target ranges identified for South African coastal marine waters in the South African Water Quality Guidelines for Coastal Marine Waters (Natural Environment), or below or within water quality classification criteria defined by scientists from the Coastal Systems research group of the CSIR. In several cases where parameter values and concentrations were classified fair, the magnitude of non-compliance was usually small and in certain cases probably irrelevant considering that the stations were situated in canals that drain freshwater into the port and naturally elevated values or concentrations for some parameters can be expected in these systems.

"Macrobenthic fauna, used as a bioindicator of water and sediment quality in this monitoring programme, showed little consistent response to the contamination issues identified above. Despite water and sediment quality impairment being measured in the Port of Richards Bay, this does not appear to be at a level that impacts significantly on benthic assemblages at the broad level of investigation used here. Physical alteration and destruction of natural habitats are probably more important issues that need to be considered in port management and development scenarios. That said the trends noted in water and sediment quality in the port, as reflected by physico-chemical monitoring, are of ecological concern and must be investigated.

Mussels at some stations monitored in the Port are bioaccumulating certain metals to a higher than expected degree based on a comparison to mussels sampled in other ports. The most important metals in this context are aluminium, iron, copper, chromium and nickel. There are identifiable anthropogenic sources of these metals in the port, most notably ferro-alloys, metal ores and scrap metal, and there seems to be little doubt that the bioaccumulated metals have a predominantly anthropogenic origin".

A second report (CSIR 2013a), compiled for the current investigation, describing turbidity and total suspended solids levels in the port refers to the biological significance of Richards Bay but was not able to attribute any adverse environmental impact to turbidity or total suspended solids. This is not totally surprising as estuaries naturally tend to be relatively turbid environments although turbidity gradients can contribute to patterns of fish distribution in estuaries.

The above paper was followed by a survey of contamination levels of 14 different metals in sediments (CSIR 2013b). Again in the words of the authors the "*study (has) provided a high resolution spatial understanding of metal contamination in sediment from the western part of Richards Bay. At the time of collection sediment in some parts of the capacity expansion programme footprint was metal contaminated, most notably by copper, chromium and zinc. Although the different approaches used to assess the potential toxicological risk of metal concentrations in sediment to bottom-dwelling organisms identify the highest risk in some parts of the Inner Basin complex* (which is the area adjacent to the 700 series berth in the western portion of the port)*, only in a few areas was there a high risk. However, the actual risk is uncertain since it is unknown whether the metals are present in a bioavailable or a particulate form. There is a possibility that the Department of Environmental Affairs may prohibit the open water disposal of sediment dredged from relatively small areas of Inner*

Basins 2 and 3 (in the area of the 800 series berths), *because of elevated copper and/or chromium concentrations in the sediment"*.

2.1.2 Delineation of the estuarine functional area

The boundary of South Africa's estuaries incorporates an area known as the estuarine functional zone (SANBI 2011). The estuarine functional zone is defined by the 5 m topographical contour (as indicative of 5 m above mean sea level). The estuarine functional zone includes:

- Open water area;
- Estuarine habitat (sand and mudflats, rock and plant communities); and
- Floodplain area.

It should be noted that the estuarine functional area indicated (SANBI 2011) is a modified contour and determined by a mix of the original land elevation and the transformed land. Infilling of land platforms for development, agricultural levees and road/bridge causeways all result in an alteration of the orginal extent of the estuarine functional zone.

The 5 m contour has been defined to allow the inclusion of estuarine linked areas and biodiversity dependent on estuarine processes and has a number of planning advantages. It allows dynamic areas to be protected as these are areas responsible for the key physical processes that drive biodiversity in estuaries and along the SA coastline. The boundaries define the estuarine functional zone of this estuary. It is important to realise that the resilience of an estuary is influenced by the intactness of its catchment and estuarine habitats. A way to ensure resilience is the determination and implementation of estuarine ecological water requirements and the protection/rehabilitation of the estuarine functional zone. It should be noted that while this delineation appears to ignore existing infrastructure and development it is important to define this estuarine functional zone to prevent unavoidable further development within this dynamic and sensitive area. The areas proposed for development of this capacity expansion programme lie within the delineated estuarine functional zone (see Figure 3.2 below). The GNR 546 Listing Notice 3 under the NEMA EIA Regulations (2010) identifies the estuarine functional zone as a sensitive area that requires environmental authorisation before a development may proceed.

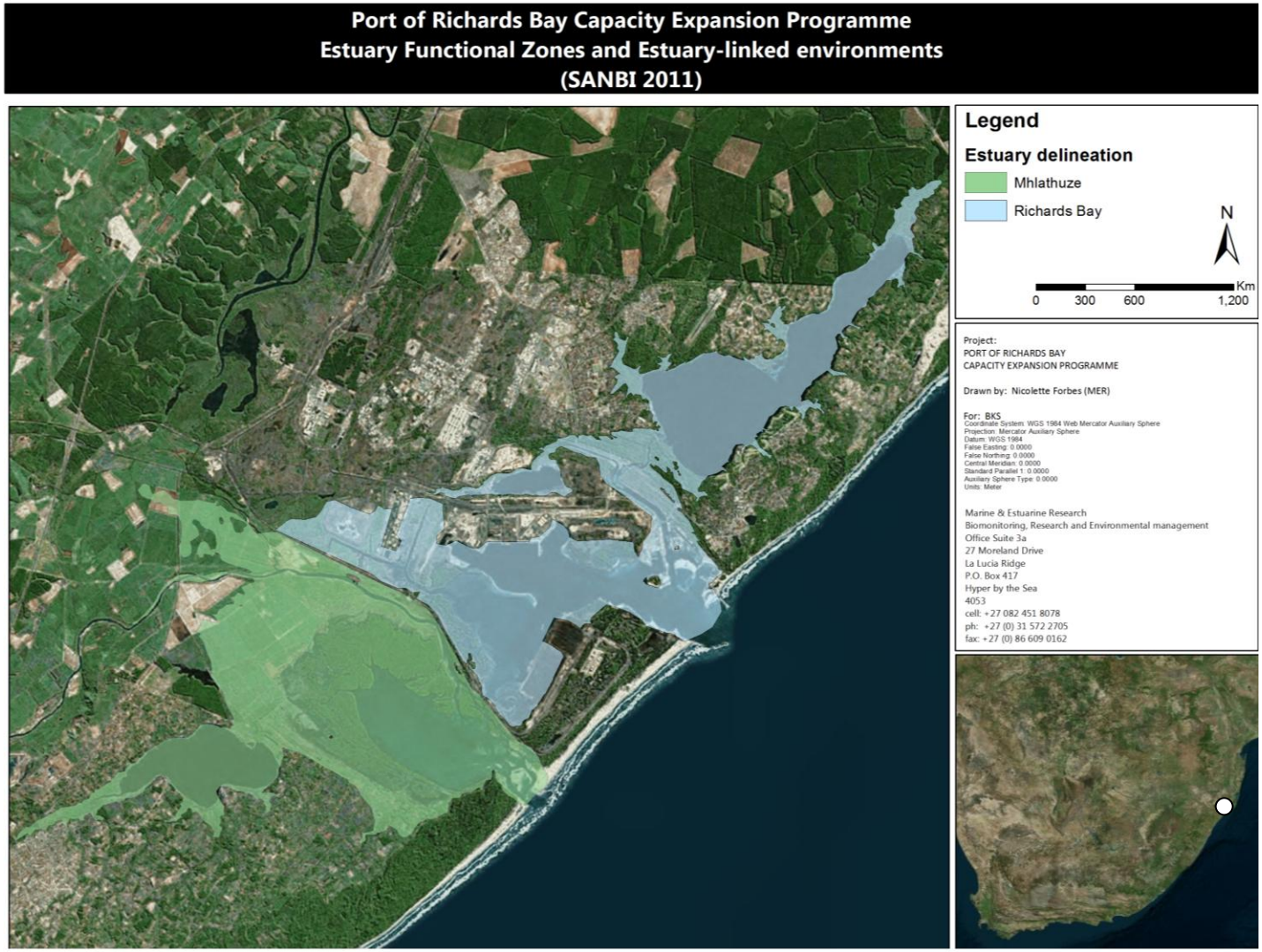

Figure 2—2 Delineation of the Richards Bay Estuary as per the method described by SANBI (2011). The boundaries of the adjacent Mhlathuze Estuary are also indicated.

2.1.3 Aquatic estuarine flora

Seagrasses

Nanozostera capensis is found along the coast of South Africa and is a temperate species only extending north into southern Mozambique (Green and Short 2003). This species is the only species of seagrass found in the southern parts of its distribution which extends down into the Eastern Cape as far as Knysna, South Africa. Due to its distribution in shallow estuarine environments, the population is severely fragmented. This species is vulnerable throughout its range due to declining habitat quality driven by a variety of human activities including coastal development, pollution and shellfish harvesting which has caused a decline in coastal populations. The disappearance of this species in Durban Bay was related to the harvesting of the prawn *Penaeus japonicus* which occurs in *Zostera capensis* beds. Harvesting caused damage to the rhizome matrix, uprooting plants ultimately destroying the habitat of this particular prawn species. This has occurred in other parts of the world, with the harvesting of prawns from *Zostera capensis* beds at Bairro dos Pescadores, Mozambique has created significant declines in prawn abundance threatening the food security of the local population (Green and Short 2003).

Seagrass typically occurs in intertidal flats and lagoons with sand or mud bottoms conditions, conditions which do occur in a few estuaries along the east coast of South Africa. Richards Bay was one of these and extensive seagrass beds were recorded in the system during the early estuarine surveys of the 1940s (Millard and Harrison 1954). These surveys reported that these habitats supported a rich diversity of marine and estuarine fauna and were believed to be vital to the nursery function of the estuary (Millard and Harrison 1954). Unfortunately seagrasses no longer occur in Richards Bay but are still found within the adjacent Mhlathuze estuary. Here these beds provide critical habitat for the migrant estuarine prawn, *Palaemon peringueyi*, an endemic species to southern Africa which is found to be strongly associated with *Zostera capensis* beds (Forbes and Cilliers 1999).

This species is now listed on the IUCN Red List as **Vulnerable** which means it is therefore considered to be facing a high risk of extinction in the wild (Short *et al* 2010).

Mangroves

In South Africa, mangrove forests only occur in estuaries. Three mangrove species occur in both the Richards Bay and Mhlathuze estuaries *viz Avicennia marina, Bruguiera gymnorrhiza* and *Rhizophora mucronata*. The distribution and abundance of mangroves have changed significantly since the 1970s when port development was initiated and berm construction created the smaller Bay area and the Mhlathuze estuary. Mangrove dynamics since then have been characterised by losses in some areas and subsequent re-colonisation in other areas in the port. While there has been major removal in the western area of the port, mangrove trees have highly effective dispersal mechanisms via the floating propagules they produce and there has been significant colonisation on the port side of the berm and in the area to the south of the RBCT. Natural colonisation by mangroves will occur in suitable intertidal areas defined by the spring high tide mark, which is the limit of water borne transport for the propagules, and the low water neap mark. The area between these two lines is exposed at every low tide and on this basis provides a suitable habitat for mangrove trees which do not survive extended periods of inundation of the root system.

The three species of mangrove are therefore found in all areas of Richards Bay and the Mhlathuze estuary but relative abundance and structure varies depending on the maturity of the stands. A major, largely monospecific expansion of the white mangrove *Avicennia marina* took place in the Mhlathuze estuary associated with sediment deposition from the newly diverted Mhlathuze River and a greater tidal range from the dredging of the new mouth in 1975. It should however be noted that a mangrove habitat consists of more than just trees and the fauna associated with mangroves, particularly the invertebrates, is richer in mature stands which are characterised by spaced, large trees. The broader significance of the mangrove habitat is therefore linked to mature stands such as those that survive to the north of the RBCT berths within the Echwebeni Reserve Heritage Site. This site of Conservation Significance covers an area of approximately 54 ha. There are four plant communities present in this relatively small area. These are coastal forest, fringing mangrove forest with mature trees of all three species, reed swamp, and swamp forest.

In addition to the true mangrove species already mentioned the fern *Acrostichum aureum,* and *Hibiscus tiliaceus* are mangrove-associates that do occur within and on the landward margin of the mangroves.

Swamp forest

Swamp forests dominated by *Barringtonia racemosa*, *Hibiscus tiliaceus* and *Ficus trichipoda* occur in coastal KwaZulu-Natal in pockets and narrow strips extending along the Indian Ocean coast. They are tall low altitude forests occurring, mainly between 20 and 60 m above mean sea level (Mucina and Rutherford 2006) in the upper reaches of estuaries and around coastal lakes.

In the Richards Bay area the swamp forest *Barringtonia racemosa - Ficus tricopoda* community which forms small dense stands along rivers, drainage channels, Lake Mzingazi and the upper portions of the estuary. This community is severy impacted by urban development in the Richards Bay and surrounding area. Some human settlements that have been developed on the borders of the small remaining stands of this community resulting in a decrease in the swamp forest area (Burger 2008). Slash and burn cultivation, which has increased the size of canopy gaps allowing invasion by other woody species has also had an impact.

Both the mangroves and the swamp forest communities, which occur within and around the Richards Bay estuary, are individually recognised as sensitive floral communities of conservation significance. Twenty-six national forest types occur in South Africa, including three azonal types that occur in small or linear locations, like riverine forests and mangrove forest. There are a variety of threats to the forests, causing loss or deterioration of forest habitats and consequently loss of biodiversity as well. Some forest types and forest patches are under greater threat than others. During the past century, the forests near the coast (such as KwaZulu-Natal Swamp Forest and Coastal Forest) have been under severe pressure due to the expansion of farmland and development. This pressure, both from legal and illegal developments, is the cause for great concern from a forest conservation perspective.

2.1.4 Fauna

Invertebrates

The estuarine invertebrates of Richards Bay are associated with a variety of habitats within the estuary *viz*:

- Supratidal beaches
- Intertidal sand and mud banks/beaches
- Mangroves and swamp forest
- Subtidal sand and mud

Supratidal beaches within the port expansion area occur on the north and south shores in the area of the port entrance and along the shorelines of the general freight terminals to the sandy peninsular that extends into the main basin from the western shore. The habitat is characterized by coarse mobile sands and the main ecological service provided by this habitat is to dissapate wave energy thereby protecting landward areas from erosion (CSIR 2005). The lack of a stable substrate together with relatively poor nutrient conditions (when compared with finer estuarine sediments) means that this particular habitat is also characterized by low diversity and abundance of fauna. Nonetheless, a specialised community of meiofauna, macrofauna and benthic diatoms are associated with this habitat and play an important role in nutrient recycling of biological materials which are transferred into this area by extreme wash events, wind or movements by animals. Possibly more significant is the importance of this habitat for resting, roosting and breeding water or shorebirds. At high tide these areas are the only areas available to these birds, many of whom would be using the intertidal zone to feed during the low tide period.

The intertidal and subtidal sand and mudbanks including those within the mangroves are usually characterized by finer sediments with raised organic content. Sand and mudflats occur along the south western edge of the port with a major area located at the outlet of the Bhizolo Canal (CSIR 2005). Intertidal and subtidal sand and mud are very important components of a functional estuarine system, supporting a diverse range of estuarine species and acting as nursery areas for marine species (Heydorn, 1972; Cyrus & Forbes, 1996). A high biodiversity characterises this habitat with many species of nematodes, polychaetes, crustaceans from numerous orders, fish (including juveniles of many species) and birds (including many species of wading birds that feed in this habitat). This habitat is essential for nutrient processing and supports a complex food web (CSIR 2005) with strong species interdependence. The importance of the 'Kabeljous Flats' has been emphasized in previous reports (CSIR 2005, Weerts *et al* 2008, CRUZ 2009 a, b, c). This area so named comprises the entire shallow south-western section of the port, adjacent to the berm between the port and the Mhlatuze Estuary (Figure 2—3). It consists of a variety of aquatic habitats, approximately 440 ha of intertidal and subtidal mud- and sandflats, fringed on the northern and western

side by mangroves (CRUZ 2009c), which serve different ecological functions and support different biotic communities (CSIR 2005). Assessment of the value of the intertidal sand and mudflats for the invertebrate fauna within the Richards Bay port, has up until now established the case for these habitats on the basis of only a few surveys (Forbes and Demetriades 2003, CRUZ unpulished data, MacKay 2006 a, b) and using the literature which exists that describes the state of knowledge surrounding the importance and value of these habitats.

Figure 2—3 Locality of the Kabeljous Flats and associated structures and habitat types in the Port of Richards Bay (from CRUZ 2009a)

To date, by far the most complete and detailed description of the macrobenthos of this area, with particular reference to the Kabeljous Flats, are contained in the reports by MacKay (2006a, 2006b), as part of a biomonitoring program for the dredging during construction of Berth 306 opposite the Kabeljous Flats at the RBCT. The macrobenthic community from these limited comprehensive sampling events indicates a diverse fauna with 61 species

recorded from bottom sediments during the 2003 surveys (Table 2—1), a total of 22 species in 2005 (CRUZ unpulished data) and 113 species from the 2006 survey (Mackay 2006 a, b data unavailable).

Table 2—1 Macrobenthic invertebrate species of the subtidal areas within the Richards Bay estuary between December 2001 and February 2003 (Forbes and Demetriades 2003).

Species list	**Dec 2001**	**Feb 2002**	**Dec 2002**	**Feb 2003**
	26 sites	21 sites	18 sites	19 sites
CNIDARIA				
Hydrozoa				
Anthozoa				
Cerianthidea				
NEMERTEA				
NEMATODA				
ANNELIDA				
Polychaeta				
Capitellidae				
Cirratulidae				
Maldanidae				
Opheliidae				
Orbinidae				
Paraonidae				
Sabellidae				
Spionidae				
Ancistrosyllis parva				
Armandia intermedia				
Axiothella sp.				
Cirriformia sp.				
Ceratonereis keiskama				
Cossura coasta				
Dendronereides zululandica				
Dendronereis arborifera				
Desdemona ornata				
Diopatra dubia				
Glycera sp.				
Malacoceros indicus				
Mesochaetopterus capensis				
Nephtys sp.				
Owenia sp.				
Pectinaria sp. ?				
Prionospio sexoculata				
Tharyx sp.				
Travisia sp.				
Hirudinea				
MOLLUSCA				
Gastropoda				
Assiminea ovata				
Cerithidea decollata				
Nassarius kraussiana				

Species list	Dec 2001	Feb 2002	Dec 2002	Feb 2003
Polynices tumidus				
Bivalvia				
Afrocardium?				
Dosinia hepatica				
Eumarcia paupercula				
Fulvia papyracea				
Solen cylindraceus				
Theora lata				
Unid. Cardiid				
Scaphopoda				
CRUSTACEA				
Copepoda				
Harpacticoida				
Ostracoda				
Amphipoda				
Corophium triaenonyx				
Grandidierella sp.				
Melita zeylanica				
Cumacea				
Mysidacea				
Gastrosaccus brevifissura				
Isopoda				
Cirolana luciae				
Leptanthura laevigata				
Tanaidacea				
Apseudes digitalis				
Penaeidea				
Metapenaeus monoceros				
Penaeus indicus				
Caridea				
Alpheidae				
Thalassinidea				
Callianassa kraussi				
Brachyura				
Hymenosoma orbiculare				
Paratylodiplax blephariskios				
SIPUNCULIDA				
Total taxa	60	61	60	59

Migrant species are by definition far more mobile, typically larger, and dominated by a variety of fish, but include penaeid prawns and the mangrove crab *Scylla serrata*. The common characteristic of both the migrant fish and these larger invertebrates is that they breed at sea where the early stages of development occur, and then migrate into the estuaries where they grow before returning to the adult marine environment. These migrations are obligatory components of the life cycle and the absence or lack of access to suitable estuarine nursery grounds disrupts the life cycle. The drying up of the St Lucia Lake

system and the development of Richards Bay, which were the prime nursery grounds for both prawns and migrant fish in north-central KZN, has resulted in the collapse of the shallow water prawn fishery on the Thukela Bank and strongly reduced recruitment into the marine populations of Natal stumpnose (Mann & Pradervand 2007). The latter situation strongly argues that other species with similar life history strategies will also have been affected. While the Richards Bay port entrance does not present any obstacle to migrating animals, the significance of the port as a nursery ground will depend on the availability of suitable habitat such as the mangroves and intertidal sand and mudbanks.

Weerts *et al.* (2003) reported 30 macrocrustacean taxa during their study, which included muddy areas and sandy areas, consisting of 15 prawn species, 12 crab species, 2 hermit crab species and 1 mantis shrimp.

Table 2—2 presents a list of all the prawns and crab species reported by these authors, which comprise 34 species, viz. 14 prawns, one sand prawn and 20 crab species.

Table 2—2 Macrocrustacean taxa recorded from selected habitat types in the Kabeljous Flats and in the Bhizolo Canal (modified from Weerts *et al.* 2003, Weerts and Newman 2009). Data present densities (number per 100m2).

Species	Bhizolo Canal	Mudflat	Sandflat	Mangrove
Prawns Decapoda Natantia				
Metapetasma africana	0.01			
Fenneropenaeus indicus	0.06	0.04	0.01	
Marsupenaeus japonicus	0.13	0.03	0.22	x
Metapenaeus monoceros	1.66	0.49	0.04	x
Penaeus monodon	0.06	0.02	x	
Macrobrachium sp	0.13	0.01		
Melicertus canaliculatus	0.01	x		
Palaemon capensis	0.02			
Palaemon debilis	0.01			
Palaemon peringueyi	5.28	0.02		
Acetes erythraeus	19.97	1.46	0.06	
Alpheus crassimanus	0.01			
Alpheus hippothoe	0.06			
Pontophilus megalocheir	0.01	0.01		
Mudprawns [sandprawn] Decapoda				
Callianassa kraussi	x			
Crabs Decapoda Brachyura				
Chiromantes eulimene	0.01	x	x	x
Clibanarius longitarsus	x	x	x	
Dotilla fenestrata	x			

Species	Bhizolo Canal	Mudflat	Sandflat	Mangrove
Hymenosoma orbiculare	0.04			
Macrophthalmus depressus	x	x		
Macrophthalmus grandidieri	x	x		
Metopograpsus oceanicus	x	x		
Metopograpsus thukuhar	x			
Neosarmatium meinerti	x	x		
Ocypode ryderi	x			
Paratylidiplax blephariskios	0.03			
Perisesarma guttatum	x	x		
Portunus pelagicus	0.01	0.02		
Scylla serrata	0.13	0.05	x	x
Sesarma catenata	0.01	x	x	
Thalamita sp	0.01			
Uca annulipes	x	x	x	
Uca chlorophthalmus	x	x		
Uca urvillei	x	x		
Uca vocans	x			
Total	**17**	**22**	**22**	**11**

CRUZ 2009b reports that Weerts and Newman (2009) compiled a list of macrocrustacean fauna that occurred in the three main habitat types in the Kabeljous Flats, including mangroves. On the basis of estuary size and from prawn catch records, St Lucia and Richards Bay are by far the major providers of prawn nursery grounds in KZN (Forbes and Demetriades 2005). These authors noted that it can be anticipated that port developments in Richards Bay in the coming years will result in progressive loss of the present prawn habitat in the mangrove lined Bhizolo and Manzamnyama Canals. This will certainly impact on the Tugela Bank fishery, particularly during periods when St Lucia becomes inaccessible due to extended mouth closure.

Prawns comprise very important prey items for a variety of fish species. The high abundance of *Acetes erythraeus* in the Bhizolo and Manzamnyama Canals throughout the year suggests that the species plays a key role as a prey species for benthic feeding juvenile fishes that utilize the port as a nursery area. This large prawn community in the Bhizolo and Manzamnyama Canals is thus expected to contribute significantly towards the food budget of the large fish population in the port (Weerts *et al.* 2003).

Within the Richards Bay estuary the habitats that support this diverse invertebrate community and their large area makes them highly worthy of conservation. In particular, the Kabeljous Flats in combination with the lower portions of the Bhizola and Manzimyama canals perform an important nursery function for a range of invertebrate and fish taxa that

are entirely dependent on suitable estuarine habitat in order to successfully complete their life cycle, including some that are of recreational and commercial importance. The value of shallow subtidal areas in providing shelter and feeding grounds for juvenile prawns and fish cannot be overemphasised (Forbes & Demetriades, 2003). In addition, its ecological functioning as a nursery area links it to the adjacent deep water areas and external marine environment. The provincial importance of the nursery functions of the Richard Bay estuarine habitats is substantial and important in maintaining offshore stocks of fish and prawns, particularly in view of the continued failure of the nursery function of the St Lucia estuarine system.

Fish

As indicated above, there are fish species which are either totally or partially dependent on estuaries during their juvenile phases (Whitfield 1998); there are also species which are permanent estuarine residents, generally small and relatively poor swimmers, accidental wanderers from the open sea, and a small number of species which use estuaries as conduits for movement between the sea and the tributary rivers. In many cases on the east coast, riverine inputs contribute fundamentally to the locating of estuaries by immigrating juvenile fish and also to the carrying capacity of these environments by the introduction of plant nutrients and organic matter. Disintegrating organic material derived from decaying plant matter, *e.g.* mangrove leaves or reeds, generated in the estuary also contribute ultimately to the energy supplies and carrying capacity in the system.

The above points are all testament to the reality that if Richards Bay is going to maintain any biological significance as an estuary in the KZN region, which is possible, it is critical to realise that this will depend on the presence of as broad a mosaic of habitats as possible plus the maintenance of adequate water quality. The latter point is particularly pertinent in the light of major fish kills in Durban Bay resulting from sewage spills (Demetriades & Forbes 2008), the apparent disappearance of the mangrove whelk *Terebralia palustris,* declines in the climbing whelk *Cerithidea decollata* and also that wader populations in Durban Bay have been on a steady trajectory of decline since the mid 1960s without any major infrastructural extension or incursions into the intertidal banks since that time (Allan, Sinclair & Rossouw 1999).

Fish surveys in Richards Bay since 1996 have emphasised both the overall significance of the

estuary and particular habitats within the system. Cyrus and Forbes (1996) sampled the sheltered mangrove areas on the south-western edge of the Kabeljous flats and although detailed information on species composition was not provided, they recorded 53 species.

Weerts (2002) reported juveniles of 64 fish species in Richards Bay estuary, of which 41 were recorded in subtidal mudflats, 32 on subtidal sandflats, 24 in mangroves and 26 in muddy substrate in the Bhizolo Canal. Nhleko and Cyrus (2008), in a comparative study on the species richness of KwaZulu-Natal estuaries, reported a total of 80 species in the Bay, the 5th highest among the 72 estuaries in the province, after St Lucia, Kosi Bay, Mlalazi Estuary and Mhlathuze Estuary. Weerts and Newman (2009) reported on the fish species known to utilize specific aquatic habitats in Richards Bay. They listed 49 species, of which 45 are known to occur in the sandflat, 44 in the mudflats and 27 in the mangroves.

As might be expected, the counts are variable but the consistently high numbers demonstrate the ongoing significance of the Bay and particularly the intertidal and shallow subtidal areas illustrate the importance of Richards Bay as an important fish nursery habitat for estuarine dependent species.

Table 2—3 Fish species recorded within Richards Bay during 1991 (Cyrus & Forbes 1996)

Family and Scientific Name	Common name
Ambassidae	
Ambassis gymnocephalus	Bald glassy
Ambassis natalensis	Slender glassy
Ambassis productus	Longspiune glassy
Belonidae	
Tylosurus crocodilus	Crocodile needlefish
Carangidae	
Caranx ferdua	Blue kingfish
Caranx melampus	Bluefin kingfish
Caranx sem	Blacktip kingfish
Caranx sexfasciatus	Bigeye kingfish
Caranx sp.	Kingfish
Scomberoides lysan	Double spotted queenfish
Scomberoides tol	Needle scaled queenfish
Scomberoides sp.	Queenfish
Trachinotus sp.	Pompano
Chanidae	
Chanos chanos	Milkfish
Clupeidae	
Sardinella sp.	Sardine

Family and Scientific Name	Common name
Gilchristella aestuarius	Estuarine roundherring
Hilsa kelee	Kelee shad
Dasyatidae	
Dasyatis sp.	Leopard ray
Drepanidae	
Drepane punctatus	Concertina fish
Engraulidae	
Thryssa vitrirostris	Orangemouth glassnose
Gerreidae	
Gerres acinaces	Smallscale pursemouth
Gerres filamentous	Threadfin pursemouth
Gerres rappi	Evenfin pursemouth
Haemulidae	
Pomadasys commersonnii	Spotted grunter
Leiognathidae	
Leiognathus equula	Slimy
Mugilidae	
Liza alata	Diamond mullet
Liza dumerilii	Groovy mullet
Liza macrolepis	Large-scale mullet
Liza subviridis	Greenback mullet
Mugil cephalus	Flathead mullet
Mugil sp.	Mullet
Myxus capensis	Freshwater mullet
Valamugil buchanani	Bluetail mullet
Valamugil cunnesius	Longarm mullet
Valamugil robustus	Robust mullet
Valamugil seheli	Bluespot mullet

Table 2—4 Checklist of species captured in Richards Bay estuary during a study in 2002 and their classification into categories based on estuarine association (e =estuarine, edm =estuarine-dependent marine, m =marine)

Family	Species	Estuarine association	RBH
Elopidae	*Elops machnata*	edm	X
Megalopidae	*Megalops cyprinoides*	edm	X
Clupeidae	*Gilchristella aestuaria*	e	
	Herklotsichthys quadrimaculatus		
	Hilsa kelee	m	X
	Dussumierinnae: Tribe Dussumierinni	m	
	Dussumierinnae: Tribe Spratelloidini sp. 1	m	X
	Dussumierinnae: Tribe Spratelloidini sp. 2	m	X
Engraulidae	*Stolephorus* spp.	m	X
	Thryssa spp.	edm	X
Chanidae	*Chanos chanos*	m	X

Family	Species	Estuarine association	RBH
Atherinidae	*Atherinomorus* /acunosus	e	X
Hemiramphidae	*Hypomamphus capensis*	e	X
Syngnathidae	*Hippichthys cyanospi/os*	e	
	Hippichthys spicifer	e	X
Solenostomidae	*Solenostomus* sp. 1	m	
Scorpaenidae	*Pterois mIles*	m	
	Sebastapistes strongia	m	
Platycephalidae	*Platycephalus indicus*	m	X
Triglidae	Triglidae sp. 1	m	
Ambassidae	*Ambassis* spp.	edm	X
Serranidae	*Epinephelus malabaricus*	m	
	Epinephelus sp. 1	m	
Teraponidae	*Pelates quadrilineatus*	m	
	Terapon jarbua	edm	X
Apogonidae	*Foa brachygramma*	m	
Haemulidae	*Pomadasys commersonnii*	edm	X
	Pomadasys kaakan	edm	X
	Pomadasys olivaceum	m	X
Lutjanidae	*Lutjanus fulviflamma*	m	
	Lutjanus sp.1	m	X
	Lutjanus sp. 2	m	X
Sparidae	*Acanthopagrus berda*	edm	X
	Crenidens crenidens	m	X
	Dip/odus sargus capensis	m	X
	Rhabdosargus globiceps	m	X
	Rhabdosargus holubi	edm	X
	Rhabdosargus sarba	edm	X
	Rhabdosargus thorpei	edm	X
Sparidae	Sparidae sp. 1	m	X
Lethrinidae	*Lethrinus* spp.	m	
Monodactylidae	*Monodactyfus argenteus*	edm	
	Monodactyfus falciformis	edm	
Gerreidae	Gerres spp.	edm	X
Mullidae	*Upeneus vittatus*	m	
Sillaginidae	*Sillago sihama*	m	X
Sciaenidae	Sciaenidae sp. 1	m	
leiognathidae	*Leiognathus equula*	m	X
Carangidae	Caranx spp.	edm	X
	Scomberoides sp.	edm	X
Pomacentridae	Pomacentridae sp. 1	m	
	Pomacentridae sp. 2	m	
Labridae	*Halichoeres* sp.	m	
	Labridae spp.	m	
Scaridae	Scaridae spp.	m	
Mugilidae	Mugilidae spp.	edm	X
Sphyraenidae	*Sphyraena barracuda*	edm	

Family	Species	Estuarine association	RBH
	Sphyraena jello	m	
Blenniidae	*Omobranchus* sp. 1	m	X
	Blenniidae sp. 1	m	
	Blenniidae sp. 2	m	X
Clinidae	Clinidae sp. 1	m	
Callionymidae	*Callionymus marleyi*	m	X
Gobiidae	*Acentrogobius audax*	e	X
	Bathygobius laddi	e	X
	Caffrogobius natalensis	e	
	Croilia mossambica	e	X
	Favonigobius melanobranchus	e	X
	Favonigobius reichei	e	X
	Glossogobius biocellatus	e	X
	Glossogobius callidus	e	X
	Mugilogobius inhacae	e	X
	Oligolepis acutipennis	e	X
	Oligolepis keiensis	e	X
	Oxyurichthys spp.	e	X
	Pandaka silvana	e	X
	Periophthalmus koelreuteri africanus	e	X
	Redigobius balteatops	e	X
	Silhouettea sibayi	e	X
	Taenioides jacksoni	e	X
	Gobiidae sp. 1	e	X
Eleotridae	*Eleotris* spp.	e	X
Kraemeriidae	*Kraemeria samoensis*	m	X
Siganidae	*Siganus sutor*	m	
Bothidae	*Pseudorhombus arsius*	m	
Cynoglossidae	*Paraplagusia bilineata*	m	X
Soleidae	*Solea bleekeri*	edm	X
Monacanthidae	*Stephanolepis auratus*	m	
Tetraodontidae	*Amblyrhynchotes honckenii*	m	X
	Arothron immaculatus	m	X
	Arothron meleagris	m	X
	Chelonodon laticeps	m	X
	Torquigener hypselogeneion m	m	X
	Tetraodontidae sp. 1	m	X

Birds

A recent comprehensive assessment of the aquatic avifauna of Richards Bay was done by Allan (2009). The most important and potentially sensitive birds to port expansion plans, are the migratory waders which move south from Europe and Asia during the boreal winter and for whom intertidal sand and mudflats are critical feeding habitat. These species are critically

dependent on either shallow wetlands or sheltered intertidal sand and mudbanks. The latter habitats in the South African context, particularly on our east coast, are restricted to open, and therefore tidal, estuarine environments. In the KZN context such habitats are found in the Kosi lake system, to some degree at St Lucia although most of that system is non-tidal and its significance to waders depends on the water level, Richards Bay, the Mhlathuze estuary and Durban Bay. The Kosi system is generally oligotrophic with a relatively low carrying capacity and wader counts at Durban Bay (Allan, Sinclair & Rossouw 1999) since the last major port expansion in the 1960s have shown precipitous declines. The combination of Richards Bay and the Mhlathuze estuary therefore represents a major area of significance on the KZN coast as far as migrant waders are concerned. The significance in turn lies in the combination of suitable intertidal sand and mudbanks with adequate populations of associated, mainly invertebrate prey species, as well as suitable undisturbed areas for roosting during high tide periods. There are still substantial areas in the Bay that provide this combination, and their loss stands to have a significant effect on the already stressed migrant wader populations.

Mangroves in South Africa are used opportunistically by a variety of bird species ranging from sunbirds and white eyes to predators such as black sparrowhawk but there are no species specifically associated with mangroves as indicated in other Indo-Pacific regions where mangroves cover much larger areas. One possible exception is the mangrove kingfisher, a winter migrant to the east coast which is known to occur in estuaries with mangroves.

Turpie (1995) analysed the water bird data from 42 estuarine systems as a means of prioritizing South African estuaries for conservation importance. Richards Bay estuary was ranked as 3rd on the Abundance rating, 3rd rd on the Conservation Value Index, 2nd on the Endemism Index and 1st on the Population Size index. In a follow-up Turpie *et al.* (2002), in a national conservation status and ecological importance study of all estuaries in South Africa, concluded that Richards Bay ranked 3rd nationally in terms of its importance to waterbird populations (after the St Lucia and Berg River systems). Of the 135 waterbird species occurring in South African wetlands, 109 have been regularly recorded at Richards Bay (Allan 2009). This diversity of waterbird species has been reported to be unparalleled in South Africa. Of these 109 regularly recorded waterbird species at Richards Bay, 82 are resident or show only local/nomadic movements, while 27 are long-distance Palaearctic migrants. An additional 29 rare vagrant waterbird species have also been recorded at

Richards Bay. This spectacular diversity relates to the wide diversity of wetland habitats present at Richards Bay.

During a one-day survey of the sand-spit during spring tide, Allan (2009) recorded 1,230 birds representing 24 species. These were dominated by curlew sandpipers, grey plovers, Terek sandpipers, Great Sand plovers, common whimbrels and eight species of terns. This area contained about 20% of the waterbirds that regularly visit Richards Bay. Many of the species found roosting on the sand spit feature in species lists associated with the Ramsar and Bonn Conventions, IBA Programme and Red Data book (Allan 2009).

Table 2—5 Bird species recorded in Richards Bay. A consolidated list of Co-ordinated Waterbird Count (CWAC) since 1992.

Common name	Taxonomic name	
Grebe, Little	*Tachybaptus ruficollis*	82
Pelican, Pink-backed	*Pelecanus rufescens*	35
Pelican, Great White	*Pelecanus onocrotalus*	140
Cormorant, White-breasted	*Phalacrocorax carbo*	40
Cormorant, Cape	*Phalacrocorax capensis*	7
Cormorant, Reed	*Phalacrocorax africanus*	342
Darter, African	*Anhinga rufa*	45
Heron, Grey	*Ardea cinerea*	40
Heron, Black-headed	*Ardea melanocephala*	7
Heron, Goliath	*Ardea goliath*	6
Heron, Purple	*Ardea purpurea*	29
Egret, Great	*Egretta alba*	18
Egret, Little	*Egretta garzetta*	64
Egret, Yellow-billed	*Egretta intermedia*	3
Egret, Cattle	*Bubulcus ibis*	54
Heron, Squacco	*Ardeola ralloides*	4
Heron, Green-backed	*Butorides striata*	6
Hamerkop, Hamerkop	*Scopus umbretta*	4
Openbill, African	*Anastomus lamelligerus*	12
Stork, Yellow-billed	*Mycteria ibis*	15
Stork, Woolly-necked	*Ciconia episcopus*	183
Ibis, African Sacred	*Threskiornis aethiopicus*	43
Ibis, Glossy	*Plegadis falcinellus*	16
Ibis, Hadeda	*Bostrychia hagedash*	43
Spoonbill, African	*Platalea alba*	61
Flamingo, Greater	*Phoenicopterus ruber*	97
Flamingo, Lesser	*Phoenicopterus minor*	1
Goose, Spur-winged	*Plectropterus gambensis*	14

Common name	**Taxonomic name**	
Goose, Egyptian	*Alopochen aegyptiacus*	12
Duck, Comb	*Sarkidiornis melanotos*	4
Pygmy-Goose, African	*Nettapus auritus*	26
Shoveler, Cape	*Anas smithii*	6
Duck, Yellow-billed	*Anas undulata*	326
Teal, Red-billed	*Anas erythrorhyncha*	228
Teal, Cape	*Anas capensis*	11
Teal, Hottentot	*Anas hottentota*	110
Duck, White-faced	*Dendrocygna viduata*	157
Pochard, Southern	*Netta erythrophthalma*	30
Duck, White-backed	*Thalassornis leuconotus*	40
Vulture, Palm-nut	*Gypohierax angolensis*	2
Fish-Eagle, African	*Haliaeetus vocifer*	9
Marsh-Harrier, African	*Circus ranivorus*	6
Osprey, Osprey	*Pandion haliaetus*	6
Rail, African	*Rallus caerulescens*	2
Crake, Black	*Amaurornis flavirostris*	16
Flufftail, Red-chested	*Sarothrura rufa*	1
Swamphen, African Purple	*Porphyrio madagascariensis*	30
Moorhen, Common	*Gallinula chloropus*	42
Coot, Red-knobbed	*Fulica cristata*	32
Crane, Grey Crowned	*Balearica regulorum*	4
Jacana, African	*Actophilornis africanus*	30
Jacana, Lesser	*Microparra capensis*	2
Turnstone, Ruddy	*Arenaria interpres*	8
Plover, Common Ringed	*Charadrius hiaticula*	357
Plover, Lesser Sand	*Charadrius mongolus*	1
Plover, White-fronted	*Charadrius marginatus*	221
Plover, Chestnut-banded	*Charadrius pallidus*	7
Plover, Kittlitz's	*Charadrius pecuarius*	12
Plover, Three-banded	*Charadrius tricollaris*	6
Plover, Greater Sand	*Charadrius leschenaultii*	65
Plover, Grey	*Pluvialis squatarola*	278
Lapwing, Blacksmith	*Vanellus armatus*	8
Sandpiper, Curlew	*Calidris ferruginea*	717
Stint, Little	*Calidris minuta*	677
Knot, Red	*Calidris canutus*	27
Sanderling, Sanderling	*Calidris alba*	195
Ruff, Ruff	*Philomachus pugnax*	64
Sandpiper, Terek	*Xenus cinereus*	410
Sandpiper, Common	*Actitis hypoleucos*	11
Redshank, Common	*Tringa totanus*	1

Common name	Taxonomic name	
Sandpiper, Marsh	*Tringa stagnatilis*	33
Greenshank, Common	*Tringa nebularia*	118
Sandpiper, Wood	*Tringa glareola*	57
Godwit, Bar-tailed	*Limosa lapponica*	10
Curlew, Eurasian	*Numenius arquata*	15
Whimbrel, Common	*Numenius phaeopus*	356
Stilt, Black-winged	*Himantopus himantopus*	29
Plover, Crab	*Dromas ardeola*	2
Thick-knee, Water	*Burhinus vermiculatus*	8
Pratincole, Collared	*Glareola pratincola*	13
Skua, Subantarctic	*Catharacta antarctica*	1
Gull, Kelp	*Larus dominicanus*	24
Gull, Grey-headed	*Larus cirrocephalus*	210
Tern, Caspian	*Sterna caspia*	51
Tern, Common	*Sterna hirundo*	13000
Tern, Sandwich	*Sterna sandvicensis*	141
Tern, Lesser Crested	*Sterna bengalensis*	80
Tern, Swift	*Sterna bergii*	115
Tern, Little	*Sterna albifrons*	700
Tern, White-winged	*Chlidonias leucopterus*	50
Tern, Whiskered	*Chlidonias hybrida*	200
Kingfisher, Pied	*Ceryle rudis*	29
Kingfisher, Giant	*Megaceryle maximus*	6
Kingfisher, Malachite	*Alcedo cristata*	13
Kingfisher, Mangrove	*Halcyon senegaloides*	3
Martin, Brown-throated	*Riparia paludicola*	1
Wagtail, African Pied	*Motacilla aguimp*	8
Wagtail, Cape	*Motacilla capensis*	23
Gallinule, American Purple	*Porphyrio martinicus*	2
Sandpiper, Broad-billed	*Limicola falcinellus*	3
Wader, Unidentified	N/A	400
Tern, Unidentified	N/A	34

Overall assessment of current status of estuarine habitat

As mentioned above, there is presently no indication of seagrass beds, *Nanozostera sp.,* in the Bay area. The precise reason(s) for this disappearance do not appear to have been documented but one or a combination of direct loss through dredging, sediment re-deposition or increased turbidity resulting from dredging activity would have been quite adequate to exclude this plant. Loss of the plant, also constitutes the loss of habitat

complexity and would have removed the physical habitat and cover provided by the leaf fronds.

Mangroves tend to colonise muddy areas because the processes which result in localised mud deposition are the same as those that control the dispersal and deposition of the propagules. Once established, the trunks and particularly the pneumatophores of the pioneer white mangrove *Avicennia marina* further slow water movement and accelerate fine sediment deposition. If however water movements or wave action change through for example deepening of adjoining channels or bow waves from tugs such that sediment dynamics are affected it is quite possible for erosion to result in tree collapse as has occurred in the Echwebeni Natural Heritage Site at the northern end of the RBCT.

The overall impression of the remaining estuarine habitats within the Bay is that they are surviving, albeit in a reduced form. There are still significant mangrove areas with losses in the west being to some degree compensated by colonisation along the Bay side of the berm and in the south-east corner. There are still apparently functional inter-tidal areas, a situation which has probably been enhanced by the enlarged port mouth and the consequently increased tidal prism. The deeper, generally muddy dredged channels (CSIR 2013a,b) would have provided a different habitat from that which existed in the pre-port situation and although this should not be seen as an enhancement of the original estuarine situation, the presence of benthic organisms in these areas is indicative of the generally acceptable levels of water quality (CSIR 2011, 2013b).

The estuary has a number of different estuarine habitats which are likely to be affected by port expansion proposals (Figure 2—4). These include:

a) Intertidal sand and mud flats*
b) Shallow subtidal sand and mud*
c) Reedbeds,
d) Swamp forest and
e) Mangrove*

* the Kabeljous Flats comprises all three of these environments within its area of 440 ha.

In the most comprehensive and up to data assessment of the ecological importance of South African estuaries, Turpie *et al.* (2002) ranked Richards Bay estuary 26th out of 250 estuaries in

the country for conservation importance. Ecological importance in this assessment was defined as *"an expression of the importance of a particular estuary to the maintenance of ecological diversity and functioning on local and regional scales."* The ecological importance of an estuary was based on the following criteria: size, link with freshwater and marine environments, estuary type rarity, habitat diversity and biodiversity importance (in terms of species richness, species rarity or endemism; and abundance). In a more regional context, when Richards Bay estuary is compared to the 22 Zululand estuaries in KwaZulu-Natal north of Durban, the system is ranked 6th th for overall conservation importance, 2nd for zonal rarity, 8th for biodiversity and one of only four estuaries with a score of 100% for estuarine size.

The most recent National Biodiversity Assessment (SANBI 2011) found that the Richards Bay system had experienced a significantly high modification to stream flow (freshwater inputs to the estuary), medium levels of pollution and a significantly high level of habitat loss and habitat modification. This was considered to put the system into a Present Ecological Category of D (Largely Modified) on a scale of A – F (where A is Unmodified, Natural and F is Extremely Degraded). The Present Ecological Status of an estuary is a measure of its present condition or 'ecological status', and should is defined on the basis of Estuarine Health.

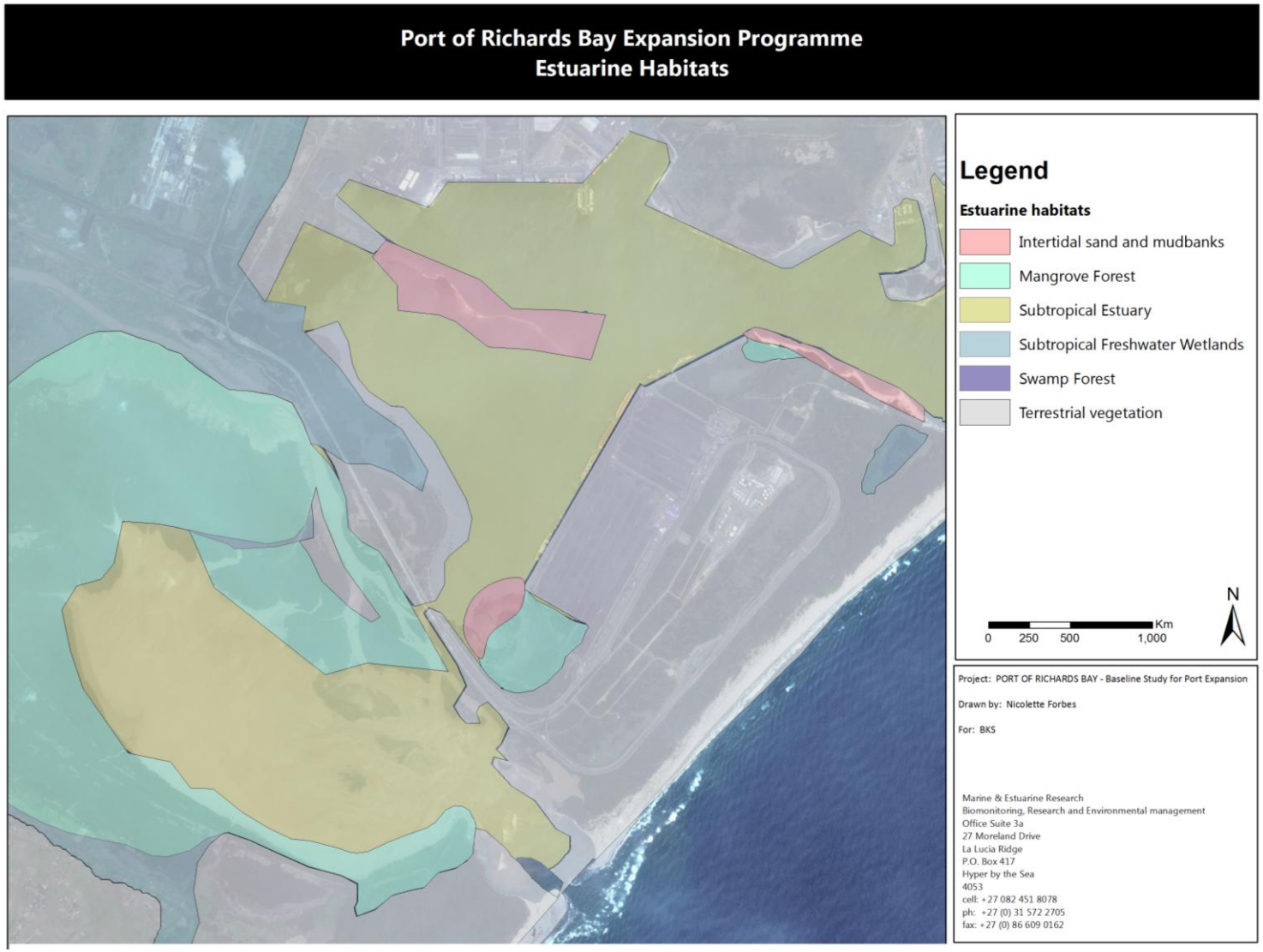

Figure 2—4 Major estuarine habitats identified within the delineated boundary of the Richards Bay Estuary

2.2 Wetlands

2.2.1 Historical review

Ellery, Cyrus & Vivier (2009) in their assessment of the impact of planned port extensions on wetlands recognized nine different types but emphasised the following three, *viz*. *Phragmites* Marsh (~310 ha) hydromorphic Grassland (270 ha), and Papyrus (*Cyperus papyrus)* Swamp (65 ha). Of these the papyrus swamp was seen as the most problematic as the Richards Bay examples are the most southerly in the country, would disappear totally if existing expansion plans were implemented and there were no known examples of papyrus swamp restoration or re-creation.

A seemingly major step forward was taken in 2010 when a draft Environmental Management Framework (EMF) for the Richards Bay Port Expansion Area and the Industrial Development Zone (IDZ) (Thornhill & van Vuuren 2010) was produced. This subsequently appeared under the slightly different title as an Environmental Management Framework *Report* for the Richards Bay Port Expansion Area and the Industrial Development Zone (DAERD 2011).

All the environmentally oriented reports emphasise the environmental significance of the Richards Bay wetland system on both a local and regional scale and also that the proposed developments, in virtually whatever form, will have or have had major environmental impacts. This assessment is taken further in the EMF as shown by the following quote. "*The first impression of the baseline situation is the inherent environmental sensitivity of the study area due to its position in the landscape. The area falls predominantly within a floodplain consisting of interconnected coastal lakes. This system has been exposed to large-scale transformation. It has significantly altered ecosystems, landscapes and their associated processes, and compromised species diversity patterns. Land-based activities in the study area are also compromising marine and coastal systems. Existing development pressures and trends are worsening the situation. In the face of continued transformation and human use of the areas resources, as well as global change, there is little doubt that Richards Bay will in the very near future be recognised as an area that has pushed integrated systems over thresholds of sustainability. This potential scenario will have to be avoided at all cost*".

Wetland Status

The available report on wetlands (Ellery, Cyrus & Vivier 2009) focuses on the existing papyrus

swamps and *Phragmites* reed marshes, the health of these systems and the possibilities of mitigation and re-establishment of these environments should they be lost during port development. The report emphasizes the significance of these wetlands to be at a national level despite modifications. The report further indicates that the papyrus swamp to the immediate west of the gypsum dam and that at Lake Nsezi are in relatively good health being only "moderately modified" while the *Phragmites* marsh is "heavily impacted", there is no indication of wetland areas that have been lost through agricultural, road or forestry developments in the report. The gypsum spoil pile was however generated in a wetland as shown by the historic bill board off the John Ross highway which once proclaimed that marshland was being reclaimed using waste gypsum. Covering an area of some 122 ha this would certainly have resulted in some wetland loss.

The National Freshwater Ecosystem Priority Areas (NFEPA) project which formed part of the South African National Biodiversity Assessment (SANBI 2011) identified freshwater ecosystem priority areas to meet national biodiversity goals, and developed methods for enabling effective implementation of the protection of these areas. The priority wetlands were identified using systemative biodiversity planning tools and the analysis was conducted at the landscape scale. This report notes that wetlands in South Africa's landscape today (those that have not been drained or concreted) make up only 2.4% of the country's area. This small area represents high-value ecological infrastructure that provides critical ecosystem services such as water purification and flood regulation. The wetlands within and around the Port study area are indicated in Figure 2—5. Six different types of wetlands have been identified within the project area (SANBI 2011), namely

- Channeled valley bottom
- Flat
- Steep
- Unchannelled valley bottom
- Valley head seep and
- Estuarine

The threat status assigned to these wetlands indicates that all are considered moderately to highly threatened as a result of the habitat modification, current land use activities and development proposals in this area. In particular the papyrus swamps are referred to as

critical ecological assests which are hydrological linked to the other wetland resoures. These critical ecological assets along with their corriodor linkages are listed as requiring protection and managent within the EMF Report and irreplaceable. Any significant threat to the sustainability of these areas requires "exceptional remedial action" and the likelihood of success of any offset proposals would need to be carefully considered. The national significance and irreplaceability of this habitat may render any proposals which cannot avoid or remove the threat from these swamps as "fatally flawed"

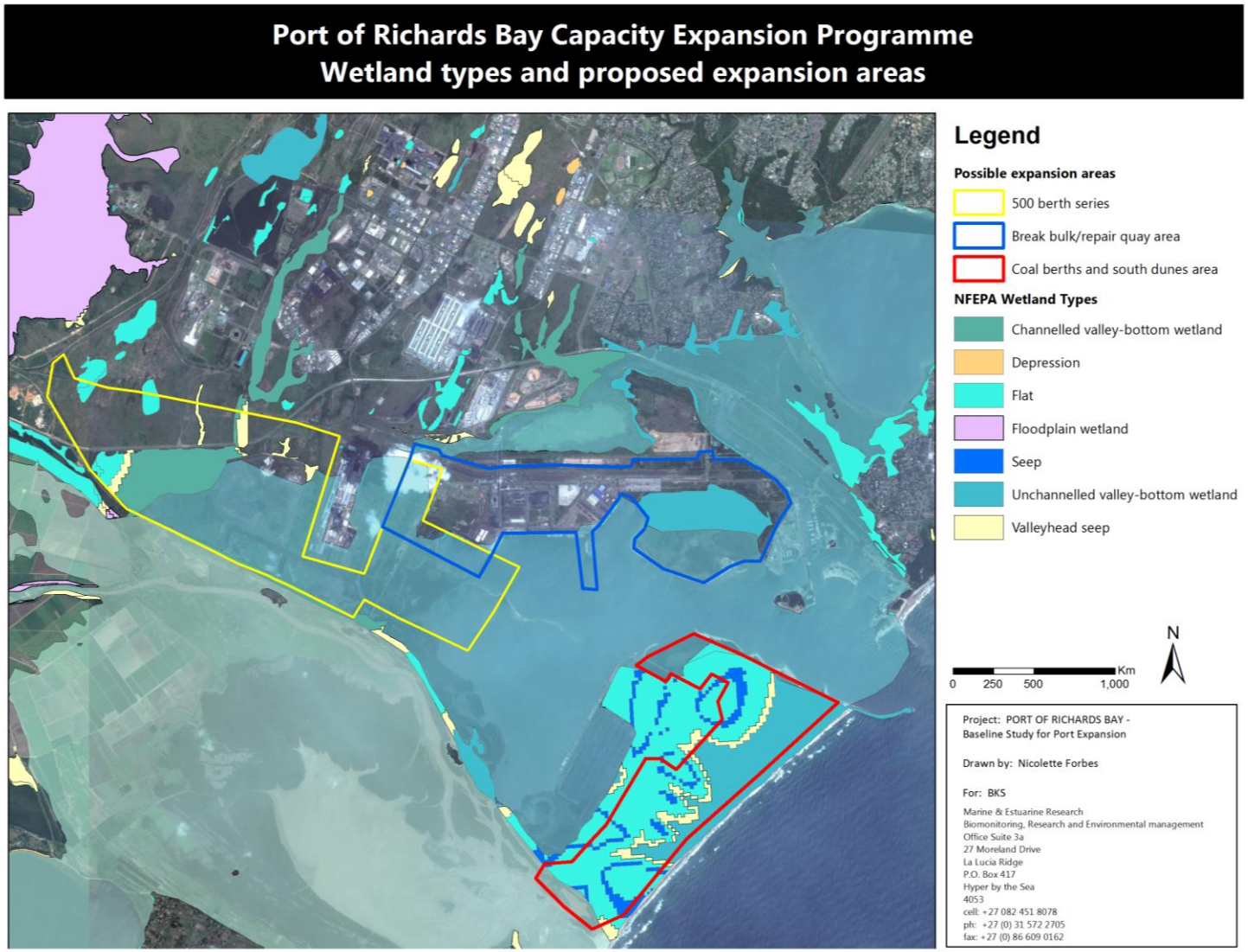

Figure 2—5 Major wetland habitats identified within the study area (SANBI 2011)

Thulazihleka Pan

This component of the wetlands of the Richards Bay area deserves a special mention given previous attention within other documentation and general concerns about its status. This pan is reported as being formed artificially by the deposition of dredged spoil during port construction in 1976. Elevated conveyor belts from the nearby fertilizer factory (FOSKOR) transport material over the western end of the pan. It is exposed to direct and indirect groundwater pollution resulting in a highly eutrophic state. Despite these conditions it has gained a reputation as a prime bird and bird watching habitat and is included in the national CWAC (Co-ordinated Water Bird Counts) activities. Table 2—6 lists the birds species and abundance counts from Thulazihleka Pan over a 17 year period. During this time a total number of 87 species, made up of approximately 9000 individual birds, has been recorded.

The pan has had the advantage (from a birdwatching point of view) of not being within the secure port infrastructure area and therefore generally accessible to the public. A hide has been constructed and has been used for many years by the bird watching fraternity. The projected land use and present pressures on this prime development area are likely to significantly impact or completely remove this particularly wetland. Proponents of developments see the pan as irrevocably degrading and consequently the area would be best used for industrial development. Others believe the pan has resilience and should be managed and maintained for its long term environmental benefits.

Table 2—6 Birds recorded at Thulazihleka Pan. consolidated list of Co-ordinated Waterbird Count (CWAC) since 1993 - 2010.

Common name	Taxonomic name	Max #
Grebe, Great Crested	Podiceps cristatus	68
Grebe, Little	Tachybaptus ruficollis	400
Tropicbird, White-tailed	Phaethon lepturus	2
Pelican, Pink-backed	Pelecanus rufescens	27
Pelican, Great White	Pelecanus onocrotalus	730
Cormorant, White-breasted	Phalacrocorax carbo	158
Cormorant, Reed	Phalacrocorax africanus	426
Darter, African	Anhinga rufa	83
Heron, Grey	Ardea cinerea	29
Heron, Black-headed	Ardea melanocephala	19
Heron, Goliath	Ardea goliath	8
Heron, Purple	Ardea purpurea	27
Egret, Great	Egretta alba	30
Egret, Little	Egretta garzetta	42
Egret, Yellow-billed	Egretta intermedia	11

Common name	Taxonomic name	Max #
Egret, Cattle	Bubulcus ibis	38
Heron, Squacco	Ardeola ralloides	53
Heron, Green-backed	Butorides striata	1
Heron, Black	Egretta ardesiaca	2
Bittern, Little	Ixobrychus minutus	4
Night-Heron, Black-crowned	Nycticorax nycticorax	10
Hamerkop, Hamerkop	Scopus umbretta	1
Openbill, African	Anastomus lamelligerus	5
Stork, Yellow-billed	Mycteria ibis	6
Stork, Woolly-necked	Ciconia episcopus	5
Ibis, African Sacred	Threskiornis aethiopicus	28
Ibis, Glossy	Plegadis falcinellus	58
Ibis, Hadeda	Bostrychia hagedash	17
Spoonbill, African	Platalea alba	136
Flamingo, Greater	Phoenicopterus ruber	134
Flamingo, Lesser	Phoenicopterus minor	170
Goose, Spur-winged	Plectropterus gambensis	44
Goose, Egyptian	Alopochen aegyptiacus	20
Pygmy-Goose, African	Nettapus auritus	115
Shoveler, Cape	Anas smithii	19
Duck, Yellow-billed	Anas undulata	168
Teal, Red-billed	Anas erythrorhyncha	58
Teal, Cape	Anas capensis	6
Teal, Hottentot	Anas hottentota	166
Duck, White-faced	Dendrocygna viduata	68
Duck, Fulvous	Dendrocygna bicolor	30
Pochard, Southern	Netta erythrophthalma	66
Duck, White-backed	Thalassornis leuconotus	359
Fish-Eagle, African	Haliaeetus vocifer	6
Marsh-Harrier, African	Circus ranivorus	3
Osprey, Osprey	Pandion haliaetus	1
Rail, African	Rallus caerulescens	15
Crake, Baillon's	Porzana pusilla	2
Crake, Black	Amaurornis flavirostris	76
Flufftail, Red-chested	Sarothrura rufa	1
Swamphen, African Purple	Porphyrio madagascariensis	41
Moorhen, Common	Gallinula chloropus	150
Moorhen, Lesser	Gallinula angulata	1
Coot, Red-knobbed	Fulica cristata	873
Jacana, African	Actophilornis africanus	121
Jacana, Lesser	Microparra capensis	16
Painted-snipe, Greater	Rostratula benghalensis	1
Plover, Common Ringed	Charadrius hiaticula	16
Plover, White-fronted	Charadrius marginatus	1
Plover, Kittlitz's	Charadrius pecuarius	55
Plover, Three-banded	Charadrius tricollaris	15
Lapwing, Blacksmith	Vanellus armatus	17
Sandpiper, Curlew	Calidris ferruginea	58
Stint, Little	Calidris minuta	295
Ruff, Ruff	Philomachus pugnax	136
Sandpiper, Common	Actitis hypoleucos	8

Common name	Taxonomic name	Max #
Sandpiper, Marsh	Tringa stagnatilis	81
Greenshank, Common	Tringa nebularia	17
Sandpiper, Wood	Tringa glareola	152
Avocet, Pied	Recurvirostra avosetta	32
Stilt, Black-winged	Himantopus himantopus	74
Pratincole, Collared	Glareola pratincola	18
Gull, Grey-headed	Larus cirrocephalus	280
Tern, Caspian	Sterna caspia	25
Tern, Common	Sterna hirundo	10
Tern, Little	Sterna albifrons	12
Tern, White-winged	Chlidonias leucopterus	2000
Tern, Whiskered	Chlidonias hybrida	200
Owl, Marsh	Asio capensis	2
Kingfisher, Pied	Ceryle rudis	20
Kingfisher, Giant	Megaceryle maximus	2
Kingfisher, Malachite	Alcedo cristata	29
Martin, Brown-throated	Riparia paludicola	1
Wagtail, African Pied	Motacilla aguimp	4
Wagtail, Cape	Motacilla capensis	13
Wagtail, Yellow	Motacilla flava	2
Wader, Unidentified	N/A N/A	50

2.3 Terrestrial vegetation

The study area falls within the Maputaland-Pondoland-Albany Biodiversity Hotspot which is recognised as the "second richest floristic region in Africa" containing approximately 80% of South Africa's remaining forests (Thornhill and van Vuuren 2009). A large proportion of this hotspot has been transformed and degraded by human activities, resulting in many vegetation types being vulnerable to further disturbances.

Port development greatly altered habitats and had an impact on the distribution of aquatic plant communities *viz*. loss of much of the original mangroves stands, destruction of the Zostera beds, loss of fringing communities with saltmarsh affinities, reduction in reed swamp and loss of freshwater swamp forest due to increased saltwater intrusion (Cyrus et al 2009). Creation of the port mouth and the new Mhlathuze Estuary mouth had a direct impact on dune scrub and dune forest communities. Stabilisation of impacted areas with Casuarina, while necessary in the short term, has prevented recovery of dune scrub and dune forest in certain areas,

Five terrestrial vegetation types are represented within the broader study area (This is a remarkably large number of national types for so small an area, indicative of the high biodiversity of this region.)

Subtropical Dune Thicket: This vegetation type occurs within coastal forest along the dune cordon where it is a successional precursor to forest, typical of cirques, which are seaward-facing areas of collapsed dune that support distinct vegetation. Based on the Vegetation Map of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006), the following two vegetation types occur within the study area: Maputaland Coastal belt and Northern Coastal Forest. These broad groupings were confirmed by the broad scale on-site investigations conducted as part of this study.

Maputaland Coastal Belt: The Maputaland Coastal Belt encompasses areas of recent marine sands and areas on hard geology. Recent marine sands support a mosaic of dry land and hygrophilous vegetation types. Dry land vegetation types are dominated by grassland or *Syzygium* savanna where fire has been frequent, but tend towards shrubland where the fire regime has been disrupted. Lack of fire and disturbance has promoted the invasion of alien trees and shrubs to the extent that distinct patches of these invaded grasslands can be recognised. In some instances self-sustaining stands of pines, eucalypts or gums have established, with usually an understory of grassland. Areas of hard geology may support grassland but also commonly support *Acacia karroo* savanna or woodland. As with vegetation of marine sands, a decrease in fire frequency or increased disturbance has promoted the establishment of alien shrubs and trees. In addition, preclusion of fire may promote thickening of woody vegetation, such that *A. karroo* thickets may develop.

Northern Coastal Forest: A substantial proportion has been transformed to secondary forest following disturbance or previous transformation, accompanied by establishment of alien trees and shrubs. *Acacia karroo* woodland occurs as distinct patches within some parts of the dune system, usually with alien species. Aliens also establish on localised sites of disturbance within otherwise intact forest. Drainage areas support a distinct Riverine Forest

Subtropical Alluvial Vegetation: Dryland alluvial areas adjacent to rivers which are not forested support woodland dominated by *Acacia karroo* or a mix of species. Woody alien species may be conspicuous within either of these.

The majority of this vegetation within the study area has been disturbed, both naturally by strong floods and by human activities, and resembles secondary woodland vegetation

Subtropical Seashore Vegetation: This is the specialised vegetation found on foredunes on which primary succession of dunes is initiated. Areas of the alien *Casuarina equisetifolia* which were planted to stabilise moving sand are included here, although they now represent areas transitional to established natural woody vegetation in many cases.

The vegetation biomes in the broader area and more detailed mapping of the vegetation types which may be impacted by further port expansion are shown in Figure 2—6 and

Figure 2—7. Unfortunately the only mapping available of the vegetation has not yet been done at a resolution which has been described as part of these initial investigations.

A total of 138 plant species were recorded during the site visits of February and March 2013 (Table 2—7). More detailed vegetation surveys are likely to yield more species and it should also be noted that the studies conducted by Ilifa (2009) and Burger (2008) covered a much broader area with additional habitats while this study (MER 2013) focused on the proposed expansion areas.

Table 2—7 Plant species from this study (MER 2013) which focussed on the proposed expansion areas and recent previous surveys from the wider Richards Bay area.

Species list	Bayside Smelter MER 2013	Bulk berth quay MER 2013	South dunes MER 2013	Ilifa Feasibility 2009	J Burger 2008
Abrus precatorius					x
Acacia kosiensis	x	x		x	
Acacia robusta					x
Acalypha sonderianum					x
Ackokanthera oppositifolia		x	x		
Albizia adianthifolia	x	x		x	
Allophylus natalensis		x		x	x
Aloe thraskii			x	x	
Amaranthus sp		x			
Arctotheca populifolia					x
Aristida junctiformis	x	x	x	x	x
Asparagus falcatus		x			
Asystasia gangetica	x	x			x
Barleria meyeriana					x
Barringtonia racemosa		x		x	
Blechnum australe					x
Brachylaena discolor			x	x	x
Brachylaena illificolia					x
Bridelia micrantha				x	x
Bulbostylis histidula					
Canavalea bonariensis					x

Species list	Bayside Smelter MER 2013	Bulk berth quay MER 2013	South dunes MER 2013	Ilifa Feasibility 2009	J Burger 2008
Canavalea rosea		x			
Carissa macrocarpa		x			x
Carpobrotus dimidiatus		x	x		x
Casuarina equisetifolia		x	x	x	x
Catunaregam spinosa					x
Chironia baccifera					x
Chloris gayana		x			
Chromolaena odorata		x		x	
Chrysanethemoides monilifera	x	x	x	x	x
Cissampelos mucronata					x
Clerodendrum glabrum	x	x	x		
Commelina erecta					x
Cryptocarya myrtifolia					x
Cymbopogon excavatus		x		x	
Cymbopogon validus					x
Cynanchum natalitium		x			x
Cynodon datylon		x			
Cyperus rupestris					x
Dactyloctenium australe					x
Dalberghia armata					x
Dichrostachys cinerea					x
Digitaria eriantha		x		x	
Dimorphotheca frutescens					x
Diospyros natalensis		x		x	x
Dracaeana aletriformis		x			
Echinocloa pyramidalis					x
Eucalyptus grandis	x			x	
Eragrostis curvula		x			x
Erythrina caffra					x
Erythrina lysistemon					x
Eucalyptus grandis					x
Euclea natalensis					
Eugenia capensis					x
Eugenia natalitia					x
Eulophia horsfalli					x
Ficus burtt davyi			x		
Ficus natalensis				x	
Ficus trichopoda		x		x	
Gazania rigens		x			x
Grewia occidentalis		x			
Grewia pondoensis					x
Halleria lucida					x
Helichrysum aureonitins					x
Helichrysum aureum					x
Helichrysum krausii		x		x	x
Helichrysum sp	x	x	x	x	
Helinus integrifolius					x

Species list	Bayside Smelter MER 2013	Bulk berth quay MER 2013	South dunes MER 2013	Ilifa Feasibility 2009	J Burger 2008
Hibiscus tliaeceus		x		x	
Hibiscus trionum					x
Hydrocotyle bonariensis					x
Hyphaenae coriacea				x	
Hypoxis haemarcallidea				x	
Imperata cylindrica					x
Indigofera spigata					x
Ipomoea cairica					x
Ipomoea pes caprae		x		x	x
Issoglossa woodii					x
Lablab puprureus					x
Lagenaria sphaerica		x			
Lantana camara		x		x	x
Laportea peduncularis					x
Launea sarmentosa					x
Macaranga capensis					x
Mariscus solidus					x
Maytenus nemorosa		x		x	x
Maytenus procumbens					x
Melia azedarach					x
Melinis repens					x
Mimusops caffra		x		x	
Momordica foetida					x
Oplismenus hirtellus					x
Panicum repens					x
Paspalum distchum					x
Passerina rigida		x	x		
Passiflora subpeltata					x
Phoenix reclinata		x		x	x
Pinus sp	x	x	x	x	x
Psidium guajava					x
Psychotria capensis		x		x	x
Pycreus micranthis					x
Pycreus polystachyos					x
Rauvolfia caffra				x	
Rhoicissus tomentosa				x	
Rubia cordifolia					
Sanseveria concinna		x			
Scadoxus multiflorus					x
Scadoxus puniceus		x			
Scaevola plumereii					x
Searsia chirindensis					x
Searsia nebulosa					x
Senecio deltoides					x
Senecio macrosgrossoides					x
Senecio madigascariensis					x
Senecio tamoides		x			x

Species list	Bayside Smelter MER 2013	Bulk berth quay MER 2013	South dunes MER 2013	Ilifa Feasibility 2009	J Burger 2008
Smilax anceps					x
Smilax kraussii		x			
Solanum panduriforme					x
Sporobolus pyramidalis				x	
Sporobolus virginicus		x	x		
Strelitzia nicolaii		x			
Strelitzia reginae					x
Strychnos madagascariensis				x	
Syzigium cordatum		x		x	
Syzigium guenensis					x
Tabernaemontana ventricosa				x	
Tagetes minuta					x
Tephrosia purpurea			x		
Trema orientalis					x
Tricalyisa lanceolata					x
Trichelia dregeana		x			x
Uvaria caffra					x
Vepris lanceolata				x	
Vigna unguiculata					x
Voacanga thouarsii				x	
Zanthoxylum davyii					x
Zehrenia parviflora					x
Ziziphus mucronata				x	

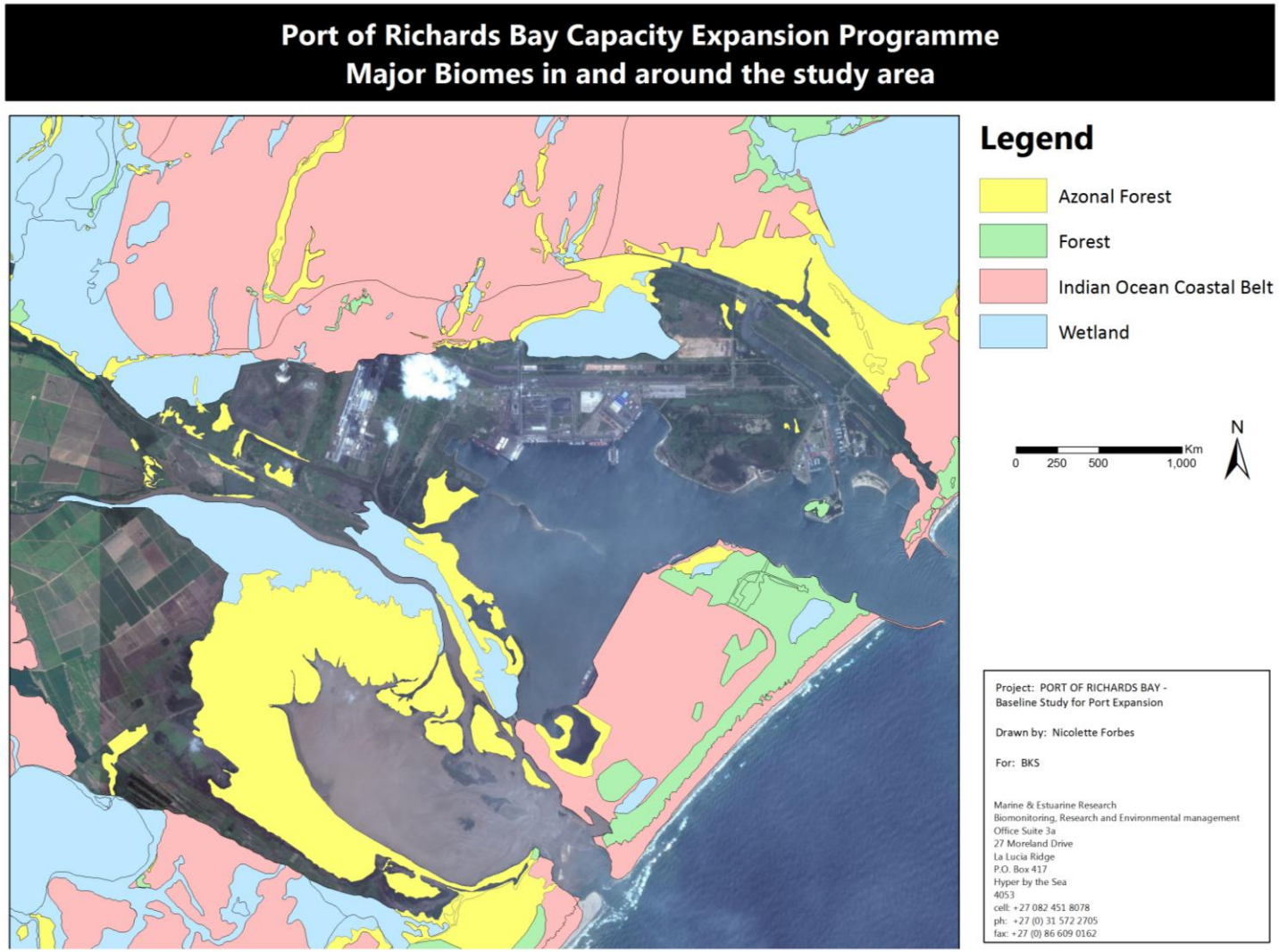

Figure 2—6 Major biomes identified within the study (EKZNW 2006). Azonal forest is largerly refers to mangrove swamp habitat.

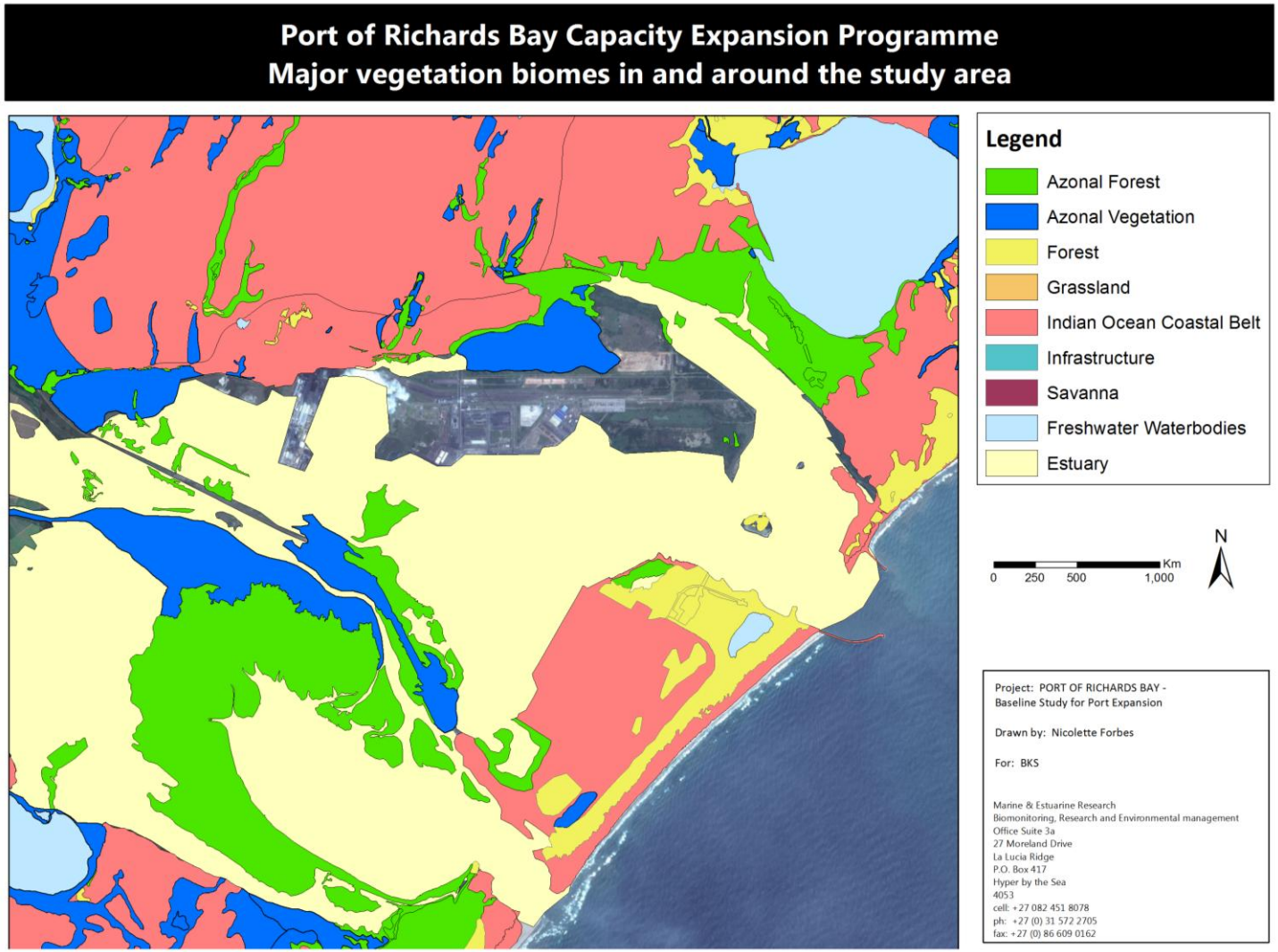

Figure 2—7 Major vegetation types identified within the study (SANBI 2011). Azonal forest largerly refers to mangrove swamp habitat.

2.4 Overview

The due diligence report by Ilifa Africa Engineers (2010) for the acquisition of land for future port expansion states the following: *"All of this planned port development will impact significantly upon sensitive ecosystem assets and the services they provide and this may negatively affect the ecology of the port, the surrounding area and possibly the entire north coast of KwaZulu-Natal"*.

However, the DAERD (2011) Environmental Management Framework Report suggested that development within the Port could be conducted to allow for the protection of critical biodiversity. The following points were included under the section dealing with conservation priorities and are of relevance *"There is significant potential for advancing conservation priorities in this zone. The Port Estuary is relatively healthy, contains critical ecological assets and fulfills an important biological function. This biological state is maintained by the existing hydrological linkages in the landscape such as the Mhlathuze River entering the intertidal bay area, the Mzingazi Canal and the tidal interchange between the two estuaries. The land-sea interface is also important. For example, intertidal areas within the port estuary support a diversity of invertebrates and are used as refuges, feeding and breeding grounds by a number of species. These areas support the regional prawn trawling industry and fisheries. The port area further has a high visual quality and the amenity value associated with open water bodies may place limitations on development"*.

"The port estuary must function as a natural system and must complement port activities. Port operations must also secure the ecological-hydrological interrelationship between the port estuary and the sanctuary estuary. This was considered to be possible (Thornhill & van Vuuren 2009) by protection and careful management of the critical ecological assets and linkages that support the estuary. They further recommended that serious efforts must be made to avoid damage or loss of habitat that will compromise local, regionally and nationally important populations of ecologically, recreationally and commercially important faunal species; and development must not interfere with the hydrological linkages that supports ecological processes and the integrity of habitats and species. They state clearly that the biodiversity richness of the estuary and its surrounding areas is of global significance and vulnerable to change.

It is therefor clear from previous assessments and this baseline ecological study that terrestrial, aquatic and estuarine ecosystem types are closely connected and spatially related to each other and processes that link these systems happen at the landscape level. Together they constitute an ecosystem that plays a significant role in the maintenance of ecosystem goods and services, including maintenance of the adjacent marine environment. These systems are under pressure due to existing and planned developments and will require careful management of the open spaces to enable the system to sustain itself and the social and economic systems of the area (Thornhill & van Vuuren 2010).

3 SENSITIVE HABITATS, POTENTIAL HABITAT TRANSFORMATION, AND THE IDENTIFICATION OF POTENTIAL ISSUES AND IMPACTS

The areas affected by the proposed port expansion lie within the delineated estuarine boundary (cf Figure 2—2) or immediately adjacent to it. Some of these areas are already irreversibly transformed land but despite this a number of unique and important habitats remain (Six different types *of wetlands have been identified within the project area (SANBI 2011), namely*

- Channeled valley bottom
- Flat
- Steep
- Unchannelled valley bottom
- Valley head seep and
- Estuarine

The threat status assigned to these wetlands indicates that all are considered moderately to highly threatened as a result of the habitat modification, current land use activities and development proposals in this area. In particular the papyrus swamps are referred to as critical ecological assests which are hydrological linked to the other wetland resoures. These critical ecological assets along with their corriodor linkages are listed as requiring protection and managent within the EMF Report and irreplaceable. Any significant threat to the sustainability of these areas requires "exceptional remedial action" and the likelihood of success of any offset proposals would need to be carefully considered. The national significance and irreplaceability of this habitat may render any proposals which cannot avoid or remove the threat from these swamps as "fatally flawed"

Figure 2—5).

The most important factors which need to be considered as part of the planning process are listed below and explained in more detail in Sections 3.1 – 4.5.

- The estuary, as a complete resource unit, is classified as an "estuarine bay", a rare estuary type in KZN. Within this bay various physical and chemical conditions as well as habitats may be affected by construction and operational activities associated with any expansion of the port.
- The intertidal mangrove habitat within the estuary is a protected forest habitat type

in its own right in terms of the National Forests Act [2] along with its associated plants, while individual species protection is also accorded to resident animals such as fiddler crabs, mangrove whelks and mudskippers.

- Open intertidal mud and sandbanks exist (an important and limited habitat type within the KwaZulu-Natal estuaries) which are highly productive and considered extremely critical habitat for a variety of invertebrate and fish populations.
- Impact to or loss of wetlands.
- Small pockets of both dune and swamp forest which remain within the development area. Swamp forest is also a protected forest habitat type in terms of the National Forests Act.
- Interference with a dynamic coastal zone cordon in the south dunes area.

3.1 Estuarine type rarity and ecological health

The estuary was historically an estuarine bay and this classification remains, albeit with the aid of breakwaters, which maintain a large open connection between the bay and the sea. Kwazulu-Natal has only two estuaries of this type and there are only three nationally. Within South Africa these are the only areas which can support open intertidal mud flats, sandbank and mangrove habitats. Thus, the Richards Bay estuary is significant in terms of its zonal type rarity and this means that this particular estuary, despite significant habitat loss and modification remains significant at a local, regional and national scale. This remains the case despite the results of a recent national estuarine health assessment (SANBI 2011) which indicated that the estuary has been comprised in terms of a significant reduction in freshwater inputs and increasing levels of pollutants which places the system in a Provisional Present Ecological Status category D. The major drivers of degradation in the system were assessed to be anthropogenic. These comprised both effectively irreversible core industrial and city infrastructure and changes in water quantity and quality. Some of the significance to the regional estuarine resource is conferred by the presence of important, rare and

[2] NO 84 of 1998

threatened or species rich habitats such as mangroves and intertidal sandbanks. It is, therefore, unsurprising that it has been selected as one of the core estuaries to satisfy the biodiversity targets of the provincial and national Conservation Plans (Turpie, Taljaard, Van Niekerk, Adams, Wooldridge, Cyrus, Clark & Forbes 2012). In fact, at a provincial level this estuary is considered "irreplaceable".

The delineation of the Richards Bay estuary (cf Section 2, Figure 2.2) takes into account the extent of tidal movement, salinity gradients, backflooding levels and known floodlines. These boundaries define the estuarine functional zone of this estuary. It is important to realise that the resilience of an estuary is influenced by the intactness of its catchment and estuarine habitats. A way to ensure resilience is the determination and provision of estuarine ecological water requirements and the protection/rehabilitation of the estuarine functional zone. It should be noted that while this delineation appears to ignore existing infrastructure and development it is important to define this estuarine functional zone to guide further development within this dynamic and sensitive area.

The port development boundaries currently indicate an overlap into both the estuarine functional zone and core estuarine habitats such as mangroves and swamp forest. The GNR 546 Listing Notice 3 under the NEMA EIA Regulations (2010) identifies the estuarine functional zone as a sensitive area that requires environmental authorisation before a development may proceed. Further design phases and planning of the port layout should take into account the mapped estuarine area and include the determination and provision of an appropriate buffer to allow continued and improved functioning of the estuary.

It is beyond the scope of this report to document the potential expansion scenarios individually. Each set of expansion plans will require a number of different activities linked with development and operation of the facilities. This will include (capital) dredging and disposal of significant volumes of sediment as well as ongoing maintenance dredging activities. The identification of specific impacts and conditions which will impact on the health of the estuary will be evaluated against the baseline conditions described in this report during the EIA phase.

3.2 Mangrove and swamp forest habitats

The mangrove and swamp forest habitats, which occur within and around the Richards Bay

estuary, are both individually recognised as sensitive floral communities of conservation significance. The National Forests Act 84 of 1998 (as amended) provides the strongest and most comprehensive legislation and mandate for the protection of all natural forests in South Africa. The principles of the Act in Section 3 state clearly that "*...natural forests may not be destroyed save in exceptional circumstances where, in the opinion of the Minister, a proposed new land use is preferable in terms of its economic, social or environmental benefits*". This prescribes that no development affecting forests may be allowed unless "exceptional circumstances" can be proven. Section 7 of the Act prohibits the cutting, disturbance, destruction or removal of any indigenous living or dead tree in a forest without a licence, while Section 15 places a similar prohibition on protected tree species listed under the Act, some of which are also forest species.

Twenty-six national forest types occur in South Africa, including three azonal types that occur in small or linear locations, like riverine forests and mangrove forest. There are a variety of threats to the forests, causing loss or deterioration of forest habitats and consequently loss of biodiversity as well. Some forest types and forest patches are under greater threat than others. During the past century, the forests near the coast (such as KwaZulu Natal Coastal Forest and Transkei Coastal Forest types) have been under more/severe pressure due to the expansion of farmland and to development. These are the very same forest types under greatest pressure from development and other activities such as bark harvesting.This pressure, both from legal and illegal developments, is causefor great concern from a forest conservation perspective.

The systematic conservation planning process undertaken by DAFF sets conservation targets for each forest type (percentage of each forest type to be included in protected areas – current and future) and identifies priority forest patches that should make up those percentages. This cyclic process is done in co-operation with the SANBI, which also involves the identification of threatened forest ecosystems (forest types and patches) to be listed under the National Environmental Management: Biodiversity Act No 10 of 2004 (NEMBA).

Forest types and forest patches listed as threatened ecosystems have to be taken into account in the Integrated Development Plans (IDPs) of local authorities, and any intended activities resulting in the loss of any amount of land area of these listed forests areas will then require at least a basic assessment under the Environmental Impact Assessment Regulations (No R544, R545 and R546 of 2010). In terms of the National Forests Act of 1998

all natural forests are important for conservation from a national perspective, but those listed under NEMBA (Critically Endangered and Endangered) must receive highest priority for protection, whether in the planning of new conservation areas, or control of development and land use change. In the case of Richards Bay three forest types, Mangrove Forest, KwaZulu-Natal Coastal Forest and Swamp Forest, occur within the site boundary and are designated as Endangered. The guidelines provided under the Forestry Act for this habitat category are indicated in Table 3—1.

Table 3—1 Guidelines for the protection of Endangered forest habitats

Threat Status Rating of forest type and forest patch	Guidelines	Offset considered if possible
Endangered	No activities or development must be considered that will destroy forest; Low-impact eco-tourist facilities like boardwalks and bird-hides, and small bush-camps, but no buildings and infrastructure.	Only for projects proven to be of national or provincial strategic importance, with no feasible alternatives.

In addition to the protection described above which relates to the forest habitat, some of the trees which occur on the site are listed as protected species (Section 12 (1) (d) in terms of Section 15 of the National Forests Act 84 of 1998. These species were included as per the Government Gazette of September 2012[3] Protected trees many not be "*cut, disturbed, damaged or destroyed and no person may collect, remove, transport, export, purchase, sell or donated …. except under a licence or exemption granted by the Minister*". Contravention of this declaration is regarded as a first category offense by this schedule.

It is important that the future designs and planning consider these habitats and tree species to preserve and protect wherever possible and implement appropriate mitigation if impacts are completely unavoidable.

[3] South Africa . 2012. **Notice of the List of Protected Tree Species under the National Forests Act, 1998 (Act No 84 of 1998)**. (Proclamation No. R, 716). Government Gazette, 35648:716, September 7th (Regulation gazette No. 7146).

3.3 Open intertidal sand and mudbanks

Intertidal mudflats and sandbanks are those areas within an estuary which remain uncovered for part of the tidal cycle. Open intertidal sand and mudflats are rich areas of biodiversity, with a high biomass of invertebrate fauna. They usually have high primary productivity in terms of benthic microalgae, resulting in high numbers of invertebrates, and so providing the basis for other tropic layers that add to the biodiversity in the estuary. This means that this high productivity can support large numbers of predatory birds and fish, and can be important nursery areas for fish.

The primary physical features of the hydrographic regime (tides, waves, residual currents) together with the underlying physiography and geology will create the conditions for a given type of substratum to develop. The characteristics and nature of the sedimentary and depth regimes are intimately related and will create conditions for the colonisation by, and maintenance of, organisms of this habitat, and for the delivery of food and colonising organisms.

Mudflats and sheltered intertidal sandflats reflect low energy conditions which are characterised by: particles of a small to medium diameter, shallow slope, high water content, high sorting coefficient, low permeability and generally low porosity, high organic content and therefore high reducing conditions, high carbon to nitrogen ratio, high microbial population and high sediment stability.

Although these habitats are relatively small areas within the Richards Bay estuary this is only found within a handful of estuaries within KZN. Fairly comprehensive surveys have been carried out within the last ten years of these intertidal areas and it is recommended that finer scale investigation of the physical and biological composition of these communities are carried out to inform the more detailed phases of port planning.

3.4 Conservation planning

The provincial and national conservation plans aim to conserve local biodiversity and to protect environmental goods and services for the benefit of current and future generations. The National Conservation Plan for estuaries (Turpie *et al* 2012) has been developed by prioritising estuaries and establishing which should be assigned Estuarine Protected Area (EPA) status, with the premise that regardless of which estuaries are selected; there should be

no net loss of estuarine habitat area or function of South African estuaries in line with the NEM:BA.

The Richards Bay estuary and its direct support habitats and surrounding natural areas are currently included in the national core set of estuaries to fulfil the country's national biodiversity commitments. This is echoed at a provincial level with the recent reassessment of the Provincial Conservation Plan of EKZNW, which found that in the case of the Richards Bay estuary the system was classed 'irreplaceable' in terms of achieving explicit conservation targets for biodiversity features and processes. It is therefore important to see the estuary as critical habitat. Insensitive and unmitigated development will effect further degradation of the general estuarine environment and the opportunity to maximize the sustainable supply of environmental goods and services will be irreversibly lost.

The water quality challenges which are predicted to occur within this estuary (CSIR 2006) will, if historic trends prevail, be exacerbated by the development of land adjacent to the estuary resulting in further inputs of pollutants. The loss of ecological corridors and 'stepping stones' which link the aquatic habitats and terrestrial environments along broadly east-west and north-south corridors is becoming apparent and would need to be properly integrated when planning new developments.

It may be argued that the habitat that exists is modified, but it is a part of the regional estuarine resource, which provides essential goods and services to the city, coastline and its residents. The potential remains for the goods and services provided by this estuary to be maintained with careful development implementation. This would maintain biodiversity value and ecological function and impart further values to the coastal system.

Some of the risks associated with the development proposals are an increased risk of changes to the turbidity regime which would result in concomitant impacts to the biotic environment, in particular benthic invertebrates and fish and increased contamination by heavy metals. Some preliminary work has already been completed to investigate baseline conditions for these factors. This work undertaken by the CSIR (2013a, 2013b) which investigates the heavy metal content of the sediments and the turbidity / suspended sediment loads suggests that in the case of the heavy metals copper, chromium and zinc, some risk does exist in certain areas of the port. Turbidity results obtained were relatively inconclusive and further work to establish the baseline would need to be conducted to allow

an assessment of the impacts of any changes. The ecological consequences will require further assessment at a much more local level during the next phase.

3.5 Wetlands and Thulazihleka Pan

Six different types of wetlands have been identified within the project area (see Section 2.2 above). Wetlands are a limited but highly significant habitat type within the country and protection of these systems has been prioritized. The Richards Bay area has significant wetlands which support a high diversity of plants and animals. The detailed investigation of these is essential to allow a thorough understanding of their composition and significance in the wetland mosaic around the bay. This will be essential if impacts are unavoidable and connot be mitigated and offsets are required.

This highly significant wetland has been mooted for further development as part of the larger IDZ. The current plans for port capacity expansion will result in development in close proximity to the pan with the possibility of a variety of impacts including run-off, dust and noise. No recent work with the exception of the CWAC counts (see Table 2—6) has been carried out on this wetland and the next phase should attempt to gather some baseline information to allow a meaningful and objective impact assessment to be carried out..

3.6 Break Bulk to Repair Quay area

Field visits were undertaken to assess this specific area during February 2013. This site is also a product of a dune stabilization initiative using the alien she-oak *Casuarina equisetifolia*. Stabilisation was achieved by planting *C equisetifolia* on a low-lying supratidal sand bank that lay seaward of a mangrove community dominated by *Avicennia marina* and *Bruguiera gymnorrhiza*.

This stabilization of the dune has allowed for the invasion of a number of exotic and indigenous mesic species, primarily *Trichilia dregeana, Mimusops caffra* and *Lantana camara*. (Plate 3.1). The success of the stabilization initiative has however been short-lived. Field surveys indicate that regression of the stabilized beach and dune has been relatively rapid and aggressive. Plate 3.2 below indicates that mature *C equisetifolia* are now subject to

undermining by clapotic[4] wave action. Such erosion implies that wave dynamics within the estuary have changed in recent times, with this point reverting from a prograding or (relatively) stable dune form to a destabilizing and eroding dune and beach. The origin of such reversal in sediment processes and wave dynamics is worth further consideration, particularly where this area is being considered for the berthing of large craft. Presently, it is suggested that such changes in clapotic and wave patterns has arisen on account of the manipulation of the mouth, changes in sediment budgets within the estuary and / or changes in currents (Hesp *et al.* 2007).

[4] Refers to non-breaking standing wave action from reflected waves of vertical shorelines

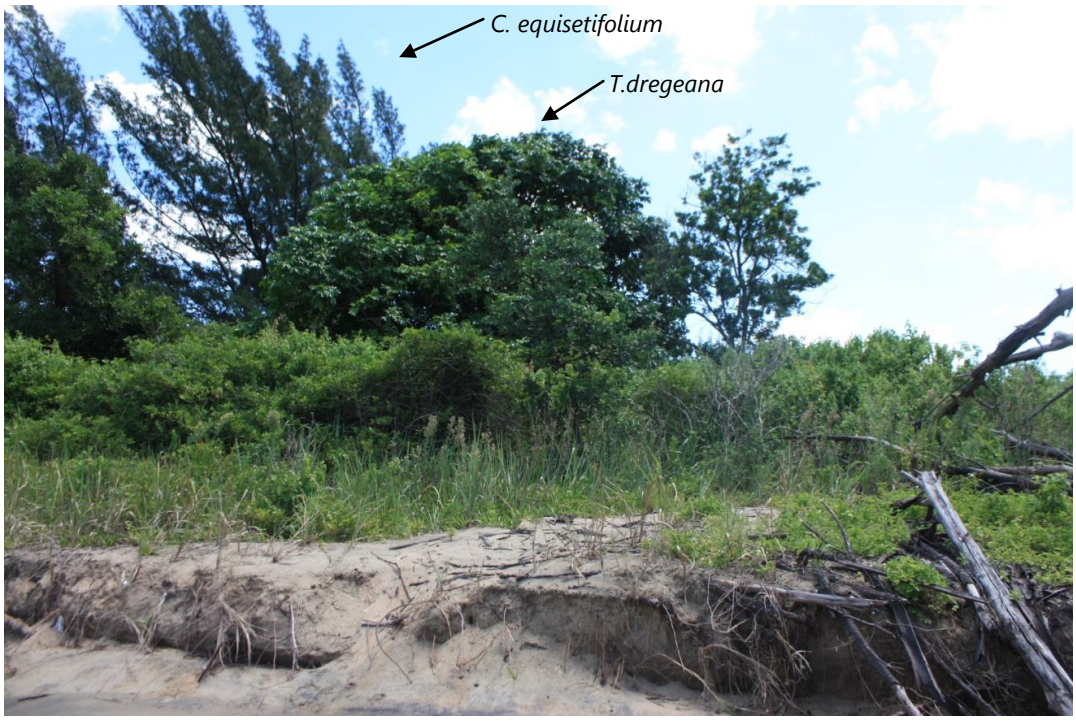

Plate 3.1 Image of site just above the high water mark indicating nature of vegetation encountered, including association of *T. dregeana* and *C. equisetifolia*

Plate 3.2 Image of a site along the shoreline of the estuary indicating *C. equisetifolia* undermined by marine action on formerly stabilized dune.

From the above it is evident that the mesic ecological components of the site are anthropogenic in origin with limited conservation significance. This does not apply to the adjacent mangrove community which requires further consideration in the EIA phase and is dealt with earlier in Section 3.2.

3.7 South Dunes

A review of aerial imagery from 1937 to date indicates that the site is a dune field previously associated with the south bank of the original uMhlatuze estuary mouth (see Plate 3.3. below) which has been stabilised.

Plate 3.3 1937 image of uMhlatuze mouth indicating dune field. Compare with more recent images below (Source : Surveyor General)

Stabilisation of the some of the dune field was initiated using vegetation, during the 1940s, followed by the establishment of storage and related port infrastructure. The review of recent aerial imagery (2004 – 2012) indicated that the stabilised dune cordon (vegetated

dune cordon) has undergone a relatively rapid period of expansion. Such expansion is quantified in Table 3—2 below,

Table 3—2 Table indicating increase in stable or vegetated dune width between 2004 and 2012 at selected points along the dune cordon

Stabilised dune width (m)	North	Central	South
2004	301	402	234
2012	333	402	258
Variance (m)	+32	0	+24

However, a concomitant decrease in the supratidal beach width has been identified whereby the average beach width in 2004 (measured at three selected points and accounting for the effects of tide and storm) showed a decrease from 116 m in 2004 to 87 m in 2012. This constitutes a 25% decrease in the width of the supratidal beach within a period of 8 years (See Plate 3.4 below). From this analysis, it is therefore suggested that stabilization of the dune field over the last 50 to 60 years is leading to a reduction in supratidal beach width and a likely change in beach–dune sediment dynamics and ecological function (e.g beach may be assuming a more reflective profile as steepening of the scarp arises). This makes it increasingly vulnerable to significant erosion in this area potentially affecting the stability of the back of dune developments.

It is recommended that this aspect be investigated in more detail if the area were to be considered for further development as changes in beach and dune morphology such as this have significant implications for further development of the dune cordon particularly in the face of climate change, sea level rise, increased storminess and coastal erosion.

Plate 3.4 Image of the dune cordon at east of Richards Bay in 2012 (upper image) and 2004 (lower image). Note evident increase in stabilized dune field.

4 Recommendations

Preliminary findings of the baseline ecological assessment of terrestrial, wetland and estuarine in selected areas of the Bay:

a) **Mangroves**: Forest types and forest patches listed as threatened ecosystems have to be taken into account during the planning of any expansion within the Port. In the case of Richards Bay three forest types, Mangrove Forest, KwaZulu-Natal Coastal Forest and Swamp Forest, occur within the site boundary and are designated as Endangered. The guidelines for the protection of Endangered forest habitats suggest that no activities or development should be considered that would destroy these habitats unless of strategic provincial or national importance with no feasible alternatives. It is important that the future designs and planning consider these habitats and tree species to preserve and protect wherever possible and implement appropriate mitigation if the impact is completely unavoidable.

b) **Intertidal areas**: Although these habitats are relatively small areas within the Richards Bay estuary this is only found within four or five estuaries within KZN. Some surveys have been carried out within the last ten years of these intertidal areas and it is recommended that finer scale investigation of the physical and biological composition of these communities are carried out to inform the more detailed phases of port expansion planning.

c) **Biodiversity targets and ecological goods and services**: It may be argued that the habitat that exists is modified, but it is a part of the regional estuarine resource, which provides essential goods and services to the city, coastline and its residents. The potential remains for the goods and services provided by this estuary to be maintained with careful development planning and implementation. This would maintain biodiversity value and ecological function and ensure continuing value to the coastal system.

d) **Ecological consequences of changes in turbidity, suspended solids and sediment contamination**: The ecological consequences of changes to the local environment in the areas of construction as a result of dredging, piling and infilling will require further assessment at a much more local level during future port planning.

e) **Thulazihleka Pan**: The area occupied by this highly significant wetland is mooted for further development. The current IDZ plans will result in development in close

proximity with the possibility of a variety of impacts including run-off, dust and noise. No recent work with the exception of the CWAC counts has been carried out on this wetland and the future planning should include the more detailed surveys of this wetland.

Preliminary findings associated with the mesic ecology of the sites under consideration indicate that:

f) **The Bayside Smelter 500 series berth site**: A literature review and preliminary field work has indicated that this site, while constituting a wetland – estuary interface has been highly transformed. In addition, the site may be subject to a high level of contaminants.
g) **The South Dunes site**: Initial assessment of the coastal and supratidal dynamics driving processes at the South Dunes suggests that this be given more detailed consideration during future port planning. A narrowing of the stabilized dune cordon has significant medium to long term effects on coastal processes, as well as the stability and security of RBCT structures built within this area.
h) The proposed development area between the Break Bulk and Repair Quay shows little ecological value in terms of the mesic habitat present on site. The site constitutes a stabilised sand bank / dune form. The area does however warrant further consideration of the mangrove community situated landward of this point.

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