CRUZ ENVIRONMENTAL

Report No. 18

Overall Findings & Assessment: Specific Abiotic & Biotic Components associated with Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project

A report prepared for AECOM SA (Pty) Ltd, Westville, Durban

by

DP CYRUS & L VIVIER

November 2014

CRUZ Environmental
PO Box 357
Empangeni
3880
Telephone: 082 4559197
Telefax: 035 9026750
Email: cyrus@iafrica.com

TABLE OF CONTENTS

1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Final Scoping Report (AECOM 2014) for the developments proposed by Transnet Capital Projects (TCP) for the Richards Bay Harbour Expansion project (Option 3A) identified that several specialist studies needed to be undertaken as part of the Environmental Impact Assessment for the proposed developments. These included elements of both Terrestrial and Aquatic Ecosystems present on the sites to be developed. In terms of the brief provided to CRUZ Environmental (CRUZ-E) three areas required Specialist Studies as part of the Richards Bay Harbour Expansion project, the localities of these are shown on Figure 1.1 below.

The report forms the Overall Finding and Assessment of the outcomes of all the Specialists Studies undertaken for this project, these include:-

Cyrus, D.P. & Vivier, L. (2014). Review of Biotic & Abiotic Reports produced for the Scoping Report on Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.11**: 1-28.

Mostert, T.H.C. (2014). Vegetation & Wetland Assessment of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.12**: 1-99.

Cyrus, D.P. (2014). Bird Fauna of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.13**: 1-20.

Du Preez, L.H. (2014). Frog Fauna of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.14**: 1-13.

Vivier, L. & Cyrus, D.P. (2014). Fish and Benthic Invertebrates Fauna associated with the Intertidal Mangroves and Sandflats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.15**: 1-22.

Vivier, L. & Cyrus, D.P. (2014). Benthic Invertebrate Fauna associated with the Finger Jetty Extension in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.16**: 1-15.

Cyrus, D.P. & Vivier, L. (2014). Aquatic Vegetation and Fish associated with the Berth 600 Series Extension in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.17**: 1-21.

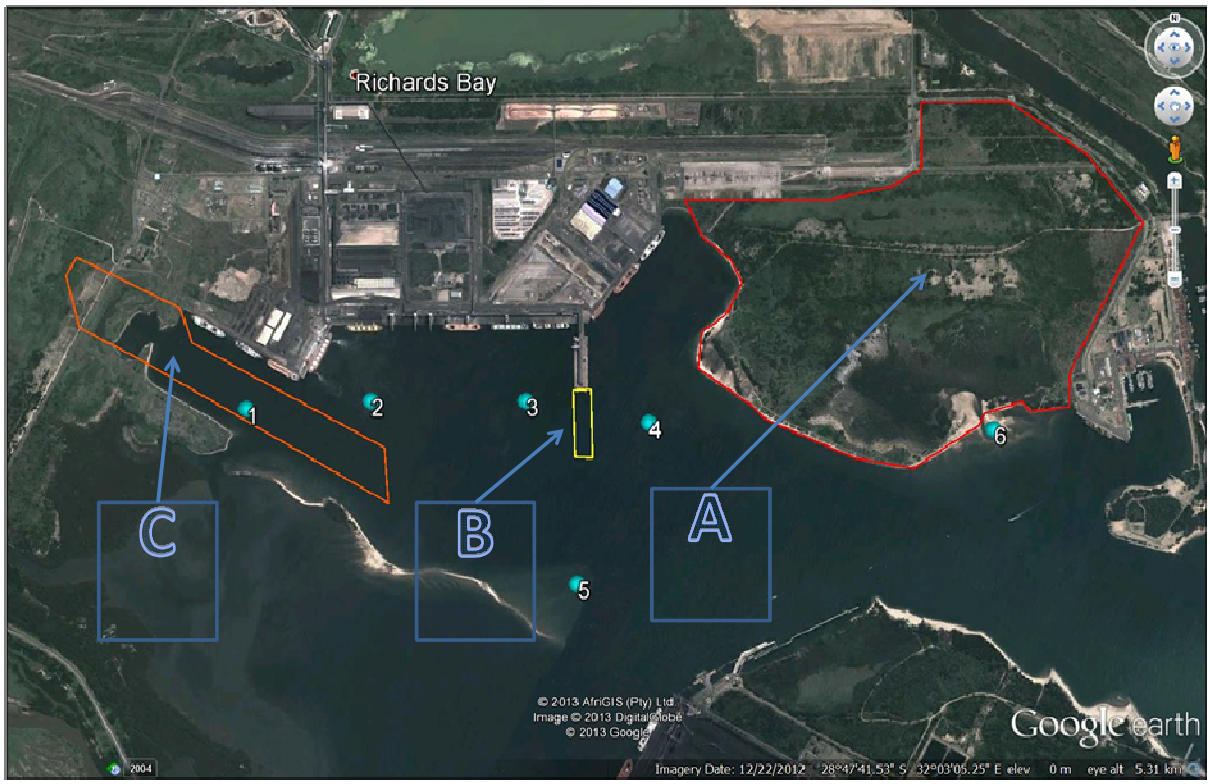

Figure 1.1 Sites associated with TCP Richards Bay Port Expansion Project, A = Rail Balloon, B = Finger Jetty Extension and C = Berth 600 Series Expansion.

1.2 TERMS OF REFERENCE

The specific terms of reference for each of the Specialist Studies are contained within each of the Specialist Reports mentioned above. These included;

1. The production of Specialist reports synthesizing the methods and findings (current status) of the biodiversity baseline surveys and including ecological assessments.
2. Review of the Marine and Terrestrial Ecology Baseline Report.
3. Review the results from the flow and dispersion modelling study (being undertaken by the CSIR) and indicate the impact from the development activities in areas beyond the boundaries of the sampling network necessitating a change in positions or additional sites. **[Note: CSIR has not completed the modelling and this component is not included in this report].**
4. Present status of the different habitats within or affected by the Richards Bay Port Expansion project as shown in Figure 1.1. Existing disturbance within each habitat unit.

5. Photographs of the verified key habitats, flora and fauna, impacting activities where possible and landscape character.
6. Detailed description and identification of specific habitat issues.

In terms of this Overall Findings & Assessment Report there were several associated components with it in the brief. These included the identification of specific habitat issues, impacts and opportunities, a description of possible constraints, extent of impacts and impact management requirements, including mitigation and activity management, the environmental risks involved and how they might be minimised for the more detailed phases and any offset recommendations that might emanate from this study.

1.3 AIM

The overall aim of the study was to complete the Terms of Reference of the brief provided to CRUZ-E by undertaking a limited amount of fieldwork, which was designated by AECOM, and the assessment of the results along with whatever other information was available in order to meet the Terms of Reference for the Marine and Land Based Ecological Impact Assessment identified for the Environmental Impact Assessment Phase as determined in the Final Draft of the Scoping Report by AECOM (2014).

2. STUDY AREA

2.1 INTRODUCTION

The area comprises three sites associated with TCP Richards Bay Port Expansion project. These are shown on Figure 1.1 and are the Rail Balloon, Finger Jetty Extension and Berth 600 Series Expansion sites.

As outlined in the Terms of Reference, Section 1.2 above, the Specialist Studies to be carried out at each site varied and the details of each of the components investigated are contained in the Specialist Reports (CRUZ Environmental Report Nos. 11 to 17) which accompany this Overall Findings and Assessment Report.

3. METHODS

3.1 INTRODUCTION

The methods used for each of the components of the Specialist Studies are outlined in the reports that have been produced related to each study and can be found in CRUZ Environmental Report Nos. 11 to 17 which accompany this Overall Findings and Assessment Report.

4. RESULTS

4.1 INTRODUCTION

The format of this section aims at summarizing the pertinent issues related to each of the three study sites which have originated form the specialist investigations and assessments undertaken by CRUZ-E. It also includes summaries of the reviews undertaken of the Water Quality, Turbidity and Total Suspended Solids reports produced by the CSIR and the Marine and Terrestrial Ecological Baseline Report produced by MER (2014).

4.2 SITE A – RAIL BALLOON AREA

4.2.1 Vegetation and Wetlands

Results from the assessment of the vegetation and wetlands of the Rail Balloon area have revealed that there are 10 plant communities present on the site several of which include Red Data Species as well as protected species for which a licence is required for removal. In addition the Wetland and Mangrove habitats are of particular significance as is the hydrological structure of the subsurface area. In terms of the latter disturbances during construction in non-wetland habitats may have far reaching effects on the wetland and mangrove habitats themselves. It is considered that the loss of the two habitats will result in a direct loss of nationally protected habitats in an area considered as a whole to have a very good potential to be rehabilitated back to a highly functional wetland and estuarine habitat (Mostert 2014).

4.2.2 Frogs

The once-off study of the frog fauna (Du Preez 2014) indicates that the loss of the habitat present will not be of any significance to the frog population in the greater uMhlathuze area.

It does however caution that this was only a once-off study which was undertaken during an extremely dry period when the major wetland on the site was almost dry. Despite this however the possibility of significant or Red Data species occurring in the area appears slim (Du Preez 2014).

4.2.3 Birds

Of the three broad habitat types used in the study the loss of the Secondary Woodland habitat, despite holding well established bird fauna, was considered to be acceptable in the broader context of the greater Mhlathuze area. Due to the extremely dry conditions the assessment of the bird fauna of the Freshwater Wetlands was considered not to be representative of the fauna that would have been expected particularly when related to the nearby Thulazihleka Wetland and some offset should be considered in this regard. Intertidal Mangroves and Sandflats which are scarce in KwaZulu-Natal were considered to be important in the context of the harbour playing a role in providing a viable habitat for migrant Palearctic waders which visit the area during the summer months. The ongoing loss of this type of habitat in the harbour is of concern and needs further investigation particularly if there are to be further losses due to the Berth 600 Series Expansion and also if Richards Bay Harbour is to continue its role as a functional estuarine type ecosystem.

4.2.4 Intertidal Mangroves & Sandflats

Results of the limited study that was undertaken have identified both habitats as important for fish, particularly juveniles of marine associated species which need to enter an estuarine environment to be able to complete their life cycle. Estuarine dependent fish species such as *Liza dumerilli* were present in large numbers, suggesting that the area is of importance as a nursery habitat for marine breeding fish. Of the fish species recorded, 75% belonged to the estuarine dependent category.

In terms of the Intertidal Sandflats this habitat and its associated fauna are considered of ecological significance. MER (2014) has noted that the total area in South African estuaries was limited and that much of it has been lost to development already, particularly in KwaZulu-Natal where there have been substantial losses already from both Durban and Richards Bay Harbours.

4.3 SITE B – FINGER JETTY EXTENSION

4.3.1 Water Quality & Turbidity

The Finger Jetty sampling sites all showed good water quality that was strongly marine dominated, with relatively high oxygen concentration and low turbidities throughout the water column.

4.3.2 Benthic Invertebrate Fauna

Deep channel sites typically had silty sediment with relatively high organic content, whilst the shallower off-channel sites had muddy sand with low organic content. The reference site on the Kabeljous mudflat was typically muddy with high organic content. In term of the faunal diversity and density, the deepwater channel sites showed very low species richness and densities, compared to the off-channel sandier sites. The highest diversity and density was found on the subtidal Kabeljous mudflat. The sites chosen for this part of the study (see Figure 2.1 in Vivier & Cyrus 2014) are considered as representative of the different habitat types that would need to be monitored during development of the Finger Jetty site.

4.4 SITE C – BERTH 600 SERIES EXTENSION

4.4.1 Vegetation and Wetlands

Results from the assessment of the vegetation and wetlands of the Rail Balloon area have revealed that there are six plant communities present on the site several of which include Red Data Species as well as protected species for which a licence is required for removal. In addition the Shallow Intertidal area (Figure 4.1) has a well established community of *Zostera capensis* present (Mostert 2014). This species has not been recorded in Richards Bay Harbour for more than 30 years and is listed as Vulnerable on the IUCN Red List of Threatened Species (Short *et al.* 2010).

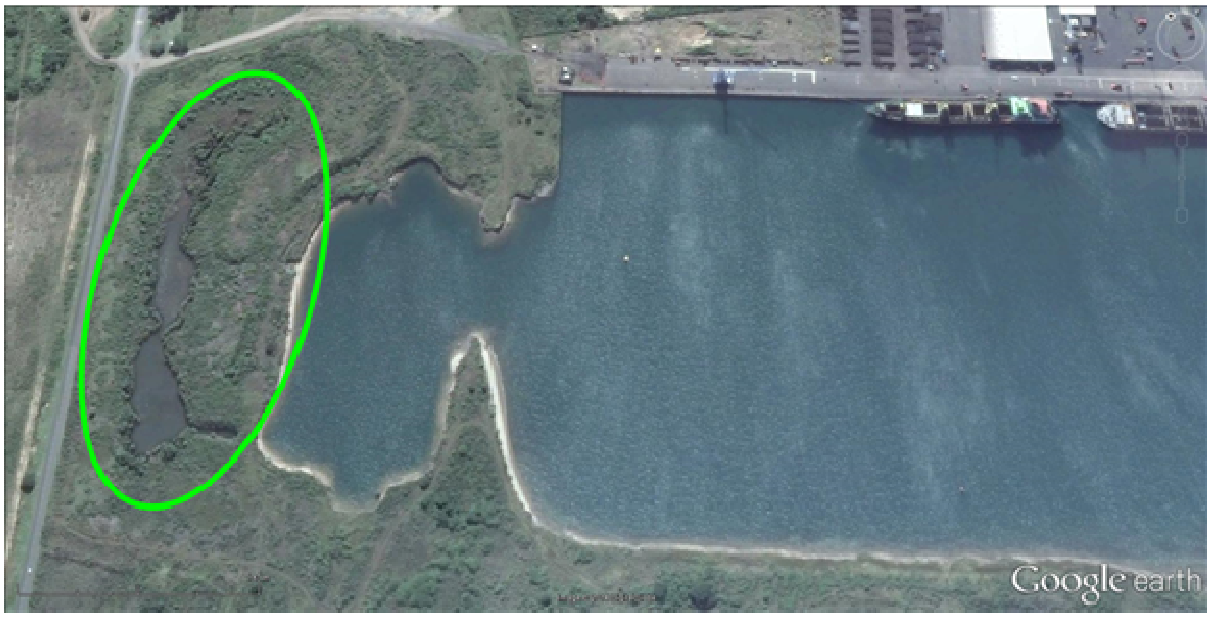

Figure 4.1 The Intertidal Shallows (enclosed in green) within the Berth 600 Series Extension area (Site C – Figure 1.1).

4.4.2 Frogs

The once-off study of the frog fauna (Du Preez 2014) indicates that the loss of the habitat present will not be of any significance to the frog population in the greater uMhlathuze area due to the fact that there are limited freshwater habitats on the site.

4.4.3 Birds

Results from the limited once-off study indicate that the bird fauna is fairly depauperate and no Red Data species or species of significance were recorded. The loss of this habitat will not be of any significance to the bird population in the greater uMhlathuze area. However, information from the Final Scoping Report for the TCP Richards Bay Port Expansion project (AECOM 2014) indicates that there will be an impact on the sand spit that lies between the harbour channel and the Kabeljous Flats. Due to not being part of this study, this matter is Red Flaged as it is considered not only to result in a potentially significant impact on the bird fauna but on ecosystem functioning of the highly significant Kabeljous Flats as a whole. The detail related to this is provided in Cyrus (2014). A second Red Flag has also been identified and relates to the fact that no evaluation of the birds or other fauna has been undertaken for the infrastructure foot print around the Berth 600 Series Extension or to issues relating to the re-routing of the harbour access road to the coal terminal quays.

4.4.4 Intertidal Shallows (with Mangroves & Seagrass)

This habitat (Figure 4.1) was not included as part of the specialist studies CRUZ-E was tasked with undertaking. However, its discovery during the vegetation survey and potential significance prompted CRUZ-E to undertake a limited investigation of the fauna and flora the habitat.

Large numbers of small to medium sized juvenile fish of many estuarine and estuarine dependent species as well as very small sized juvenile prawns were recorded utilizing the site which has a well-established *Zostera capensis* population. This area has been identified as a significant ecosystem that is not known to occur anywhere else in the port.

4.5 WATER QUALITY, TURBIDITY & SEDIMENT METAL REPORTS

A brief Summary of Comments from the Review is presented here, the full review is contained in Cyrus & Vivier (2014).

The CSIR produced four reports for the Scoping Report as well as developing sediment dispersal models related to the planned dredging activities. The latter were not available in time to be reviewed by CRUZ-E and are not covered by this report. The reports are as follows,

1. CSIR. (2013a). Richards Bay Expansion Programme: Metal contamination of sediment and implications for dredging - technical report. CSIR Report CSIR / NRE / ECOS / ER / 2013 / 0022 / C.
2. CSIR. (2013b). Port of Richards Bay expansion programme: Turbidity and total suspended solids. CSIR Report CSIR/NRE/ECOS/ER/2013/0027/C.
3. CSIR. (2013c). Port of Richards Bay expansion programme: Implications of a basic water quality survey. CSIR Report CSIR/NRE/ECOS/ER/2013/0028/C.
4. CSIR. (2014). Definition of Turbidity and Suspended Solids Concentration Thresholds for Dredging Compliance Monitoring in and near Richards Bay. CSIR Report CSIR/NRE/ECOS/ER/2014/00XX/B.

The CSIR Metal contamination of sediment and implications for dredging (technical) report provided a high resolution spatial understanding of metal contamination of sediment, not only in the expansion footprint, but across the port. It has provided much needed insight into the potential ecological implications of dredging of potentially contaminated sediments

required for the port expansion. Recommendations were made with regard to mitigation of the current contamination levels and also how to approach the environmental and legal issues related to the dredging of the sediment. The primary issues raised in the report included that the Inner Basin complex contained metal contaminated sediment of anthropogenic origin, more specifically related to port associated activities. The major implications for the proposed Richards Bay Port Expansion programme was the possibility that the DEA may prohibit unconfined openwater disposal of sediment dredged from certain contaminated areas of Inner Basins 2 and 3, where concentrations of some metals exceeded the Level II of the South African sediment quality guidelines.

The CSIR Turbidity and total suspended solids report provided comprehensive overview of TSS and water turbidity, the availability of relevant data on these parameters in the port, the need for continued focused monitoring and the potential effects associated with elevated levels of these parameters. Turbidity and total suspended solids concentrations at all stations in the port, were relatively low, with the implication that the water in the port (at least at the 15 sites sampled) was relatively clear and there was no cause for concern related to elevated TSS concentrations. It was however, acknowledged that there is too little data to define turbidity and total suspended solids baselines for all areas of Richards Bay, notably for the Inner Basin complex, where the majority of construction activities for proposed expansion footprint will be. As a result, further monitoring/research prior to and during construction will be required for the definition of baselines and to estimate the potential ecological risks associated with dredging.

The CSIR basic water quality survey provided a detailed overview of the water quality of the port and the potential implications for the port expansion programme. The implications of elevated nutrient concentrations from surface runoff and anthropogenic activities raises concerns related to the potential eutrophication of the dead-end Inner Basins 1, 2 and 3 in the proposed Richards Bay Port Expansion programme. The implication for the proposed expansion programme is that if port development further restricts the exchange of water between ‘dead-end’ basins and the greater Richards Bay and anthropogenic nutrient inputs continue then there is strong possibility that eutrophic conditions may manifest. This will ultimately lead to the development of hypoxia and possibly even anoxia in bottom water and sediment, with a host of associated adverse ecological impacts. Careful consideration must, therefore, be given during the infrastructure design phase for achieving the maximum possible water exchange between ‘dead-end’ basins and the greater Richards Bay.

The CSIR repport on Turbidity and Suspended Solids Concentration thresholds for Dredging Compliance Monitoring provides a detailed and comprehensive overview of the importance of turbidity and suspended solids concentrations during compliance monitoring for dredging during the upcoming Richards Bay Port Expansion project. Relevant turbidity and suspended solids threshold concentrations were derived based on field and laboratory data and using appropriate regression methods. Importantly, guidelines are provided for compliance monitoring in terms of the frequency and duration of monitoring and the methodology to be used. Guidelines are also provided for openwater spoil disposal compliance monitoring, based on the outcome and lessons learnt during previous monitoring programmes.

4.6 MARINE & TERRESTRIAL ECOLOGICAL BASELINE REPORT

A brief Summary of Comments from the Review is presented here, the full review is contained in Cyrus & Vivier (2014).

The review report by MER (2013) provided comprehensive insight into the Marine (& Estuarine) and Terrestrial habitats and their ecological importance and functional contribution. In order for Richards Bay Harbour to continue functioning as a significant ecosystem, cognisance needs to be taken of these habitats and it should be ensured that there is sufficient of each remaining after all future projected developments of the port have occurred, ensuring that each habitat can still make a contribution to overall ecosystem functioning.

A criticism of this report is that despite there being a significant mangrove stand and large intertidal sandflats in the Rail Balloon site (also known as the ‘Casuarinas’) these are not included in any part of the review nor are they shown on any of the habitat maps in the report. As pointed out by Vivier & Cyrus (2014) these two habitats may make a major contribution to the ecological functioning of the ports estuarine type habitat.

4.7 DREDGE SPOIL DISPOSAL SITES REVIEW

A brief Summary of Comments from the Review is presented here, the full review is contained in Cyrus & Vivier (2014)

While the review of options for dredge spoil disposal are treated comprehensively, the BKS (2013) report falls well short on matters associated with land based disposal. This

particularly as an old 'Full Development Plan of the Port' assessed by CSIR (2004) was used as the basis of the assessment. In addition CRUZ-E believe that the assessment of environmental impacts related to spoil disposal may not be as comprehensive as they should be in line with the significance of the ecosystems in the Port of Richards Bay and the adjacent Mhlathuze Estuary that may be impacted by these activities. Furthermore land based dispersal of spoil containing a high salt content would have substantial impacts on the fauna and flora. Based on the selected sites in BKS (2013) study and results of previous investigations into dredge spoil disposal, it is concluded that offshore disposal would ecologically be the best option.

5. DISCUSSION & RECOMMENDATIONS

The aim of this section is to provide discussion on the issues that have been raised from the results of the specialist studies and to provide recommendations as to a way forward.

5.1 SITE A – RAIL BALLOON AREA

5.1.1 Important Habitats

Intertidal Mangrove and Sandflats are both important ecosystems in terms of Richards Bay Harbour as well as KwaZulu-Natal estuaries as a whole.

5.1.1.1 Intertidal Mangroves

Intertidal mangroves and swamp forest habitats in Richards Bay Harbour are individually recognised as sensitive floral communities with conservation significance. MER (2104) have indicated that *"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. Also protected are the plants associated with the mangroves as well as individual resident species including fiddler crabs, mangrove*

whelks and mudskippers. 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. 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".

Three mangrove species occur in both the Richards Bay and Mhlathuze estuaries these are *Avicennia marina, Bruguiera gymnorrhiza and Rhizophora mucronata*. There are large stands of Mangroves present in both Richards Bay and the Mhlathuze Estuary with all three of the mangrove species that occur being wide spread in the area (MER 2013). However the majority of these largely monospecific stands *of Avecennia marina* that have colonised areas of sediment deposition from the Mhlathuze River and the greater tidal range that has resulted from the dredging of the new mouth for the Mhlathuze River in 1975. MER (2013) have pointed out 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".*

It would appear however that no consideration was given by MER (2013) to the large stand of mangroves, which has all three species present, in the Rail Balloon area as it is not demarcated as 'Mangrove Forest' in their Figure 2-4. This area had already been identified by Cyrus *et al.* (2008) as an area containing the mangrove *Bruguiera gymnorrhiza*. Based on Figure 5.1 it would appear that the Rail Balloon Mangroves occupy a greater area (possibly twice the size) than that of the Echwebeni Reserve Heritage Site. The latter site covers 54 ha however this includes three additional plant communities as mentioned above by MER (2013). Reed/papyrus swamp and swamp forest also occur in the Rail Balloon area and the outer edge of the mangrove forest is bounded by a Samphire zone (area of high salt content in the soil) referred to as 'salt pan' by Mostert (2014). In addition Seasonal Wetlands are also

present adjacent to the mangroves (Mostert 2014). This potentially indicates a larger and far more florally and faunally diverse area than the Echwebeni Reserve Heritage Site.

Mostert (2014) has indicated that ecosystem functionality in the mangrove habitat is still very high and that the conservation value of this plant community is therefore regarded as very high. This is confirmed by the utilization of this area by many estuarine dependent species. Furthermore the large number of fish from this group that were netted in the Intertidal Sandflats may well have been waiting for the onset of high tide in order to be able to access and utilize the Intertidal Mangrove area for feeding.

5.1.1.2 Intertidal Sandflats

Results from the limited once-off study undertaken for this project have shown that this area is utilized by a number of faunal groups.

Open intertidal sandflats are an important and limited habitat type within the KwaZulu-Natal estuaries. These are highly productive and considered extremely critical habitat for a variety of invertebrate and fish populations (MER 2014). They noted that the total intertidal sand flat area in South African estuaries was limited and that much of it has already been lost to development, particularly in KwaZulu-Natal where there have been substantial losses from both Durban and Richards Bay Harbours.

As part of a Strategic Environmental Assessment (SEA) for the Port of Richards Bay, a study was done on the natural habitats within the Port Development Framework (PDF) boundary (CSIR 2005). The study assessed the conservation significance or value of each habitat type based on selected criteria related to quality or value. Ten criteria were used to assess the ecological value of each habitat, such as size of habitat, biodiversity, naturalness of habitat and species rarity. Of particular relevance to this report are the rating scores of the intertidal and mangrove habitat types (Table 5.1). Of all the identified habitats within the PDF, intertidal sandflats were scored the highest in terms of ecological significance, with a score 27/30. This habitat was reported to support a high biodiversity, provides shelter and a feeding ground for juvenile fish, is utilised by birds and is important in ecological functioning through nutrient processing. Large sand flat habitats such as that in the Rail Balloon area are rare in KwaZulu-Natal and only occur within the larger estuaries such as the Mhlathuze Estuary, Kosi Bay and Durban Harbour, adding substantially to its ecological significance (CSIR 2005).

Figure 5.1 Stands of mature mangroves in Richards Bay Harbour, Yellow Box = Echwebeni Reserve Heritage Site & Green Box = Rail Balloon Mangrove Site.

5.1.2 Impacts & Opportunities

Based on the final Scoping Report for the project (AECOM 2014), the initial phase of development involves construction of the Rail Balloon and Ferro Drainage in the northern half of this site (See AECOM 2014; Figure 2-4). The impact will be the loss of the entire northern half of the site. Mostert (2014) has indicated that disturbances during construction in non-wetland habitats may have far reaching effects on the wetland and mangrove habitats themselves due to disturbance of the hydrological structure of the subsurface area. It is considered that the loss of the two habitats will result in a direct loss of nationally protected habitats in an area considered as a whole to have a very good potential to be rehabilitated back to a highly functional wetland and estuarine habitat (Mostert 2014).

With full development of the project (See AECOM 2014; Figure 2-2) the entire site will be lost to key development, and the impact will be total. Based on the development plan, no opportunities are envisaged for mitigation in relation to the habitats present.

Table 5.1: The Ecological significance scores of the different habitat types within the proposed boundary in the Port of Richards Bay (information from CSIR (2005)).

Habitat type	Score (Max 30)
Sandflats	27
Mudflats	26
Papyrus Swamp	26
Hygrophilous Trees (swamp forest)	25
Mangrove Swamps	25
Freshwater pans/channels	24
Tidal Artificial Channel	23
Reed Swamp	23
Rivers	21
Harbour (Marine embayment)	20
Intertidal Beaches	17
Deepwater Sediments	13

5.1.3 Constraints, Mitigation & Activity Management

The major constraint on the development of the site is the fact that intertidal sandflats and mangroves have been shown ecologically to be some of the most important and sensitive habitats in Richards Bay Harbour (CSIR 2005) and are considered rare habitat in KwaZulu-

Natal. In total, approximately 34% of the site to be developed consists of intertidal sand flat and mangroves which is a significant constraint to the development going ahead.

Mitigation of the first phase of the development would need to involve an understanding of the hydrological dynamics of the entire site so as to reduce impacts on the remaining habitats that are connected to it. The only possible mitigation related to full development of the site, if approved by the relevant authority, would be to offset the intertidal sand flat and mangrove areas lost during the development.

It is unfortunate that this study was carried out when the Wetland was at its driest for many years as it is considered that it may have been found to hold an important species composition. Comparison with the bird fauna of Thulazihleka Pan (Figure 5.2), an important water bird habitat, give some indication as to the diversity and density of species that may be present under normal rainfall conditions. Constraints imposed by the loss of the wetland habitat could potentially be mitigated for by some form of offset related to Thulazehleka Pan. Despite being afforded some conservation status by the uMhlathuze Municipality, this pan needs a management plan to be drawn up, implemented and monitored so as to able to maintain this important ecosystem.

5.1.4 Minimizing Environmental Risks

During the first phase development, issues related to minimizing impacts on the remaining habitats on the site will need to be considered and relevant measures implemented. This would include implementation of measures to prevent contaminated storm water runoff, including that from the proposed surge dam, from entering the intertidal mangroves and ending up on the intertidal sandflats. Measures to implement a buffer zone between developmental activities and the remaining habitat should be considered.

During the final phase of development, when all habitats will be lost, environmental issues related to sediment dispersal and increased water turbidity during dredging, and possible heavy metal contamination of adjacent areas will need to be mitigated for in order to minimize any environmental risks. The Environmental Scoping Report for development of Berth 306 (AECOM 2014) identified the disturbance of fine sediments during dredging and the disposal of this dredged spoil as the cause of greatest concern to the ecology of the surrounding beach, estuarine and marine environments (Institute of Natural Resources 2005, CSIR 2008).

5.1.5 Offset Recommendations

If an Offset is to be established for the loss of the Intertidal Mangrove and Sandflats habitat this should include guaranteed conservation status for the area in question. The offset should form part of the planned offsets for the full development of the port as determined and specified in the TNPA Due Diligence Investigation (Cyrus & Vivier 2009; Elliott *et al*. 2009). These reports evaluated offsets for the TNPA 'Preferred' Development Option, a 'Potential Environmentally Acceptable' Development Option and an option for development only within the current port boundary. The critical issue related to offsets is that they need to be developed well in advance of the loss of habitat that is due to take place (Elliott *et al*. 2009).

In terms of the loss of the Wetland habitat the offset could be in the form of an intervention to assist uMhlathuze Municipality develop, implement and maintain a management plan for the ecologically important Thulazhileka Pan that will ensure that it maintains itself as a functional wetland ecosystem (Figure 5.2).

Figure 5.2 Relative position of the Rail Balloon wetland and (Red circle) and Thulazihleka Pan (Green circle).

5.1.6 Overall Recommendations

This study has identified a number of gaps in the information base which need to be addressed prior to decisions being able to be made regarding ecosystem loss and the associated impacts on various faunal groups and the way forward with the development.

1. More detailed investigation of the status of the intertidal mangrove area is needed so that its significance in relation to the currently conserved Echwebeni Reserve Heritage Site and other mature mangrove stands can be determined.
2. With regard to the intertidal sandflats, an assessment needs to be undertaken as to the contribution of the area to the total sand flat habitat within the port so that the significance of its loss may be determined.
3. With regard to the wetland, an assessment needs to be made as to the feasibility of developing, implementing and maintaining a management plan for Thulazihleka Pan as an offset for the loss of the wetland.

5.2 SITE B – FINGER JETTY EXTENSION

5.2.1 Important Habitats

There are no important ecologically sensitive habitats in the area of development. However, in close proximity are ecologically sensitive areas such as the intertidal sandflats on the Sand Spit and the intertidal Kabeljous mudflat. Macrobenthic sites selected for this component of the study are considered to be suitable monitoring sites for use during development.

5.2.2 Impacts & Opportunities

While the impacts of piling for the development will be limited to the immediate area of construction, any dredging activities have the potential to affect a wider area. The effective opportunity is that from an ecological perspective the loss of fauna in the deep channel will have a negligible impact on the macrobenthic community of the harbour as a whole.

5.2.3 Constraints, Mitigation & Activity Management

Constraints related to this section of the project are limited and revolve mainly around potential impacts outside the area of development. These would be in the form of impacts on the fauna of high sediment loads in the water column and on the substrate should it settle out in sensitive areas or if contaminated sediments were distributed through the water column.

Mitigation and associated Activity Management would need to take the form of a before, during and after monitoring programme, with a set of Limits of Acceptable Concern being built in, this should be implemented at the selected monitoring sites prior to development of the site taking place. This has been dealt with by CSIR (2014).

5.2.4 Minimizing Environmental Risks

Environmental Risks could be minimised through the implementation of a monitoring programme as referred to in 5.2.3 above. Precautions to minimize the environmental risk of re-suspension of fine sediments and distribution of potentially contaminated sediment should be implemented. In terms of the latter, the area in the immediate vicinity of the development has been shown by the CSIR (2013) as having moderate to high levels of certain heavy metals. The highest probability for metal concentrations in dredged sediment to elicit toxic effects to bottom-dwelling organisms was in the current Berth 600 Series basin, which is adjacent to the development site.

5.2.5 Offset Recommendation

No offsets are required for this component of the development.

5.2.6 Overall Recommendations

This study has identified no gaps in the information base which would need to be addressed prior to decisions being able to be made regarding the way forward with the development.

5.3 SITE C – BERTH 600 SERIES EXTENSION

5.3.1 Important Habitats

5.3.1.1 Shallow Intertidal (seagrass & mangroves)

The discovery of well-established stands of *Zostera capensis* which is being utilized by the fauna in the Intertidal Shallows area is of great significance due to the contribution it is making in terms of estuarine ecosystem functioning within Richards Bay Harbour. It is also significant due to this species having been absent from the harbour for more than 30 years and the fact that it is now on the IUCN Red List of Threatened Species and designated as Vulnerable.

5.3.1.2 Kabeljous Sand Spit

While not part of this study CRUZ-E has identified that this habitat and in fact the ecological function of the Kabeljous Flats (Figure 5.3) may be at risk due to the proposed dredging of

the Berth 600 Series Extension. Figure 2.3 of Final Scoping Report (AECOM 2014) indicates that there will be a 'dredged' area or slope area southwards of the 24m Dredged Channel which is planned to be dredged and that this will impinge on and cut away a section of the Sand Spit (Figure 5.4) that protects the Kabeljous Flats, for more details see Cyrus (2014). Ecologically Kabeljous Flats is of great significance in terms of the Port of Richards Bay maintaining a functioning estuarine type ecosystem. In addition the Sand Spit which is a major intertidal area has in the past been identified as potentially being of significance in terms of the fauna present, this includes a bird component (Vivier & Cyrus 2009)

5.3.2 Impacts & Opportunities

The impact of the Berth 600 Series Extension will be total as the area assessed (Figure 1.1 – Site C) will all be dredged, this will result in the loss of the Shallow Intertidal habitat which holds established stands of the Red Data species *Zostra capensis*. In addition to this there will be additional impacts, which were not assessed as part of this study, these will be in the Quay footprint that will be developed for the berth extension around the dredged channel. In addition impacts relating to re-routing of the coal terminal access road have not been covered. Furthermore it appears from the Final Scoping Report (AECOM 2014), that there will be impacts on the Sand Spit which forms the northern boundary of the Kabeljous Flats (Figures 5.3 & 5.4). These have been identified as potentially having significant impacts on ecosystem functioning in Richards Bay Harbour.

Due to the fact that the development of the quays will result in all habitats in the designated study area being lost no Opportunities have been identified. However, dependent on the composition and number of additional berths in the 600 expansion, it may be possible to avoid the loss of the *Zostra capensis* bed.

5.3.3 Constraints, Mitigation & Activity Management

The major constraint to the development of the site is due to the significance of the Zostera capensis beds which occur in the area which are ecologically of significance, this is a Red data species. Furthermore two potential Red Flags have been identified these are;

1. Red Flag 1: No assessment has been done on the impact on the bird fauna associated with the Swamp Forest to the West of the designated site. However it is considered that infrastructure development (including Quay footprint) and road re-routing will impact on the habitat.

Figure 5.3 Position of the Kabeljous Flats, associated structures and habitat types in the Port of Richards Bay. Blue stippled line indicates the boundary of the flats.

Figure 5.4 Sand Spit habitat on the northern boundary of the Kabeljous Flats (1 = Area of potential impact).

2. Red Flag 2: No assessment has been done on the impact on the bird and other fauna associated with the Sand Spit or the Kabejous Flats. The Final Scoping Report for the project (AECOM 2014) indicates that dredging associate with the extension of the Berth 600 Series Extension will impact on this area which is utilized by waders, terns and gulls. The Sand Spit is also an important intertidal area, a habitat that is ecologically significant and whose area of occurrence within the port and KwaZulu-Natal as a whole has been declining (Vivier & Cyrus 2009 MER 2014). The Kabeljous Flats is protected from the impact of wave action from passing ships and tidal surge by the Sand Spit. Information in the Final Scoping Report for the project (AECOM 2014) indicate that dredging associated with the extension of the Berth 600 Series Extension will remove part of the Sand Spit creating a gap between the deep water channel and the Kabeljous Flats which could change the dynamics of the area.

Mitigation options for the Shallow Intertidal where the *Zostera* occurs are limited and only some form of offset may be an option. In terms of mitigation related to the two Red Flags identified, these did not form part of this study but do need to be addressed.

5.3.4 Minimizing Environmental Risks

During development, when all habitats will be lost, environmental issues related to sediment dispersal and increased water turbidity during dredging, and possible heavy metal contamination of adjacent areas will need to be mitigated for in order to minimize any environmental risks. The area in the immediate vicinity of the development has been shown by the CSIR (2013) as having high levels of a number of heavy metals. Figure 5.5 shows the number of metals exceeding warning levels and their distribution in the port as determined by CSIR (2013). The highest probability for metal concentrations in dredged sediment to elicit toxic effects to bottom-dwelling organisms was in the current Berth 600 series basin, referred to as the Inner Basin in Figure 5.5, which is the development site. Dredging in this area therefore has a high environmental risk associated with it. The Environmental Scoping Report for development of Berth 306 identified the disturbance of fine sediments during dredging and the disposal of this dredged spoil as the cause of greatest concern to the ecology of the surrounding beach, estuarine and marine environments (Institute of Natural Resources 2005, CSIR 2008). In terms of minimizing environmental risks related to the two Red Flags identified, these did not form part of this study but do need to be addressed.

5.3.5 Offset Recommendation

If an Offset is to be established for the loss of the Shallow Intertidal habitat where the *Zostera* occurs this should include guaranteed conservation status for the area in question. In terms of the potential need for offsets related to the two Red Flags identified, these did not form part of this study but do need to be addressed. Any offset should form part of the planned offsets for the full development of the port as determined and specified in the TNPA Due Diligence Investigation (Cyrus & Vivier 2009; Elliott et al. 2009). These reports evaluated offsets for the TNPA 'Preferred' Development Option, a 'Potential Environmentally Acceptable' Development Option and an option for development only within the current port boundary. The critical issue related to offsets is that they need to be developed well in advance of the loss of habitat that is due to take place (Elliott et al. 2009).

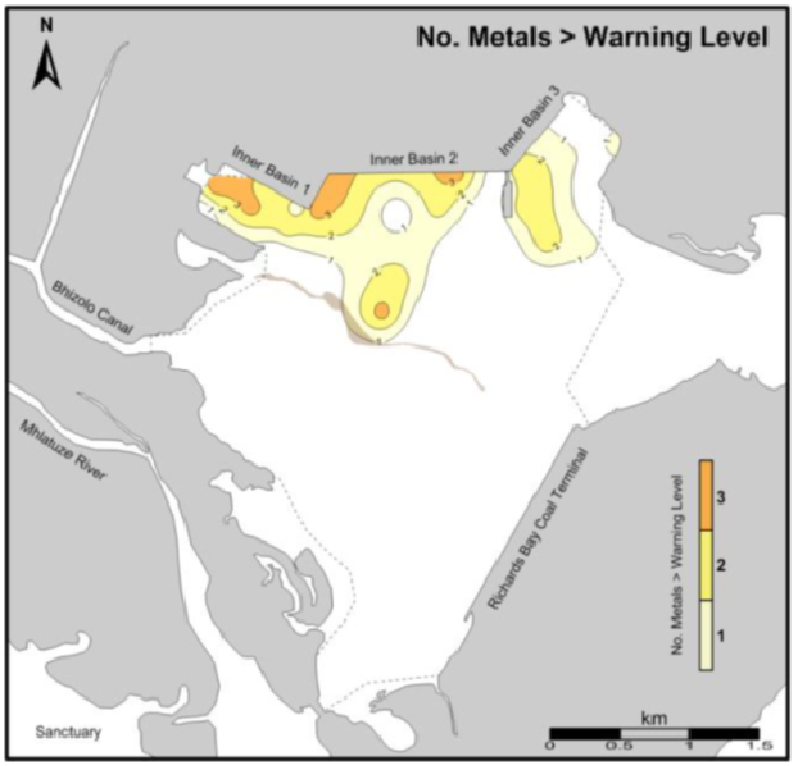

Figure 5.5: Spatial trend for the number of metal concentrations in sediment collected from Richards Bay in 2012 that exceeded the Warning level of the sediment quality guidelines used to determine whether sediment identified for dredging in SA ports is of a suitable quality for unconfined open water disposal (CSIR, 2013).

5.3.6 Overall Recommendations

This study has identified a number of gaps in the information base which need to be addressed prior to decisions being able to be made regarding ecosystem loss and the associated impacts on various faunal groups and the way forward with the development.

1. A detail investigation of the distribution and ecological status of *Zostera capensis* within Richards Bay Harbour and the Mhlathuze Estuary is needed in order to establish the extent of occurrence and the overall significance of the stands present on the site to be developed.
2. Should the dredging for the development be going to impact on the Sand Spit, as indicated in Figure 2-3 of the Final Scoping Report (AECOM 2014), an investigation into the ecological status of this area, its contribution to the total sandflats habitat within the port, the significance of its loss and the potential impact on ecosystem functioning of the Kabeljous Flats needs to be undertaken. This matter lies outside the area designated for this study. MER (2104) have identified that *"An improved understanding of the ecological value of the intertidal sand and mudflats on the western boundary of the port known locally as the Kabeljous Flats is needed"*.
3. Should the infrastructure footprint of the Quay be going to impact on habitat outside of that area designated as Site C (Figure 1.1) then an assessment of habitats present which will be lost will need to be undertaken as this did not form part of the current study.

6. CONCLUSIONS

This section aims to draw conclusions regarding the possible implications of the recommendations related to a successful completion of the Environmental Impact Assessment of the TCP Richards Bay Harbour Expansion project.

6.1 IMPORTANCE OF RICHARDS BAY AS AN ESTUARINE ECOSYSTEM

Numerous reports have highlighted the significance of Richards Bay Harbour as a functional estuarine ecosystem and that it makes a major contribution in this regard both in terms of KwaZulu-Natal and Nationally (CSIR 2005; Cyrus & Vivier 2009; MER 2013 and many more). MER (2013) has stated that *"It is, therefore, unsurprising that it (Richards Bay Harbour) has been selected as one of the core estuaries to satisfy the biodiversity targets of the provincial and national Conservation Plans (Turpie et al. 2012). In fact, at a provincial level this estuary is considered "irreplaceable".* This is almost certainly the case from a National level as well.

In the most comprehensive and up to data assessment of the ecological importance of South African estuaries, Turpie *et al.* (2002) ranked Richards Bay 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, rarity of estuary type, habitat diversity and biodiversity importance (in terms of species richness, species rarity or endemism; and abundance).

What is of particular importance to this study is that Nationally the port was ranked 3rd in the country for the ecological significance of its fish and for its bird communities, 5th for zonal type rarity with a score of 80% (classification of an estuary in conjunction with the biogeographical zone determines how "rare" or "unique" the estuary is for the zone under consideration), a score of 100% for estuarine size (score based on relative size of estuarine area in the country) and a very high score of 85% for biological diversity. In addition, as noted earlier (see section 6), Turpie (1995) ranked estuaries based on water bird assemblages and Richards Bay was ranked 3rd on the Abundance rating, 3rd on the Conservation Value Index, 2nd on the Endemism Index and 1st on the Population Size index.

In a more regional context, when Richards Bay Harbour is compared to the 22 Zululand estuaries in KwaZulu-Natal north of Durban (Table 5.2), the system is ranked 6th for overall conservation importance, 2nd for zonal rarity, 8th for biodiversity and is one of only four estuaries with a score of 100% for estuarine size.

6.2 INFORMATION GAPS IDENTIFIED IN THE EIA DATA BASE

The aim of the investigations and assessments undertaken by CRUZ-E were aimed at providing what is needed from an environmental perspective to meet the requirements for the Environmental Impact Assessment Phase. This has not been possible due to the fact that a numbers of gaps in the required data have been identified. Most of these have come to light as a result of the work that CRUZ-E has carried out on this project and include such issues as those associated with the discovery of *Zostera capensis* in the harbour. Others have been identified as areas not covered in the brief, such as the potential impact of proposed dredging on the Sand Spit, possible impacts on the Kabiljous Flats and the impact of the infrastructure development foot print associated with the dredging for the Berth 600 quay.

Specific details pertaining to information gaps identified related to each of the three study sites shown on Figure 1.1 and are provided under Sections 5.1.6, 5.2.6 and 5.3.6.

Table 5.2. Conservation Importance ranking of the 22 estuaries in KwaZulu-Natal from Durban Bay northwards. (See Turpie *et al.* 2002 for description of criteria).

Estuary	Rank	Conservation Importance %	Size %	Habitat %	Zonal Rarity %	Biodiversity %
Kosi Bay	1	96.9	100	100	70	99.5
St Lucia	2	96.6	100	100	70	98.5
Mhlathuze	3	93.5	100	100	80	82.0
Mfolozi	4	91.1	90	100	70	92.5
Mlalazi	5	85.0	90	90	30	94.0
Richard's Bay	6	81.8	100	50	80	85.0
Matigulu/Nyoni	7	78.8	90	70	30	89.0
Mgeni	8	77.6	80	90	10	88.5
Nhlabane	9	77.0	100	50	70	70.0
Mhlanga	10	71.9	90	70	10	69.5
Mdloti	11	71.4	80	90	10	63.5
Tugela	12	70.6	80	50	70	76.5
Zinkwasi	13	68.6	60	90	10	84.5
Mhlali	14	68.1	60	90	10	82.5
Mdlotane	15	67.9	70	90	10	65.5
Tongati	16	61.4	70	80	10	49.5
Durban	17	59.9	10	100	80	91.5
Mvoti	18	58.4	60	30	70	79.5
Mgobezeleni	19	53.0	20	80	70	72.0
Nonoti	20	51.1	60	60	10	44.5
Siyaya	21	49.5	40	60	10	70.0
Seteni	22	37.8	20	80	10	35.0

6.3 MOVING FORWARDS WITH THE EIA PROCESS

From a CRUZ-E perspective the way forward towards finalizing the EIA is that the data gaps identified for each of the three sites need to be investigated. This will allow for the full assessment of potential impacts on the biotic environment caused by the proposed activities at each site. The outcomes of this should lead to the Environmental Assessment Process moving forward to completion.

6.4 TNPA DUE DILLIGENCE INVESTIGATION & FULL DEVELOPMENT OF THE PORT

Finalization of any plans for development related to the TCP Richards Bay Port Expansion project should be undertaken taking cognisance of the framework of the TNPA Due Diligence Investigation for the future full expansion of Richards Bay Harbour by Illifa Africa Engineers (Pty) Ltd. (2008 & 2010). This investigation considered the potential impacts of four development scenarios on the environment and how any habitat losses could be mitigated (Cyrus & Vivier 2009). Included in these was an option related to development only taking place within the current area of the port. If development proceeds without taking cognisance of future development and offset requirements this could have major implications for the long term development of the Port of Richards Bay. The critical issue related to offsets is that they need to be developed well in advance of the loss of habitat that is due to take place (Elliott *et al*. 2009). This should be taken into account during the EIA process for the current TCP Richards Bay Port Expansion project.

7. REFERENCES

AECOM. (2014). Proposed Richards Bay Port Expansion Programme within Umhlathuze Local Municipality in Kwa-Zulu Natal Province. Final Scoping Report, 122 pages.

Begg, G.W. (1978). The Estuaries of Natal. *Natal Town and Regional Planning Report* **41**: 1-657.

BSK. (2013). Richards Bay Port Expansion Programme Dredge Disposal Site Selection. Unpublished Report for Transnet SOC Limited. Project J02031, 31 pages.

CSIR. (2004). Evaluation of Options for the Disposal of Dredge Spoil at Richards Bay. CSIR Draft Report.

CSIR. (2005). Strategic Environmental Assessment Port of Richards Bay State of the Environment Report Report No. ENV-D-C 2004-022 Prepared for: National Ports Authority Port of Richards Bay CSIR: Environmentek. Unpublished.

CSIR. (2008). Biomonitoring of dredging operations associated with the development of Berth 306, Richards Bay: Final report. CSIR Report No. CSIR / NRE / ECO / ER / 2008 / 0131 / C.

CSIR. (2013). Richards Bay Expansion Programme: Metal contamination of sediment and implications for dredging - technical report. CSIR Report CSIR / NRE / ECOS / ER / 2013 / 0022/ C.

CSIR. (2014). Definition of Turbidity and Suspended Solids Concentration Thresholds for Dredging Compliance Monitoring in and near Richards Bay. CSIR Report CSIR/NRE/ECOS/ER/2014/00XX/B.

Cyrus, D.P. (2014). Bird Fauna of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.13:** 1-20.

Cyrus, D.P. & Forbes, A.T. (1994). The Role of Harbours in Natal, South Africa as alternative nursery sites for juvenile marine fish normally utilizing estuaries. In: Systematics and Evolution of Indo Pacific Fishes. Proc. 4th Indo Pacific Fish Conference, Bangkok, Thailand, 1993, pp340 353.

Cyrus, D.P. & Forbes, A.T. (1996). Preliminary results on the role of KwaZulu Natal harbours as alternative nursery grounds for juveniles of selected marine organisms which utilize estuaries. *S. Afr. J. Wildl. Res.,* **26:** 26 33.

Cyrus, D.P. & Vivier, L. (2009). Due Diligence Investigation Expansion of Richards Bay Harbour: Overall Assessment of Estuarine and Freshwater Components. *CRUZ Investigational Report,* **No.139**: 1-134.

Cyrus, D.P. & Vivier, L. (2014). Review of Biotic & Abiotic Reports produced for the Scoping Report on Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.11**: 1-28.

Cyrus, D.P. & Vivier, L. (2014). Aquatic Vegetation and Fish associated with the Berth 600 Series Extension in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.17**: 1-21.

Cyrus, D.P., MacKay, C.F. & Weerts, S.P. (2008). Intrusion of beach-disposed dredger spoil into the Mhlathuze Estuary, South Africa and its impacts on *Zostera capensis*. *Afri. J. Aquat. Sci.*, **33(3):** 223-231.

Du Preez, L.H. (2014). Frog Fauna of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.14:** 1-13.

Elliott, M., Cutts, N., Cyrus, D.P., Thompson, S.M., and Vivier, L. (2009). Expansion of Richards Bay Harbour: Review of Ecosystem Loss and Offset Development Potential. *CRUZ Investigational Report*, **No.138**: 1-43.

Forbes, A.T., Demetriades, N.T. & Cyrus, D.P. (1997). The significance of Harbours as Coastal Marine Environments in KwaZulu Natal, South Africa. *Aquatic Conservation: Marine & Freshwater Ecosystems*, **6:** 331-341.

Ilifa Africa Engineers (Pty) Ltd. (2008). Due diligence investigation for the acquisition of land for future port development. Gap Analysis. Draft report submitted to Transnet under contract No. RB 2008/12: Unpublished.

Ilifa Africa Engineers (Pty) Ltd. (2010). Due diligence investigation for the acquisition of land for future port expansion. Port of Richards Bay. Final Report (Revision 1) Volume 1. Report prepared for Transnet National Ports Authority. Unpublished.

Institute of Natural Resources (2005). Biomonitoring programme for the aquatic environmental impacts associated with the construction of Berth 306 Richards Bay. Report for TNPA.

MER (2013). Baseline Ecological Assessment for the Port of Richards Bay Expansion Programme – Selected Aquatic and Terrestrial Habitats. *MER Report* **7/2013.**

Mostert, T.H.C. (2014). Vegetation & Wetland Assessment of Priority Habitats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.12:** 1-99.

Short, F.T., Coles, R., Waycott, M., Bujang, J.S., Fortes, M., Prathep, A., Kamal, A.H.M., Jagtap, T.G., Bandeira, S., Freeman, A., Erftemeijer, P., La Nafie, Y.A., Vergara, S., Calumpong, H.P. & Makm, I. (2010). *Zostera capensis*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. < www.iucnredlist.org >.

Turpie, J.K. (1995). Prioritizing South African estuaries for conservation: a practical example using waterbirds. *Biological Conservation* **74**: 175-185.

Turpie, J.K., Adams, J.B., Joubert, A., Harrison, T.D., Colloty, B.M., Maree, R.C., Whitfield, A.K., Wooldridge, T.H., Lamberth, S.J., Taljaard, S. and Van Niekerk, L. (2002). Assessment of the conservation priority status of South African estuaries for use in management and water allocation. *Water SA* **28:** 191 - 206.

Vivier, L., and Cyrus, D.P. (2009). Ecological Importance of the Intertidal Kabeljous Flats, Port of Richards Bay. *CRUZ Investigational Report*, **No.132**: 1-55.

Vivier, L. & Cyrus, D.P. (2014). Fish and Benthic Invertebrates Fauna associated with the Intertidal Mangroves and Sandflats in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.15**: 1-22.

Vivier, L. & Cyrus, D.P. (2014). Benthic Invertebrate Fauna associated with the Finger Jetty Extension in Transnet Capital Projects Richards Bay Port Expansion Project. *CRUZ Environmental Report*, **No.16**: 1-15.

ABRIDGED CURRICULUM VITAE

PROF. DIGBY PAUL CYRUS

Occupation:	Senior Academic & Estuarine Ecologist		
Positions:	Head: Department of Zoology (1995 to June 2014) Research Fellow (July 2014 to date)		
Organisation:	Department of Zoology, University of Zululand		
Address:	Private Bag X1001 KwaDlangezwa 3886 South Africa	**Tel:** +27 (0)35 9026738/6742 **Fax:** +27 (0)35 9026750 **Email:** cyrusd@unizulu.ac.za	
Place of Birth:	Pretoria, South Africa - South African Citizen		

Qualifications & Courses:	**BSc** (Zoology, Entomology)	**1977**
	BSc Hons (Hydrobiology)	**1978**
	MSc (*cum laude)* (Estuarine Ecology)	**1980**
	PhD (Estuarine Ecology)	**1984**
	Integrated Environmental Management - Theory & Practice	**1991**
	Offshore Marine Pollution	**1997**
	ISO 14001 Environmental Management Systems	**1998**
	Public Participation in EIA's – Theory & Practice	**2002**
Awards	**Southern African Society of Aquatic Scientists – Gold Medal**	**2011**

Academic Experience: Thirty three years' experience lecturing a wide range of Zoology related subjects as well a supervising numerous MSc and PhD students.

Research Experience: Forty years covering Estuarine, River, near-shore Marine and Coastal Lake environments. Have participated in numerous contract research projects such as the determination of the Environmental Reserve for Coastal Lakes and Estuaries, the effects of intrabasin transfer schemes in the area, A Strategic Environmental Scan with reference to Biotic components of the Richards Bay area and Instream Flow Requirements for Rivers. Involved with Freshwater Flow Requirements for Estuaries. Was part of the Scientific team that formulated the biological requirements for the South African Resource Directed Measures Legislation to determine Flow Allocations for Environmental Purposes for Estuaries & Rivers and the monitoring thereof.

Specialisations: Estuarine, River and Coastal Lakes Ecology. Flow Allocations for Environmental Purposes for Estuaries and Rivers based on Biotic component requirements. Fish Specialist. Also specialist in ornithological issues related to association of birds with Estuaries, Rivers and Coastal Lakes.

Environmentally Related Activities: Have been involved in over 130 research projects concerned with Environmental Impact Assessments on the ecology of nearshore marine, estuarine and freshwater systems and project leader/senior author on some 90 of these. Fields include specialist biological surveys, ecological assessments, biomonitoring, specialist review consulting, Estuarine Flow Requirements and numerous studies on impacts of developments on aquatic environments. Have been involved with Reserve determinations for the Mkomaas, Mhlathuze, St Lucia, Siyaya and Nhlabane Systems as well as with the revision of the estuarine RDM Protocols, Thukela Intermediate EFR study and development of Estuarine Base line and long term Monitoring Protocols for RDM of Estuaries. Assessment of the Environmental Impacts of the development of the Port of Richards Bay over the next 40 years.

Presentation of Research Findings:

Publications:
146 Scientific Journal Publications (124 on Estuaries)
142 Environmental Project Reports

Conference Presentations:
76 National Conferences
67 International Conferences

Co-operative and Collaborative Research: Current and past involvement with the Universities of Natal (Durban & Pietermaritzburg) and Port Elizabeth, the SA Institute for Aquatic Biochemistry, KZN Wildlife, World Wildlife Fund - Conservation Division, National Ports Authority, Mondi Forests, Sappi Stanger Environmental Liaison Committee, CSIR, Institute for Natural Resources, Oceanographic Research Institute as well as three overseas based projects (University of Hull, UK & CSIRO, Australia).

Membership of Scientific Societies: Southern African Society of Aquatic Scientists (SASAqS), Estuarine and Coastal Shelf Sciences Society (ECSA), Consortium for Estuarine Research and Management (CERM), Zoological Society of South Africa & Ornithological Society of South Africa (Bird Life SA).

2014-11-10

ABRIDGED CURRICULUM VITAE

Dr LEON VIVIER

Occupation: Academic & Researcher
Organisation: Department of Zoology, University of Zululand

Address: Private Bag X1001
KwaDlangezwa 3886
South Africa

Tel: +27 (0)35 9026741
Fax: +27 (0)35 9026750
Email: lvivier@pan.uzulu.ac.za

Place Of Birth: Cape Town, South Africa - South African Citizen

Languages: English, Afrikaans

Qualifications:	**BSc** (Zoology, Biochemistry)	**1987**
	BSc Hons (Zoology)	**1988**
	MSc (Zoology)	**1992**
	PhD (Zoology)	**2010**

Experience: Twenty two years experience in estuarine ecological research on KZN rivers, estuaries and coastal lakes - mostly on zoobenthos, fish & water quality. Current fields of research include biology and ecology of estuarine zoobenthos and fish, and sediment toxicity bioassay procedure development for nearshore, estuarine and marine sediment and water. Have participated in many co-operative and contract research projects i.e. environmental biotic studies of Richards Bay Harbour and adjacent estuarine and wetland areas, environmental reserve for coastal lakes and estuaries, instream flow requirements for rivers,strategic environmental scan with reference to biotic components of the Richards Bay area, deign and monitoring of fishways in KZN, survey of water quality and biota of the Bivane and Phongola Rivers, ecostatus of the Phongolo river floodplain.

Specialisations: Zoobenthic & fish community ecology and water quality assessment of coastal lakes and east coast estuaries. Estuarine water and sediment pollution/quality surveys, including use and development of sediment toxicity assessments and assays.

	Publications:	**Conference Presentations:**
Presentation of Research Findings:	22 reviewed journal publications, co-author of 38 consultancy reports.	10 National Conferences 9 International Conferences

Co-operative And Collaborative Research: Have participated in joint Unizul, Rhodes, UPE, CSIR & JLB Smith RDM projects on the Mhlathuze and Nhlabane Estuaries. Have collaborated with ORI scientists in a multi-disciplinary MCM funded survey of the drought related impacts on the fish community of St Lucia.

Membership of Scientific Societies: Member of the Southern African Society of Aquatic Scientists and the Consortium for Estuarine Research and Management.

2014-09-09