PROPOSED COASTAL PROTECTION SCHEME,
ST FRANCIS BAY, KOUGA LOCAL MUNICIPALITY, EASTERN CAPE PROVINCE

ESTUARINE AND DUNE SYSTEM
IMPACT ASSESSMENT

DRAFT

Prepared for

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PO Box 18
St Francis Bay
6312

On behalf of

Kouga Local Municipality
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Jeffreys Bay
6330

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<table>
<thead>
<tr>
<th>Document Title</th>
<th>Estuarine and Dune Assessment: Proposed Coastal Protection Scheme, St Francis Bay, Kouga Local Municipality, Eastern Cape Province</th>
</tr>
</thead>
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| Client Name & Address | St Francis Property Owners NPC  
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St Francis Bay  
6312  

*On behalf of*  
Kouga Local Municipality  
PO Box 21  
Jeffreys Bay  
6330 |
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<th>Description</th>
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<tbody>
<tr>
<td>AEMP</td>
<td>Aquatic Ecosystem Management Programme</td>
</tr>
<tr>
<td>BGIS</td>
<td>Biodiversity Geographical Information Systems</td>
</tr>
<tr>
<td>EAP</td>
<td>Environmental Assessment Practitioner</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EI</td>
<td>Ecological Importance</td>
</tr>
<tr>
<td>EIR</td>
<td>Environmental Impact Report</td>
</tr>
<tr>
<td>EMPr</td>
<td>Environmental Management Programme</td>
</tr>
<tr>
<td>ES</td>
<td>Ecological Sensitivity</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information Systems</td>
</tr>
<tr>
<td>ICM Act</td>
<td>Integrated Coastal Management Act</td>
</tr>
<tr>
<td>Imp</td>
<td>Importance Score</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
</tr>
<tr>
<td>LM</td>
<td>Local Municipality</td>
</tr>
<tr>
<td>MLRA</td>
<td>Marine Living Resources Act</td>
</tr>
<tr>
<td>NBA</td>
<td>National Biodiversity Assessment</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Environmental Management Act</td>
</tr>
<tr>
<td>NEMBA</td>
<td>National Environmental Management Biodiversity Act</td>
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<tr>
<td>NEMPAA</td>
<td>National Environmental Management Protected Areas Act</td>
</tr>
<tr>
<td>NMU</td>
<td>Nelson Mandela University</td>
</tr>
<tr>
<td>PES</td>
<td>Present Ecological State</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Participation Process</td>
</tr>
<tr>
<td>PSU</td>
<td>Practical Salinity Unit</td>
</tr>
<tr>
<td>SBDM</td>
<td>Sarah Baartman District Municipality</td>
</tr>
<tr>
<td>SFPO NPC</td>
<td>St Francis Property Owners Non-Profit Company</td>
</tr>
<tr>
<td>WMA</td>
<td>Water Management Area</td>
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EXECUTIVE SUMMARY

1.1 Background

The St Francis Property Owners Non-Profit Company (SFPO NPC), on behalf of the Kouga Local Municipality (Kouga LM), has proposed the implementation of a coastal protection scheme proposed for St Francis Bay beach, located within the Eastern Cape Province. The proposed project area is situated approximately 100 km west of Port Elizabeth, and is located within the Kouga LM, seated within the Sarah Baartman District Municipality (SBDM).

The coastal protection scheme will include sourcing sand material from the Kromme Estuary for the purpose of beach nourishment of St Francis Bay beach. The scheme will also entail the development of coastal structures to prevent further erosion of St Francis Bay beach.

CES were appointed by the SFPO NPC to apply for an Environmental Authorisation (EA) by means of conducting a Scoping and Environmental Impact Reporting (S&EIR) process. This was initiated in 2018. In 2019, CES together with the SFPO produced a Draft and Final Scoping Report and Sand Sourcing Specialist Report which was subject to the mandatory 30-day public participation process (PPP) between 20th of August 2019 until the 18th of September 2019. Following on from the approval of the Scoping Report by the Department on the 25th October 2019, CES progressed with the development of the Draft EIR and Draft Estuarine and Dune Assessment Specialist Report which was subject to PPP between 19th December 2019 – 5th February 2020.

It was decided that the Final EIR would not be submitted and the application (EC08/C/LN2/M/42-2019) was allowed to lapse in order to re-visit the design based on comments from I&APs and the Department. The update to the design required additional studies, which have now been completed and this specialist report has been updated to consider the additional information and design available.

1.2 Methodology

A literature review was conducted using the available information on the Kromme Estuary and the coastline, as well as relevant legislation in South Africa (please refer to the references at the end of this report). There is a wealth of data available on the Kromme River Estuary. A comprehensive reserve determination was conducted for the Kromme Estuary by Ninham Shand and Coastal and Environmental Services from 2003 to 2006, this included an ecological water requirement report (completed in 2005) and estuarine surveys and specialist workshops which took place between September 2004 and February 2005. The literature used to compile this report ranges from 1983-2017 (refer to reference list).

The base map for the Estuarine Functional Zone of the Kromme Estuary was obtained from the National Estuaries (2012) vector geospatial data set obtained from BGIS (www.bgis.sanbi.org). The data set contains information on 299 South African estuarine systems that was digitised using Spot 5 imagery (2008) and Google Earth. The lateral boundaries include all the associated wetlands, intertidal mud and sand flats, beaches and foreshore environments that are affected by riverine or tidal flood events (Edgar, 1999). The 5 m topographical contour (obtained from Chief Directorate Surveys and Mapping) was used as the boundary to delineate the floodplains. From this delineation spatial data such as area, length and perimeter (estuary coastline) and distance to next system could be inferred. The estuarine vegetation within the estuarine functional zone (as determine by BGIS) was delineated using the most recent aerial imagery available on Google Earth Pro in order to determine any changes in vegetation communities over time. The CES methodology has been used for assessing the significance of the impacts.
1.3 Description of the Estuary

The Kromme River is approximately 95 km long (Scharler and Baird, 2000) and has many unnamed, small ephemeral tributaries that support dense pockets of indigenous vegetation. The main tributary is the Geelhoutboom River, which originates south of Humansdorp, and joins the Kromme Estuary about 8 km upstream of the mouth. The flow pattern of the Kromme River has been modified by two large dams, i.e. the Churchill Dam (built in 1943; capacity of $33 \times 10^6$ m$^3$) and the Mpofu Dam (built in 1983; capacity of $107 \times 10^6$ m$^3$) (Bickerton and Pierce, 1988; Bate and Adams, 2000). Both dams have the combined capacity of storing ca 133 % of the mean annual run-off of the Kromme River catchment (Bate and Adams, 2000; Scharler and Baird, 2000). The dams in the catchment are considered to attenuate all floods with a return period of less than 1 in 30 years (Bickerton and Pierce, 1988).

The Present Ecological State (PES), the Ecological Importance (EI) and the Ecological Sensitivity (ES) of the Kromme and Geelhoutboom Rivers and their tributaries are presented in the table below (Department of Water and Sanitation, 2014). These rivers define the upper boundary of the tidal influence, or the extent of saline intrusion upstream, of the Kromme Estuary.

### Environmental Sensitivity of the Kromme and Geelhoutboom

<table>
<thead>
<tr>
<th>River</th>
<th>Present Ecological State (PES)</th>
<th>Ecological Importance (EI)</th>
<th>Ecological Sensitivity (ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kromme River</td>
<td>PES D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>2. Geelhoutboom River</td>
<td>PES D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

The estuarine functional zone includes open water, estuarine habitat and the floodplain, and the results of the mapping exercise are presented in the figure below:
The Kromme Estuary is a permanently open estuary that is situated in a warm temperate biogeographical region. The Kromme is considered a permanently open estuary with all images showing the mouth open to the sea and in a similar position year on year. The analysis of the sediment and its particle size suggest that the sediment in the lower reaches of the estuary are considered to be medium sand according to the Udden-Wentworth scale.

1.4 Description Of The Dune And Beach System

On the south bank of the estuary mouth is a sand spit that extends for approximately 900m, and this spit tends to push the mouth channel northwards. For most of its length the sand spit is well vegetated with typical pioneer woody species such as *Chrysanthemoides monolifera* (Bitou), but the most dominant species is the invasive *Acacia, Acacia cyclops* (Rooikrans). The mouth of the Sand River is located 2km upstream of the mouth, on the south bank of the river. The Sand River’s contribution to the freshwater inflow into the Kromme system is negligible. The dominant flow within the Sand River is subterranean, but reduced flows both in the system as well as the Kromme has resulted in a substantial accumulation of sand along this 250m of river bank. The sand mass is approximately 180m wide and 300m long and has become stabilised by pioneer dune and salt marsh vegetation. Further east the sand has not yet become vegetated, as it is still inundated at high tide. Over time, and with ongoing sand accumulation it is expected that this sand will also become stabilised with dune vegetation. The dune system at the Sand river has become well vegetated say with typical saltmarsh species closer to the river’s edge, giving way to dune slack species in the depressions.

1.5 Site Sensitivity

The proposed project must avoid all areas of high sensitivity. Areas considered to be of moderate sensitivity could withstand some loss, however this should be avoided as far as practical. The sensitivity map below was developed by identifying areas of high, medium and low sensitivity.
Sensitivity Map of the Kromme Estuary.

1.6 Impact Assessment

The table below provides a summary of the existing and the potential impacts associated with the proposed project.

Summary of the Existing & Potential Impacts

<table>
<thead>
<tr>
<th>PHASES OF DEVELOPMENT &amp; POTENTIAL IMPACTS</th>
<th>SIGNIFICANCE WITHOUT MITIGATION</th>
<th>SIGNIFICANCE WITH MITIGATION</th>
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<tr>
<td><strong>EXISTING IMPACTS</strong></td>
<td></td>
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<tr>
<td>Estuary Bank Erosion</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Increased Siltation</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Deterioration in Water Quality</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>Increased Salinity</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Impact on Submerged Macrophytes</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact on Submerged Salt Marsh</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact on fauna - increase in sandbank habitat as a result of the impoundments upstream</td>
<td>MODERATE+</td>
<td></td>
</tr>
<tr>
<td>Impact on fauna - shift to a marine dominated system</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Impact on Social Amenities</td>
<td>MODERATE+</td>
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</tr>
<tr>
<td>Impact on Ecosystem goods and services</td>
<td>LOW</td>
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<tr>
<td>Impact on infrastructure and dune habitat as a result of a breach in the spit</td>
<td>HIGH</td>
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<tr>
<td>Ongoing erosion to the beaches to the north</td>
<td>MODERATE</td>
<td></td>
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### CONSTRUCTION AND OPERATIONAL PHASE

<table>
<thead>
<tr>
<th>Impact Description</th>
<th>MODERATE-</th>
<th>LOW-</th>
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<tbody>
<tr>
<td>Increase in Sedimentation and Turbidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Estuarine Vegetation Communities</td>
<td>MODERATE-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Loss of Estuarine Faunal Communities</td>
<td>MODERATE-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Impacts on the Estuarine Functional Zone</td>
<td>MODERATE-</td>
<td>MODERATE-</td>
</tr>
<tr>
<td>Improvements to the Recreational Amenities Offered by the Kromme</td>
<td>MODERATE+</td>
<td>HIGH+</td>
</tr>
<tr>
<td>Loss of Access to Particular Sites and Restrictions on the use of the Estuary during Dredging Operation</td>
<td>LOW-</td>
<td>LOW-</td>
</tr>
<tr>
<td>A Reduction / Loss of Sandbanks Supporting Fauna</td>
<td>LOW-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Visual Intrusion of Dredging Equipment and Pipelines</td>
<td>MODERATE-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Noise Disturbance Impacts</td>
<td>MODERATE-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Impact on Navigation and Boating Safety</td>
<td>MODERATE+</td>
<td>MODERATE+</td>
</tr>
<tr>
<td>Loss of Dune Vegetation on The Vegetated Sand Bank at The Sand River Mouth</td>
<td>MODERATE-</td>
<td>MODERATE-</td>
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<tr>
<td>Disturbance to dune vegetation on the sand spit and other foredunes during construction</td>
<td>LOW-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Effects of Groyne Construction on The Beach and Nearshore Area</td>
<td>MODERATE-</td>
<td>MODERATE-</td>
</tr>
<tr>
<td>Accretion and Resultant Widening of The Beaches as A Result of Beach Nourishment Scheme</td>
<td>MODERATE-</td>
<td>HIGH+</td>
</tr>
<tr>
<td>Stabilisation of The Shoreline and Protection from Storm Surges and Sea-Level Rise</td>
<td>VERY HIGH+</td>
<td></td>
</tr>
<tr>
<td>Long to Improvement to Recreational Amenities Offered by The Beaches</td>
<td>VERY HIGH+</td>
<td></td>
</tr>
<tr>
<td>Acceleration of erosion as a result of the groynes</td>
<td>MODERATE-</td>
<td>LOW-</td>
</tr>
<tr>
<td>Restriction of Sediment Transport to the North</td>
<td>MODERATE-</td>
<td>LOW-</td>
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### DECOMMISSIONING PHASE

<table>
<thead>
<tr>
<th>Impact</th>
<th>MODERATE-</th>
<th>LOW-</th>
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</thead>
<tbody>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
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### CUMULATIVE IMPACTS

<table>
<thead>
<tr>
<th>Impact</th>
<th>MODERATE-</th>
<th>LOW-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Estuary Bank Erosion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While there are sensitive habitats with species deemed vulnerable and near threatened the loss of these species is anticipated to be a small area of their overall distribution within the Kromme Estuary and even smaller proportions regionally. The species that will be directly lost (benthic organisms) as a result of the dredging activity are not sensitive species and while their abundance may be reduced initially it is expected that these species will return and inhabit newly dredged areas. Alternative locations for birds and fish are available throughout the estuary system, since there are similar habitats upstream and along the beach in St Francis Bay.

Those areas of sand bank that are vegetated with dune vegetation do occur within the estuary and within those areas expected to be dredged. Since this vegetation is indigenous, and exhibits a clear successional gradient, its loss will result, despite the fact that it has established as a result of altered flow regimes in the Kromme. However, it is postulated that under normal flow conditions this sand bank would not have been as aggressively colonised by dune species as has occurred, due to reduced flows and infrequent flooding resulting in a more stable habitat. The construction of the groynes, as well as activities associated with beach nourishment will require access over the foredunes in selected areas, and damage to the foredunes and the loss of some vegetation is inevitable. Since much of this vegetation is not indigenous, and the areas disturbed are likely to be localised, the impacts are not expected to be significant. The nourishment of the beach along the St Francis Bay frontage will provide additional habitat for the development of dune species. It will also stabilise the shoreline and protect the foredunes from wave attack from storm surges. These are seen as beneficial impacts.
From a socio-economic perspective the restoration of the beach amenity and additional area within the lower reaches of the estuary are seen as beneficial impacts of the dredging. The visual and noise disturbance impacts as a result of the dredging and potential pumping of sediment can be suitably mitigated to reduce the impacts that may arise from the dredging activity.

Based on this assessment there are no fatal flaws.

1.7 Recommendations

It is recommended that the following Construction Phase and Operation Phase mitigation measures are included in the Environmental Management Programme (EMP):
The Table included below outlines the requirements of a Specialist Report as outlined in Appendix 6 of the NEMA EIA Regulations (as amended) and cross-reference the Sections in this report where the relevant information can be found.

<table>
<thead>
<tr>
<th>NEMA REQUIREMENT</th>
<th>RELEVANT SECTION IN THE REPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A specialist report prepared in terms of the NEMA EIA Regulations must contain</td>
<td>Detail of the specialists are provided in the following sections of the report:</td>
</tr>
<tr>
<td>details of:</td>
<td>→ The specialist who prepared the report;</td>
</tr>
<tr>
<td>→ The expertise of that specialist to compile a specialist report including</td>
<td>→ Presented at the start of this report:</td>
</tr>
<tr>
<td>curriculum vitae</td>
<td>→ Appendix 1: Curriculum Vitae</td>
</tr>
<tr>
<td>A declaration that the specialist is independent in a form as may be specified by</td>
<td>Specialist declarations are available in Appendix 2.</td>
</tr>
<tr>
<td>the competent authority.</td>
<td></td>
</tr>
<tr>
<td>An indication of the scope of, and the purpose for which, the report was prepared</td>
<td>Section 2.1 in Chapter 2 of this report provides the terms of reference for the estuarine</td>
</tr>
<tr>
<td>An indication of the quality and age of base data used for the specialist report.</td>
<td>assessment</td>
</tr>
<tr>
<td></td>
<td>There is a wealth of data available on the Kromme River Estuary. A comprehensive reserve</td>
</tr>
<tr>
<td></td>
<td>determination was conducted for the Kromme Estuary by Ninham Shand and Coastal and Environmental Services from 2003 to 2006, this included an ecological water requirement report (completed in 2005) and estuarine surveys and specialist workshops which took place between September 2004 and February 2005. The literature used to compile this report ranges from 1983-2017 (refer to reference list). Bathymetry data was collected in 2020 and used in the dredging scenario modelling.</td>
</tr>
<tr>
<td>A description of existing impacts on the site, cumulative impacts of the proposed</td>
<td>Existing impacts are outlined in Chapter 8.1.1 – 8.1.3. Cumulative impacts are outlined in</td>
</tr>
<tr>
<td>development and levels of acceptable change</td>
<td>Chapter 8.1.4.</td>
</tr>
<tr>
<td>The duration, date and season of the site investigation and the relevance of the</td>
<td>Chapter 4.2 describes the surveys carried out.</td>
</tr>
<tr>
<td>season to the outcome of the assessment</td>
<td></td>
</tr>
<tr>
<td>A description of the methodology adopted in the preparing of the report or</td>
<td>Chapter 3 describes the methodology used for the preparation of this report.</td>
</tr>
<tr>
<td>carrying out the specialised processes inclusive of equipment and modelling used.</td>
<td></td>
</tr>
<tr>
<td>Details of an assessment of the specific identified sensitivity of the site related</td>
<td>Chapter 7 provides a sensitivity analysis of the proposed site and an explanation on the</td>
</tr>
<tr>
<td>to the proposed activity or activities and its associated structures and</td>
<td>requirements for layout adjustments.</td>
</tr>
<tr>
<td>infrastructure, inclusive of a site plan identifying site alternatives.</td>
<td></td>
</tr>
<tr>
<td>An identification of all areas to be avoided including buffers.</td>
<td>Chapter 7 provides a sensitivity analysis of the proposed site and identifies all areas of</td>
</tr>
<tr>
<td></td>
<td>high sensitivity that must be avoided.</td>
</tr>
<tr>
<td>NEMA REQUIREMENT</td>
<td>RELEVANT SECTION IN THE REPORT</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.</td>
<td>Chapter 7 provides a sensitivity map of the proposed site superimposing project activities. This map identifies all areas of high sensitivity that must be avoided.</td>
</tr>
<tr>
<td>A description of any assumptions made and any uncertainties or gaps in knowledge.</td>
<td>This is available in Chapter 2 Section 2.2</td>
</tr>
<tr>
<td>A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities</td>
<td>Chapter 11 deals with the recommendations to be considered should this project proceed.</td>
</tr>
<tr>
<td>Any mitigation measures for inclusion in the EMPr</td>
<td>These are outlined in Chapter 11, Table z11.2</td>
</tr>
<tr>
<td>Any conditions for inclusion in the Environmental Authorisation</td>
<td>These are outlined in Chapter 11, Table 11.2</td>
</tr>
<tr>
<td>Any monitoring requirements for inclusion in the EMPr or Environmental Authorisation.</td>
<td>These are included in Chapter 10 of this report.</td>
</tr>
<tr>
<td>A reasoned opinion:</td>
<td>Chapter 11 considers whether there are any fatal flaws with this project. It is the opinion of the expert that the project can proceed. However, there are requirements for monitoring and the development of an adaptive management plan to ensure that measures to reduce unforeseen impacts can be implemented without resulting in delays to the project.</td>
</tr>
<tr>
<td>→ As to whether the proposed activity, activities or portions thereof should be authorised;</td>
<td></td>
</tr>
<tr>
<td>→ Regarding the acceptability of the proposed activity or activities; and</td>
<td></td>
</tr>
<tr>
<td>→ If the opinion is that the proposed activity or activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable the closure plan.</td>
<td></td>
</tr>
<tr>
<td>A description of any consultation process that was undertaken during the course of preparing the specialist report.</td>
<td>This is outlined in Chapter 2, Section 2.3.</td>
</tr>
<tr>
<td>A summary and copies of any comments received during any consultation process and where applicable all responses thereto.</td>
<td>Comments on this draft report have been considered recorded in the Issues and Response Trail for the EIR.</td>
</tr>
<tr>
<td>Any other information requested by the competent authority.</td>
<td>The competent authority have raised the following on the Estuarine and Dune Ecology Specialist Report: “The Estuarine and Dune System Assessment, dated August 2019, has not, as per the comments in the acceptance of the FSR dated 25 October 2019, addressed possible impacts of the proposed coastal protection scheme on the areas northwards of the area proposed for the groynes, specifically addressing any potential accretion / erosion of the northern beaches/coastline.” This report has been updated to address these concerns (See Section 5 and Section 9).</td>
</tr>
</tbody>
</table>
PROJECT TEAM

Details of the Specialists

Mr Gregory Shaw (Estuarine Specialist: Site Investigation & Lead Report Writer)

Mr. Shaw is a Principal Environmental Consultant. Gregory has more than 10 years consulting experience in Environmental Impact Assessment (EIA) in the coastal and marine environment. He has an MSc in Botany and has been involved in marine studies for projects throughout Africa and the United Kingdom.

Dr Chantel Bezuidenhout (Estuarine Specialist: Report Writing Assistance)

Dr Chantel Bezuidenhout is a Principal Environmental Consultant with 10 years’ consulting experience and she is the Branch Manager of the Port Elizabeth branch. Chantel holds MSc and PhD degrees in Botany (estuarine ecology) and a BSc degree in Botany and Geography from Nelson Mandela University (NMU). Chantel’s main focus is estuarine ecology and she has done extensive work on 13 systems from the Orange River Mouth in the Northern Cape to the Mngazi Estuary in the Transkei. As a result she has been involved in a number of ecological reserve determination studies including the Kromme, Seekoei and Olifants systems. Chantel is well versed in environmental legislation and has been involved in number of environmental impact assessments and management plans in South Africa, Zambia, Mozambique and Madagascar.

Ms Nicole Wienand (Consultant / GIS)

Ms Nicole Wienand is an Environmental Consultant with less than 1 years’ experience and she is based in the Port Elizabeth branch. Nicole obtained her BSc Honours in Botany (Environmental Management) from Nelson Mandela University (NMU) in December 2018. She also holds a BSc Degree in Environmental Management from NMU. Nicole’s honours project focused on the composition of subtidal marine benthic communities on warm temperate reefs off the coast of Port Elizabeth (a baseline survey) and for her undergraduate project she investigated dune movement in Sardinia Bay. Although she is new to the environmental consulting field, her key interests include the GIS Mapping, the general EIA process, Public Participation Process (PPP) and Ecological Impact Assessments.

Dr Ted Avis (Dune Ecology, Report Review and Final Sign-Off)

Ted Avis is a leading expert in the field of Environmental Impact Assessments and environmental management, having project-managed numerous large-scale ESIs and ESMPs to International Finance Corporation Performance Standards. Ted has been EIA study leader on numerous large scale ESIA’s and ESHIA’s for projects with capital investments ranging from US$200m to over US$1billion. He has been study leader for ESIs and related environmental studies completed to international standards (e.g. International Finance Corporation). Ted was principle consultant to Corridor Sands Limitada for the development of all environment aspects for the US$1billion Corridor Sands Project. He has managed ESIA studies and related environmental assessments of similar scope in Kenya, Madagascar, Egypt, Kenya, Liberia, Mozambique, Madagascar, Malawi Sierra Leone, South Africa and Zambia. Ted also has experience in large scale Strategic Environmental Assessments in southern Africa and has been engaged by the International Finance Corporation (IFC) on a number of projects.

Most of the ESIA work Ted has been involved in has included the preparation of various Environmental & Social Management Plans, Resettlement Action Plans and Monitoring Plans. These ESIA’s cover a range of sectors including infrastructure, mining (heavy minerals, graphite, tin, copper, iron), agri-industrial, forestry, resorts and housing development, energy, ports and coastal developments.
Ted holds a PhD in Botany and was awarded a bronze medal by the South African Association of Botanists for the best PhD adjudicated in that year, entitled “Coastal Dune Ecology and Management in the Eastern Cape”). He has delivered papers and published in the field of EIA, Strategic Environmental Assessment and Integrated Coastal Zone Management and has been a principal of CES since its inception in 1990 and Managing Director since 1998.

Ted was instrumental in establishing the Environmental Science Department at Rhodes University whilst a Senior lecturer in Botany, based on his experience running honours modules in EIA practice and environmental management. He was one of the first certified Environmental Assessment Practitioner in South Africa, gaining certification in April 2004. He has been a professional member of the South African Council for Natural Scientific Professionals since 1993.
INTRODUCTION

1.1 Background

The St Francis Property Owners Non-Profit Company (SFPO NPC), on behalf of the Kouga Local Municipality (Kouga LM), has proposed the implementation of a coastal protection scheme proposed for St Francis Bay beach, located within the Eastern Cape Province. The proposed project area is situated approximately 100 km west of Port Elizabeth, and is located within the Kouga LM, seated within the Sarah Baartman District Municipality (SBDM).

The coastal protection scheme will include sourcing sand material from the Kromme Estuary for the purpose of beach nourishment of St Francis Bay beach. The scheme will also entail the development of coastal structures to prevent further erosion of St Francis Bay beach.

CES were appointed by the SFPO NPC to apply for an Environmental Authorisation (EA) by means of conducting a Scoping and Environmental Impact Reporting (S&EIR) process. This was initiated in 2018. In 2019, CES together with the SFPO produced a Draft and Final Scoping Report and Sand Sourcing Specialist Report which was subject to the mandatory 30-day public participation process (PPP) between 20th of August 2019 until the 18th of September 2019. Following on from the approval of the Scoping Report by the Department on the 25th October 2019, CES progressed with the development of the Draft EIR and Draft Estuarine and Dune Assessment Specialist Report which was subject to PPP between 19th December 2019 – 5th February 2020.

It was decided that the Final EIR would not be submitted and the application (EC08/C/LN2/M/42-2019) was allowed to lapse in order to re-visit the design based on comments from I&APs and the Department. The update to the design required additional studies, which have now been completed and this specialist report has been updated to consider the additional information and design available.

1.2 Value Of Estuaries

The South African National Biodiversity Assessment (NBA, 2011) defines estuaries as:

“An estuary is a partially enclosed, permanent water body, either continuously or periodically open to the sea on decadal time scales, extending as far as the upper limit of tidal action or salinity penetration. During floods an estuary can become a river mouth with no seawater entering the formerly estuarine area, or, when there is little or no fluvial input, an estuary can be isolated from the sea by a sandbar and become a lagoon or lake, which may become fresh or hypersaline” (Van Niekerk & Turpie, 2012).

Van Niekerk & Turpie (2012) describe estuaries as valuable national assets that provide essential ecosystem services. The ecosystem services typically provided by estuaries could include, but are not limited to:

- Inflow of freshwater and nutrients from rivers to the marine environment;
- Fish nursery habitats for marine fish and invertebrates;
- Regulation of greenhouse gases and opportunities for carbon sequestration;
- A significant buffer against floods as well as sea storms;
- Recreational and tourism areas (e.g. sports fishing, boating, bathing and scenic views);
- Resources for food (e.g. bait harvesting and subsistence fishing);
- Unique and diverse habitats to microalgae, macrophytes, benthic invertebrates and fish; and
- Bird feeding and roosting areas.
Turpie and Clark (2007) updated estuary importance scores for all South African estuaries. The overall importance score (Imp) is calculated from the size score (S), habitat importance score (H), zonal type rarity score (Z) and the updated biodiversity importance score (B). The estuarine importance score of the Kromme Estuary is as follows:

<table>
<thead>
<tr>
<th>SIZE</th>
<th>HABITAT IMPORTANCE</th>
<th>ZONAL TYPE RARITY</th>
<th>BIODIVERSITY IMPORTANCE</th>
<th>IMPORTANCE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>90</td>
<td>20</td>
<td>95.5</td>
<td>88.4</td>
</tr>
</tbody>
</table>

This means that the Kromme Estuary is ranked as the 17th most important estuary in South Africa. Even though the Kromme Estuary is not currently considered to be a protected area, it does form part of the list of desired protected areas (i.e. the Kromme forms part of the minimum set of estuaries required in a protected area network to represent 100% of estuarine species).

Turpie and Clark (2007) recommend that “all estuaries are zoned using similar types of zones and markings, and that each estuary may contain a fully protected area, or sanctuary area (including a portion of the terrestrial margin which is protected from development and excessive use), and a conservation area (which includes the remainder of the terrestrial margin). The latter might be zoned in a number of different ways, depending on the vision and requirements for that estuary.” In terms of the Kromme Estuary the following is recommended:

<table>
<thead>
<tr>
<th>PART OF THE CORE SET REQUIRED TO MEET BIODIVERSITY TARGETS</th>
<th>RECOMMENDED EXTENT OF SANCTUARY PROTECTION</th>
<th>RECOMMENDED EXTENT OF UNDEVELOPED MARGIN</th>
<th>RECOMMENDED MINIMUM ECOLOGICAL MANAGEMENT CLASS</th>
<th>PRIORITY FOR REHABILITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Half</td>
<td>50%</td>
<td>A/B</td>
<td>High</td>
</tr>
</tbody>
</table>

The Kromme Estuary is considered to be in a fair state of health (Whitfield, 2000) and in need of rehabilitation. According to Turpie and Clark (2007), the Kromme Estuary is listed as a high priority for rehabilitation, particularly water quality (silt), water quantity and the clearance of alien vegetation.

In 2007 Anchor Environmental Consultants prepared the CAPE Action Plan for the Environment (C.A.P.E) Regional Estuarine Management Programme. The main aim of the programme was to develop a strategic conservation plan for the estuaries of the Cape Floristic Region (CFR), and to prepare detailed management plans for each estuary. The overall objective of the study was to identify (in collaboration with estuarine managers and scientists and the broader stakeholder community) which CFR estuaries should be assigned Estuarine Protected Area (EPA) status, and to prioritise estuaries in need of rehabilitation, on the bases of an updated classification of estuaries in terms of health, conservation importance and socio-economic value.

CES have provided a high-level review of the Regional Estuarine Management Programme since the specific Estuarine Management Plans have not been developed. Estuaries were prioritised in terms of the need for rehabilitation, and the type of rehabilitation required was described (see Table 1.1). It was further recommended that each estuary should contain a fully protected area, or sanctuary area (including a portion of the terrestrial margin which is protected from development and excessive use), and a conservation area (which includes the remainder of the terrestrial margin). Table 1.1 provides results for the Kromme and others in the vicinity of the study area. It indicates that the Kromme estuary is part of the identified core set of estuarine systems required to meet biodiversity targets. To achieve the protection required, in terms of the proportion of targeted habitats and populations requiring full protection in a sanctuary, half the system requires Sanctuary Protection. The recommended proportion of terrestrial marginal area to be included as a no-development area is 50%,
to achieve an ecological management class of A/B. Note that the recommended extent of protection should be seen as ideal goals.

**Table 1.1. Summary of the recommended extent of protection required and priority for rehabilitation for each of the estuaries in the study area.**

<table>
<thead>
<tr>
<th>Estuary (West to East)</th>
<th>Core biodiversity set</th>
<th>Recommended extent of sanctuary protection</th>
<th>Recommended extent of undeveloped margin</th>
<th>Recommended minimum Ecological Management Class</th>
<th>Priority for rehabilitation (blank = not required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tsitsikamma</td>
<td>None</td>
<td>-</td>
<td>D</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Klipdrif</td>
<td>None</td>
<td>-</td>
<td>D</td>
<td>Med</td>
<td></td>
</tr>
<tr>
<td>Slang</td>
<td>None</td>
<td>-</td>
<td>D</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Kromme</td>
<td>Core</td>
<td>Half</td>
<td>50%</td>
<td>A/B</td>
<td>High</td>
</tr>
</tbody>
</table>

1 Management class denotes the future state of health of the estuary, from A (near natural) to D (functional), and with A-class systems having greater water requirements than D-class systems.

The top 40 estuaries and their former rankings are shown in Table 1.2. Three-quarters of these are temperate estuaries.

**Table 1.2. Top 40 estuaries in South Africa in terms of the updated importance rating of South African estuaries. Temperate estuaries are marked with an asterisk.**

<table>
<thead>
<tr>
<th>Overall score</th>
<th>Importance rank</th>
<th>Rank (this study)</th>
<th>Rank (Turpie et al. 2004)</th>
<th>Rank (Turpie et al. 2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knysna</td>
<td>100</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Orange</td>
<td>99</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Berg</td>
<td>98</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Olifants</td>
<td>98</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Klein</td>
<td>97</td>
<td>5</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Kosi</td>
<td>97</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Swartvlei</td>
<td>97</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Bot/Kleinmond</td>
<td>97</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>St Lucia</td>
<td>97</td>
<td>9</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Durban Bay</td>
<td>92</td>
<td>10</td>
<td>11</td>
<td>88</td>
</tr>
<tr>
<td>Swartkops</td>
<td>92</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Gamtoos</td>
<td>92</td>
<td>12</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Great Fish</td>
<td>92</td>
<td>13</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Mfolozi</td>
<td>91</td>
<td>14</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Keiskamma</td>
<td>91</td>
<td>15</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Mangazana</td>
<td>91</td>
<td>16</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>Kromme</td>
<td>88</td>
<td>17</td>
<td>20</td>
<td>17</td>
</tr>
</tbody>
</table>

The associated socio-economic values estimated for each estuary are presented in Table 1.3, highlighting estuaries for which certain types of value are noteworthy. The Kromme has substantial recreational and nursery value, and a scenic value of medium.
Table 1.3. Preliminary estimates of the recreational, subsistence and nursery value of estuaries, and their relative existence value (which is largely associated with scenic beauty). Highest values are shown in bold.

<table>
<thead>
<tr>
<th>Estuary</th>
<th>Recreational value (R millions/y)</th>
<th>Subsistence value (R millions/y)</th>
<th>Nursery Value (R millions/y)</th>
<th>Scenic/Existence value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keurbooms</td>
<td>&gt;100</td>
<td>0.1-0.5</td>
<td>10-20</td>
<td>Medium</td>
</tr>
<tr>
<td>Matjies/Bitou</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Sout (Oos)</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>1-5</td>
<td>High</td>
</tr>
<tr>
<td>Groot (Wes)</td>
<td>5-10</td>
<td>&lt;0.05</td>
<td>1-5</td>
<td>High</td>
</tr>
<tr>
<td>Bloukrans</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Lottering</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>0.5-1</td>
<td>Medium</td>
</tr>
<tr>
<td>Elandsbos</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>0.1-0.5</td>
<td>High</td>
</tr>
<tr>
<td>Storms</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Elands</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Groot (Oos)</td>
<td>0.05-0.5</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Tsitsikamma</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Klipdri</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Slang</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>Medium</td>
</tr>
<tr>
<td>Kromme</td>
<td>20-50</td>
<td>0.1-0.5</td>
<td>10-20</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Part of the Regional Estuarine Management Programme mandate was to prioritise estuaries for rehabilitation. A total of 50% of estuaries were considered to be in need of rehabilitation (Table 1.4). Water quality was the most important rehabilitation issue, but alien clearing and water quantity (too much as well as too little) were also important issues. The Kromme was rated as priority 1, with water quality (silt), water quantity and alien vegetation clearing identified as concerns.
Table 1.4 Temperate estuaries, their state of heath according to Whitfield (2000) or updated at workshop (signified by *), the need for rehabilitation and level of priority, and the type of rehabilitation required.

<table>
<thead>
<tr>
<th>Estuary</th>
<th>Health (Whitfield 2000)</th>
<th>Need Rehab</th>
<th>Priority 1 = High, 2 = Med, 3 = Low</th>
<th>Water Quality (Pollution)</th>
<th>Water Quality (Silt)</th>
<th>Water quantity</th>
<th>Alien Clearing</th>
<th>Fix inappropriate bank stabilisation</th>
<th>Mouth Management</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matjies/Bitou</td>
<td>Excellent</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Breaching mouth to protect septic tanks</td>
</tr>
<tr>
<td>Sout (Oos)</td>
<td>Excellent</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groot (Wes)</td>
<td>Good</td>
<td>Yes 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloukrans</td>
<td>Excellent</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lottering</td>
<td>Good</td>
<td>Yes 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elandsbos</td>
<td>Good</td>
<td>Yes 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storms</td>
<td>Excellent</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elands</td>
<td>Good</td>
<td>Yes 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groot (Oos)</td>
<td>Good</td>
<td>Yes 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tsitsikamma</td>
<td>Good</td>
<td>Yes 3</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Klipdrift</td>
<td>Fair</td>
<td>Yes 2</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slang</td>
<td>Poor</td>
<td>Yes 3</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>Remove groynes near mouth</td>
</tr>
<tr>
<td>Kromme</td>
<td>Fair</td>
<td>Yes 1</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>No Dredging</td>
</tr>
</tbody>
</table>
The Turpie et al. report developed a set of criteria against which all estuaries could be classified and prioritised for the establishment of protection areas. The Kromme was deemed to be an important ecological (17 of 40 estuaries) and socio-economic (recreational and nursery value) asset. The data in the report suggests that these two characteristics may have a positive correlation, although not necessarily a strong one. The report recommends that the Kromme Estuary be prioritised for rehabilitation with the intention of returning it to a Category A/B estuary (i.e. near natural). The main types of rehabilitation required were:

1. Water quality;
2. Water quantity; and
3. Alien clearing.

There was an “other” statement of no dredging.

The report does not expand on these rehabilitation requirements nor does it provide data on which of these recommendations have been made. CES have provided their understanding for these below:

1. Clear water is deemed to be more suitable than water that has higher suspended sediment. This is due to silt limiting the ability of estuarine organisms to photosynthesize (vegetation) and to locate their food (fauna). Settlement of fine silt material may also lead to smothering of species that are not able to move. The “no dredging” statement has been added presumably due to the existing dredging of the canals and placement of material on the adjacent spit. Given the low flow within the canals it is anticipated that the material is finer than that of the estuary since finer material in the estuary does not settle.

2. It has been well documented that there has been a significant reduction in the volume of water entering the estuary due to the development of the dams upstream. Water flow in an estuary helps to “flush” the system. Higher flow maintains water channels, water quality and in some cases maintains the mouth characteristics of estuaries. Conversely, low flow reduces the ability to flush the estuary of sediment build up and maintain water quality.

3. Alien vegetation has a higher water requirement than that of indigenous vegetation. This has been well documented with natural and regional Working for Water schemes aiming to reduce the distribution of alien vegetation, especially in catchment areas. Property owners also have an obligation to manage alien vegetation.

The priorities therefore relate to water quality and quantity, and alien vegetation clearing. It remains unclear what the “other” statement of no dredging specifically relates to.

### 1.3 Value Of Dune Systems

Coastal Sand Dunes have a unique mobile physical structure and ecological composition. Frontal dunes are part of the sediment exchange system between land and sea, as they generally occur within the littoral active zone. The protection of especially frontal dunes is therefore critical to maintaining both the ecological integrity of the dune system and maintain its important function of coastal defence. This is particularly important at the mouth of an estuary, where not only the forces of wind and wave attack are important, but also the erosional forces of the estuarine system.

Together with beaches, frontal dunes form the most important sea and wind energy dissipating system. Together with beaches, they protect the hinterland from storm surges and wave attack. This is particularly important when coastal developments might be threatened, and the risks to social infrastructure will be exacerbated when the beach system is eroding, as is the case at St Francis Bay. This is further compounded by sea-level rise associated with climate change.
At St Francis Bay it is a well-known fact that the beaches have suffered from significant erosion events over the past few decades. This has been attributed to the stabilisation of the large headland bypass dune system during the 1970s and 1980s. This led to a reduction in sediment supply to the beach, compounded by the construction of the Impofu dam upstream of the Kromme River. This has resulted in a rapid retreat of the shoreline (Advisian, 2018. Advision, 2020). The most susceptible area is the sand spit immediately south of the river mouth, in front of Ski Canal in the Marina.

1.4 Key Legislation

An extensive legal framework governs the marine and coastal environments in South Africa. Table 1.5 lists the legislation that is applicable to the Kromme Estuary and its associated coastal dune system and describes these Acts.

Table 1.5: Relevant estuarine legislation.

<table>
<thead>
<tr>
<th>LEGISLATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Environmental Management: Integrated Coastal Management Act (ICM, Act No. 24 of 2008, as amended 2014)</td>
<td>The ICM Act aims to achieve harmony between the physical processes of estuaries and human activities. This is achieved by the protection of essential estuarine and dune ecological processes and diversity, while accommodating sustainable estuarine and coastal resource utilisation.</td>
</tr>
<tr>
<td>National Environmental Management: Biodiversity Act (NEMBA, Act No. 10 of 2004)</td>
<td>The Biodiversity Act aims to conserve biological diversity and to regulate the sustainable use of biological resources, which includes the unique estuarine and coastal systems and their resources.</td>
</tr>
<tr>
<td>National Environmental Management: Protected Areas Act (NEMPAA, Act No. 57 of 2003)</td>
<td>The Protected Areas Act aims to protect and conserve the ecologically viable areas representative of South Africa’s biological diversity and its natural landscapes and seascapes.</td>
</tr>
<tr>
<td>Local Government: Municipal Systems Act (Act No. 32 of 2000)</td>
<td>The Municipal Systems Act focuses on Integrated Development Planning with the objective of harmonising planning over a range of sectors such as water, transport, land use and environmental management. It requires each local authority to adopt a single, inclusive plan for the development of the municipality which, among other things, aligns the resources and capacity of the municipality with the implementation of the plan.</td>
</tr>
</tbody>
</table>
2 TERMS OF REFERENCE & PROJECT DESCRIPTION

2.1 Terms of Reference

The Estuarine and Dune Assessment terms of reference include, but are not limited to:

→ A detailed description of the Kromme Estuary within the vicinity of the proposed development, including the physio-chemical characteristics;
→ An ecological description of the frontal dune system at the mouth of the system, and on the sand flats at the mouth of the Sand River further upstream;
→ A description of the flora, fauna and avifauna of the estuary;
→ A description of the physical nature of the banks of the estuary;
→ The identification and assessment of the magnitude and significance of the positive and negative impacts on the estuary associated with the proposed project;
→ The identification and assessment of the magnitude and significance of the positive and negative impacts on the dune systems associated with the beach and estuarine, and
→ A description of appropriate mitigation measures to minimise negative impacts or to maximize positive impacts on the estuarine and dune system features.

The significance of the potential impacts and benefits will be assessed using the methodology prescribed by CES (refer to Chapter 3 included below).

2.2 Assumptions and Limitations

There are a number of assumptions and limitations associated with this report.

They are:

- The data has been taken from desktop information which has been referenced at the end of this report;
- A site visit was carried out in December 2018. The site visit included the collection of sediment samples and representative photographs of the habitats adjacent to the project site. The site visit lasted one day and the experts travelled by boat from the eastern most point of the study area (Kromme River Mouth) to the western most point of the study area (approx. 500 m past the bridge crossing the Kromme River). The survey was conducted in summer as this is the peak growing season for floral species. Faunal species are unlikely to exhibit significant seasonal variation.
- The site visit also included an investigation of the beach and dune systems on either side of the Kromme River Mouth, but this was limited to a visual inspection. No quantitative sampling of vegetation was undertaken as this was not required.
- New bathymetry data was collected in 2020 and used to inform the modelling of the pre- and post-dredging scenarios.
- A brief discussion on the particle size of the sediment within the Kromme is included in Chapter 4. A more detailed description of the sediment is included in the Sand Sourcing Specialist Study;
- Many chemical contaminants have an affinity for fine-grained sediment particles. These contaminants generally arise from industries located in or upstream of urban areas, or industries that discharge wastes into waterways. Dense populations also contribute contaminants through sewage discharges and agricultural runoff. The Kromme estuary does not have a history of heavy industry and while there is the potential for agricultural contaminants from fertilizers (phosphates and nitrogen) these are not anticipated to be significant, especially since the particle size of the sediment is coarse. Research into the
nutrient status of the estuary following a release from the upstream impoundments showed that the estuary returned to its “normal” state within days; and

- It is assumed that a pre-construction survey will take place prior to construction of the project to establish the parameters for monitoring contamination during the project.

### 2.3 Public Participation

The Final Scoping Report described the Public Participation Process (PPP) followed to date. This Specialist report was released for public review during the period December 2019 and January 2020, prior to the EIA process being placed on hold. This version of the report therefore includes comments received from IAPs.

This specialist report forms part of the updated Draft EIR report and will be made available for a formal 30 day commenting and review period again. All comments and issues received during this second review period related to the estuarine and dune assessment will be included in the Final Estuarine and Dune Assessment Report.

### 2.4 Project Description

As a result of significant erosion events occurring over the past few decades, the St Francis Bay beach has lost a considerable amount of sand material, and the existing frontal dune area has become more vulnerable to being breached during storm surges. The effects of the erosion of the beach (in both width and depth of sediment) has been realised across the full frontage, stretching from the car park at the end of Nevil Rd in the south to the Kromme Estuary mouth in the north (Figure 2.1). Approximately 700 m of the frontage, referred to as “the spit” is particularly vulnerable. The erosion has been significant and dramatic that over the 42 year period between 1975 and 2017, the high water mark has retreated by 75 metres. As a result, the beach has effectively been lost, and erosion of the vegetated sand spit is occurring. In 2020 the spit breached 4 times during particularly high tides and storm swell. Not only does the erosion of the spit impact on the recreational amenity that is the beach area, but it also has the potential to threaten the existing infrastructure (houses, roads and canals) which are located behind the beach spit.

The Spit breached for the first time on the 8th April 2020. The second breach occurred on 5th July 2020 and the third breach on 15th August 2020. On each occasion the Kouga Local Municipality (KLM) reacted immediately and closed the breach within days. The breaches were closed with sand material using front end loaders, and bolstered with rock placed with excavators.
After the first breach the KLM commenced with the construction of an emergency rock revetment along the spit in certain areas, with the scope increasing as the number of breaches increased. KLM’s marine engineers, PRDW, provided the design for the emergency revetment and guided the on-site work. The emergency revetment has now been completed along the entire length of the spit. The structure is approximately 640 m long, approximately 6 m wide and 2.5 m high from the bottom of the toe (Plate 6.9).

The fourth breach occurred on 13/14th September 2020 at the northern end of the spit. This breach has not yet been repaired, but in the meantime properties at the northern end of Ski Canal have been protected through the construction of revetments.

A risk analysis undertaken by PRDW (St Francis Bay Spit Protection Emergency Revetment: Construction History, Surveys and Risk Assessment, 2020) noted that:

- The emergency rock revetment is vulnerable and could be undermined / damaged at any time by wave activity / storm surges; and
- The Phase 2 permanent solution should be implemented as soon as possible to minimise further expenditure on emergency works.

A number of interventions have been implemented in the past. All have been short term solutions, and a long-term approach has now been proposed in order to prevent this section of coastline from undergoing further erosion.

Several conceptual options were initially investigated by Advisian (a division of the Worley Parsons Group). However, the implementation of beach nourishment (i.e. the placement of a large volume of sand on the beach) together with the development of short stub groynes (i.e. a low solid barrier built into the sea) was considered to be the most suitable option (Figure 2.1 and Figure 2.3). The details of the other alternatives which were considered are provided in Chapter 3 of the Environmental Impact Report. The description below is therefore based on the preferred design option.
2.4.1 Beach Nourishment

In order to protect the St Francis Bay coastline from further erosion, the option to artificially nourish the beach with sediment from a suitable borrow source has been identified as the preferred option. In order for beach nourishment to be implemented, sand must first be obtained from a suitable source area. The identification of a suitable source area is based largely on finding an area where sand material has similar grain size to that which is required on the beach.

Three (3) potential source areas were initially identified, which are all located within the Kromme River estuarine functional zone. These were subsequently refined into two areas defined as priority and secondary areas (Figure 2.2). Within these areas there are additional zones within which source material will be used. The approach for the priority and secondary areas is to target those areas of lower sensitivity (ecological and social) as well as those closest to where the material is required (i.e. the spit and beaches).

The maximum volume of sand which will need to be sourced is approximately 854,000 m\(^3\). It will be transported either via dredger, truck or a pipeline and pumping system. The aim of the beach nourishment scheme is to establish an area above the high-tide water mark that is 40 m wide. At the moment (December 2020) the beach is non-existent, and is regarded as 0 m wide. This sand will provide protection from erosion as waves will dissipate their energy before reaching the existing eroding area, and will to some extent re-instate the beach to what it was prior to the severe erosion experienced in the last two decades.
2.4.2  **Stub Groynes**

In order to maintain the sand on the beach, and to promote increased sedimentation in the future (changing the beach from an erosional system to an accreting system), six (6) stub groynes will be constructed along the length of the beach. These stub groynes will extend from the back end of the beach, above the HWM, and will be anchored into the frontal dune system. They will extend between 170 m and 200 m offshore (Figure 2.3). The stub groynes will be angled perpendicular to the shoreline (except groyne 5 which is oblique), and will be shorter than full length groynes which are generally used for erosion prevention. The shorter (stub) groynes will allow a certain percentage of sediment to pass between each groyne. The Supplementary Shoreline Modelling Report (2020) suggests that 50% of the sediment will by-pass the groyne structures. It also indicates that the new shoreline will effectively re-establish a beach where one presently does not exist. This is referred to as the Planform – the shape or outline of something as projected upon a horizontal plane - in Figure 2.3 below.

A maximum of approximately 44 300 m$^3$ of rock material will be required to construct the proposed stub groynes. The rock material used for the groynes will be sourced from a licenced local quarry, the details of which will be subject to availability, grading of rock material and cost.
A phased implementation will be required due to financial constraints. It is estimated that the total construction period without phasing will be approximately twenty-three (23) months (from start to finish). The phased implementation which will be implemented is based on five (5) areas along St Francis Bay beach (Figure 2.3). Area 1 will consist of a 650 m length of beach which will undergo beach nourishment as well as the construction of two 200 m long groynes, one at each end. Area 2 will consist of a 472 m long beach with one 170 m groyne, while Area 3 will consist of a 337 m length of
beach and two groynes which are 170 m in length. No groynes will be constructed in Area 4, but one groyne of 170 m in length is required for Area 5, and the proposed length of the beaches are 282 m and 391 m respectively.

3 METHODOLOGY

3.1 Desktop Assessment

A literature review was conducted using the available information on the Kromme Estuary and the coastline, as well as relevant legislation in South Africa (please refer to the references at the end of this report). There is a wealth of data available on the Kromme River Estuary. A comprehensive reserve determination was conducted for the Kromme Estuary by Ninham Shand and Coastal and Environmental Services from 2003 to 2006, this included an ecological water requirement report (completed in 2005) and estuarine surveys and specialist workshops which took place between September 2004 and February 2005. The literature used to compile this report ranges from 1983-2017 (refer to reference list).

The information presented in the Advisian reports, and especially the St Francis Bay Beach Long-term Coastal Protection Phase 2 report of 2018 was used to describe the dune and beach system. Further information from the Supplementary Shoreline Modelling Report (Advisian, 2020) was used to update the report, as well as comments received from IAPs on the previous version.

3.2 Mapping

The base map for the Estuarine Functional Zone of the Kromme Estuary was obtained from the National Estuaries (2012) vector geospatial data set obtained from BGIS (www.bgis.sanbi.org). The data set contains information on 299 South African estuarine systems that was digitised using Spot 5 imagery (2008) and Google Earth. The lateral boundaries include all the associated wetlands, intertidal mud and sand flats, beaches and foreshore environments that are affected by riverine or tidal flood events (Edgar, 1999). The 5 m topographical contour (obtained from Chief Directorate Surveys and Mapping) was used as the boundary to delineate the floodplains. From this delineation spatial data such as area, length and perimeter (estuary coastline) and distance to next system could be inferred. The estuarine vegetation within the estuarine functional zone (as determine by BGIS) was delineated using the most recent aerial imagery available on Google Earth Pro in order to determine any changes in vegetation communities over time.

3.3 CES Methodology for Assessing the Significance of Impacts

The identified impacts have been assessed against the following criteria:

→ Temporal scale (Table 3.1);
→ Spatial scale (Table 3.1);
→ Likelihood or risk (Table 3.1);
→ Severity or benefits (Table 3.2); and the
→ Overall significance rating (Table 3.3).

The relationship of the issue to the temporal scale, spatial scale and the severity are combined to describe the overall importance rating, namely the significance of the impact.

<table>
<thead>
<tr>
<th>TEMPORAL SCALE (DURATION OF THE IMPACT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3.1 Significance Rating Table.</td>
</tr>
</tbody>
</table>
Short term: Less than 5 years (Many construction phase impacts are of a short duration).

Medium term: Between 5 and 20 years.

Long term: Between 20 and 40 years (From a human perspective almost permanent).

Permanent: Over 40 years or resulting in a permanent and lasting change that will always be there.

**SPATIAL SCALE (AREA IN WHICH ANY IMPACT WILL HAVE AN AFFECT)**

- Localised: Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
- Study area: The proposed site and its immediate surroundings.
- Municipal: Impacts affect the municipality, or any towns within the municipality.
- Regional: Impacts affect the wider area or the province as a whole.
- National: Impacts affect the entire country.
- International/Global: Impacts affect other countries or have a global influence.

**LIKELIHOOD (CONFIDENCE WITH WHICH ONE HAS PREDICTED THE SIGNIFICANCE OF AN IMPACT)**

- Definite: More than 90% sure of a particular fact. Should have substantial supportive data.
- Probable: Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
- Possible: Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
- Unsure/Unlikely: Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.

### Table 3.2: Impact Severity Rating.

<table>
<thead>
<tr>
<th>IMPACT SEVERITY (SEVERITY OF NEGATIVE IMPACTS, OR HOW BENEFICIAL POSTIVE IMPACTS WOULD BE ON A PARTICULAR AFFECTED SYSTEM OR AFFECTED PARTY)</th>
<th>VERY SEVERE</th>
<th>VERY BENEFICIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very severe</td>
<td>An irreversible and permanent change to the affected system(s) or party (ies) which cannot be mitigated. For example the permanent loss of land.</td>
<td>A permanent and very substantial benefit to the affected system(s) or party (ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.</td>
</tr>
<tr>
<td>Severe</td>
<td>Long term impacts on the affected system(s) or party (ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.</td>
<td>A long-term impact and substantial benefit to the affected system(s) or party (ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.</td>
</tr>
<tr>
<td>Moderately severe</td>
<td>Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing a sewage treatment facility where there was vegetation with a low conservation value.</td>
<td>A medium to long term impact of real benefit to the affected system(s) or party (ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a ‘slight’ improvement in sewage effluent quality.</td>
</tr>
<tr>
<td>Slightly severe</td>
<td>Medium- or short-term impacts on the affected system(s) or party (ies). Mitigation is very easy.</td>
<td>A short to medium term impact and negligible benefit to the affected system(s) or party (ies).</td>
</tr>
</tbody>
</table>
cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.

<table>
<thead>
<tr>
<th>No effect</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>The system(s) or party (ies) is not affected by the proposed development.</td>
<td>In certain cases it may not be possible to determine the severity of an impact.</td>
</tr>
</tbody>
</table>

Table 3.3: Overall Significance Rating.

<table>
<thead>
<tr>
<th>OVERALL SIGNIFICANCE (COMBINATION OF ALL THE ABOVE CRITERIA AS AN OVERALL SIGNIFICANCE)</th>
<th>VERY HIGH NEGATIVE (-)</th>
<th>VERY BENEFICIAL (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY HIGH NEGATIVE (-)</td>
<td>VERY BENEFICIAL (+)</td>
<td></td>
</tr>
<tr>
<td>These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH NEGATIVE (-)</th>
<th>BENEFICIAL (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long-term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODERATE NEGATIVE (-)</th>
<th>SOME BENEFITS (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium-term change to the (natural and/or social) environment. These impacts are real but not substantial.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOW NEGATIVE (-)</th>
<th>FEW BENEFITS (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short-term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are no primary or secondary effects at all that are important to scientists or the public.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNKNOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information.</td>
</tr>
</tbody>
</table>
4 DESCRIPTION OF THE ESTUARY

4.1 Climate

St Francis Bay is characterised by a warm, temperate climate, with average temperatures ranging between 18.5 °C in July to 24 °C in February. The coldest temperatures are experienced during July, where average temperatures may drop to a low of 8.2 °C. The warmest months include January and February (Figure 4.1). Rainfall in St Francis occurs throughout the year, averaging around 525 mm per annum. The highest rainfall occurs during August, averaging around 62 mm, while the lowest rainfall occurs during January (26 mm).

![Figure 4.1 Average rainfall, midday temperatures and night-time temperatures for St Francis Bay (SA Explorer, 2017).](image)

4.2 Hydrology

The Proposed Coastal Protection Scheme is located in Water Management Area seven (WMA 7): Mzimvubu-Tsitsikamma in Primary Drainage Region K, Quaternary Catchment K90E.

The Kromme River is approximately 95 km long (Scharler and Baird, 2000) and has many unnamed, small ephemeral tributaries that support dense pockets of indigenous vegetation. The main tributary is the Geelhoutboom River, which originates south of Humansdorp, and joins the Kromme Estuary about 8 km upstream of the mouth. Other tributaries are the Dwars River (8 km downstream of the source of the Kromme River), the Diep River (downstream of the Churchill Dam), the Klein River (11.6 km upstream of the mouth), the Boskloof River (5.2 km upstream of the mouth), the Sand River (2 km upstream of the mouth) and the Huis River (1 km upstream of the mouth) (Baird et al., 1992).

Under natural conditions the Geelhoutboom tributary, on average, is estimated to have contributed less than 5 % of the freshwater inflow into the estuary throughout the year. Under current conditions this contribution is less than 1 % in mid- to late summer, but typically between 10 to 30 % during the remainder of the year (i.e. the peak contribution is during the early part of the wet season). Under current conditions, during dry years the Geelhoutboom tributary contribution is negligible in terms of freshwater inflow to the Kromme Estuary in the dry summer months, but typically 15 to 20 % during the remainder of the year. During wet years the freshwater contribution from the Geelhoutboom ranges between 5 to 10% during the rainy season in late winter to early spring to approximately 20 % during the dry months in mid to late summer. The contribution from the Sand River is considered to be negligible (Coastal and Environmental Services, 2006).

The flow pattern of the Kromme River has been modified by two large dams, i.e. the Churchill Dam (built in 1943; capacity of $33 \times 10^6$ m$^3$) and the Mpofu Dam (built in 1983; capacity of $107 \times 10^6$ m$^3$) (Bickerton and Pierce, 1988; Bate and Adams, 2000). Both dams have the combined capacity of storing ca 133 % of the mean annual run-off of the Kromme River catchment (Bate and Adams, 2000; Scharler and Baird, 2000). The dams in the catchment are considered to attenuate all floods with a return period of less than 1 in 30 years (Bickerton and Pierce, 1988).
Model simulations, carried out by Advisian in 2020, concluded that the flow in the estuary is mainly tide dominated under normal conditions (Figure 4.2). During high river discharge conditions, the flow is dominated by river discharge (Figure 4.3). The maximum current speeds at the river mouth range from 1.8 m/s to 2.4 m/s during lean and high discharge conditions respectively. The current speed inside the main estuary and river is usually less than 0.3 m/s.

**Figure 4.2 Spatial variation of currents during normal conditions. Higher current speeds are at the mouth (Advisian, 2020)**
4.3 Ecological Condition

The Present Ecological State (PES), the Ecological Importance (EI) and the Ecological Sensitivity (ES) of the Kromme and Geelhoutboom Rivers and their tributaries are presented in Table 4.1 below (Department of Water and Sanitation, 2014). These rivers define the upper boundary of the tidal influence, or the extent of saline intrusion upstream, of the Kromme Estuary.

Table 4.1 Environmental Sensitivity of the Kromme and Geelhoutboom

<table>
<thead>
<tr>
<th>RIVER</th>
<th>PRESENT ECOLOGICAL STATE (PES)</th>
<th>ECOLOGICAL IMPORTANCE (EI)</th>
<th>ECOLOGICAL SENSITIVITY (ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kromme River</td>
<td>PES D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>2. Geelhoutboom River</td>
<td>PES D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

4.4 Estuarine Functional Zone

As discussed in Section 3.2 above, the base map for the Estuarine Functional Zone of the Kromme Estuary was obtained from the National Estuaries (2012) vector geospatial data set obtained from...
BGIS (www.bgis.sanbi.org). The estuarine vegetation within the estuarine functional zone (as determined by BGIS) was delineated using the most recent aerial imagery available on Google Earth Pro in order to determine if there have been any changes in the extent of vegetation communities over time. The estuarine functional zone includes open water, estuarine habitat and the floodplain, and the results of the mapping exercise are presented in Figure 4.4 a & b. According to BGIS, the 5m contour has the following biodiversity and planning advantages:

→ “The 5m contour encapsulates most dynamic areas influenced by long-term estuarine sediment processes, i.e. sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes and changes due to coastal storms. Allowing for natural variability is important as these are some of the key physical processes that drive biodiversity along the coastline.

→ The 5m contour encompasses the floodplain and estuarine vegetation that contribute detritus (food) and provides refuge to the systems. Note: salt-marsh vegetation can occur further than 500m away at a number of the larger estuaries. Most estuarine-associated biota occur under the 5m contour, as this is as far as the influence of the ocean can be detected on land.

→ Temporarily open/closed estuaries can close at levels of between 2.5 and 4.5m. The 5m contour allows for water-level increases due to back-flooding under closed mouth conditions or wave action from wind.

→ In most cases, the 5m contour allows for the inclusion of a buffer zone of terrestrial vegetation that represents the transition between terrestrial and coastal ecosystems.

→ The 5m contour should provide a buffer zone that can allow an estuary to retreat in the future in the event of sea-level rise due to climate change. It also allows for the inclusion of some terrestrial fringe vegetation that contributes detritus to the system and refuge areas during floods.

→ Flood lines (1:50/1:100) for estuaries are often inaccurately determined under open mouth conditions, which leads to underestimation of flood heights. In the absence of long-term berm height data (which can vary substantially under different climatic conditions) the 5m contour provides the best protection against natural hazards such as floods and storms.

→ The 5m contour minimizes the risk of pollution to estuaries. Septic tanks are sunk about 2 m into the ground. During closed mouth conditions (and very high tides) density differences between fresh and salt water cause drainage problems or infrastructure damage if tanks are not situated above the 5m contour.

→ Water resources development and land-use change in the catchment can lead to the changes in mouth behaviour, i.e. change estuary type from permanently open to temporarily open.”
Figure 4.4a: The Kromme Estuary Functional Zone and Habitat Map.
Figure 4.4b: The Kromme Estuary Functional Zone and Habitat Map (Lower Estuary).
4.5 Physical Characteristics of the Functional Zone

The Kromme Estuary is a permanently open estuary that is situated in a warm temperate biogeographical region. According to Whitfield (1992), some of the characteristics of permanently open estuaries are as follows:

- Moderate tidal prisms;
- Tidal/riverine mixing process;
- Average salinity ranges from 10 to less than 35 ppt;
- Longitudinal salinity gradient with possible vertical stratification, depending on the bathymetry and tidal cycle and river inflow;
- Catchments typically >500 km²;
- Under natural conditions rivers have perennial flow;
- Linkages to coastal lakes;
- Presence of wetlands and/or mangroves;
- Both marine and estuarine biota dominant;

The Kromme Estuary is tidal for approximately 14 km (Bickerton and Pierce, 1988). A massive sandspit of about half a kilometre long extends from the south bank of the estuary mouth and tends to push the mouth channel northwards. In the lower reaches of the estuary (up to about 5 km from the mouth) channel depths are around 1.5 m, characterised by a sandy bottom substrate. Further upstream, the estuary becomes deeper (3 to 5 m). In the upper reaches current velocities are usually lower than 0.3 m.s⁻¹, while current velocities of 1 m.s⁻¹ are common near the mouth. Extensive salt marshes cover the banks of the estuary in the middle and lower reaches, while the channel meanders between vegetated cliffs in the upper reaches. A marina has been developed on the west bank near the mouth (Coastal and Environmental Services, 2006). The mouth of the Kromme Estuary is flood tide dominated resulting in the ingress of marine sediment in its lower reaches (Bickerton and Pierce, 1988).

As mentioned above, the natural runoff from the Kromme River catchment area has been severely restricted by impoundments with storage capacities exceeding the mean annual runoff (MAR). Daily average discharge data was available for the location K9H003 from 1983 to 2020 with a gap in data from November 1996 to February 1998 (Advisian, 2020). The data showed very low daily average discharges – less than 1 m³/s most of the time, with one high discharge maxima of up to 313 m³/s recorded in 2006. There were two peaks of more than 200 m³/s in 2011 and one other high flow event (100 m³/s) in 2014. All of these would be related to high rainfall events.

The nutrient status in the estuary is fairly stable. The annual allocation of storage water to the estuary (2 x 10⁶ m³) was released from the Mpofu Dam as a single release in 1999 and the impact on various physio-chemical parameters as well as inorganic dissolved nutrients (phosphate, nitrate, nitrite, ammonia) in the estuary was investigated with regards to the magnitude, persistence and management of future releases. This was initiated with the aim of understanding how the system would respond to the freshwater input in order to inform future releases from the dam for ecological purposes. The impact on dissolved nutrient concentrations was short-lived (less than 7 days), and pre-release concentrations were quickly re-established (Sharler and Baird, 2000). The release raised especially nitrate and nitrite concentrations temporarily, because of elevated concentrations in the storage water (i.e. from agricultural practices), but phosphate concentrations in the estuary were slightly diluted. The research showed no long-lasting effect on the physical conditions of the estuary in terms of inorganic dissolved nutrients from the freshwater release. Natural runoff reaching the estuary appears to be more beneficial, especially in terms of phosphate.

A direct impact of the extensive water abstraction in the catchment is the presence of high salinity levels in the water column throughout the year, and the occasional occurrence of hypersaline
conditions in the upper reaches. Several studies have characterised the estuary as freshwater-starved (e.g. Marais, 1983; Hanekom and Baird, 1984; Emmerson and Erasmus, 1987; Adams et al., 1992; Newman, 1993; Jerling and Wooldridge, 1994). This is largely because the Sand and Geelhoutboom Rivers, the biggest tributaries to the Kromme system, are not viable freshwater contributors to the estuary, based on studies over the last 25 years (Scharler et al., 1997). Salinity values above 35 ppt dominate at the tidal head of the estuary (i.e. 14km upstream), whereas lower salinity values (< 35 ppt) were only measured occasionally near the surface in the upper reaches of the estuary (i.e. closer to the Mpofu Dam) (Scharler et al., 1997). Based on this, the Kromme estuary is essentially a marine system and creates habitats for marine vegetation and species.

Reduction in freshwater flow also results in marine sediments moving upstream due to tidal flow (sediment enters from the tidal head and inlet). Since the construction of the Churchill and Mpofu dams on the Kromme River, the upstream migration of marine sand has increased (Reddering and Esterhuysen, 1983). In an unmodified system, the net long-term rate of sediment build-up is relatively slow because periodic freshwater floods scour the channels and remove accumulated sediment out to sea. The sediment balance in the estuary has thus been disrupted through artificial modification (specifically a reduction in freshwater inflow) resulting in limited scouring (there are still occasional floods of freshwater to the sea, but because of the large sizes of the impoundments, these are very irregular), which consequently results in continuous sediment build-up in the system (Lee et al., 2014). Another source of sediment for the Kromme River Estuary is the Sand River (approximately 2 km upstream from the mouth). This tributary deposits a small amount of sand into the estuary on the southern bank, which is then spread upstream and downstream in the estuary by the tidal currents.

The mouth of the estuary experiences regular tidal inflow and outflow, which is sufficient to maintain a tidal inlet. Consequently, the flood-tidal delta of the Kromme is well-developed and extends 4-5 km upstream of the mouth where it produces large intertidal sand flats, which are densely colonised by burrowing infauna (mainly Callianassa spp.). The open connection with the sea and strong tidal currents permit both active and passive migration of biota and enable the maintenance of “typical” estuarine water level fluctuations, creating extensive sandy intertidal areas and salt marshes, which are important habitats for the estuarine biota (Harrison et al., 1996a; Harrison et al., 1996b).

The aerial imagery in Figure 4.5 shows the relative stability and persistence of the sand banks in the lower parts of the estuary (near the mouth) extending up to the R330 road bridge. The images show that very little change has taken place with regards to development along the estuary and the vegetation seems similar at this scale.

The Kromme is considered a permanently open estuary with all images showing the mouth open to the sea and in a similar position year on year.

The analysis of the sediment and its particle size suggest that the sediment in the lower reaches of the estuary are considered to be medium sand according to the Udden-Wentworth scale. The distribution of this sediment is uniform throughout the lower reaches. It is anticipated that upstream from the R330 road bridge the particles become finer.
Figure 4.5 Aerial Imagery of the Kromme Estuary during the period of 2004 – 2017.
4.6 Flora Of The Functional Zone

Vegetation in the Kromme Estuary can be divided into four (4) distinct groups:

- **Submerged Macrophytes**: Dominated by *Zostera capensis*;
- **Intertidal Salt Marsh**: Dominated by salt marsh species such as *Sarcocornia decumbens, Triglochin striata, Triglochin bulbosa, Bassia diffusa, Sporobolus virginicus, Limonium linifolium, Spartina maritima* and *Salicornia meyeriana*;
- **Supratidal Salt Marsh**: Dominated by *Sarcocornia pillansii*; and
- **Reeds and Sedges**: Dominated by *Phragmites australis*

Plate 4.1 below shows three (3) of the typical vegetation/habitat types at the Kromme Estuary. Given the state of the tide (rising) images of submerged macrophytes were not taken.

| a) Dune vegetation (sedges) coverage on the southern bank of the estuary looking upstream, recently established following the 2012 Sand River flood. | b) Image of the mouth of the estuary on the rising tide looking south. |
| c) Southern bank of the estuary in the lower reaches showing bare intertidal area and vegetated supra-tidal areas. | d) Stable dune covered in reeds and sedges located at the entrance to the Sand River, recently established following the 2012 Sand River flood. |
e) Dune vegetation covering the southern bank of the estuary near the R330 road bridge, recently established following the 2012 Sand River flood.

f) Sand bank upstream of the R330 road bridge looking north.

g) Southern bank of the estuary downstream of the R330 road bridge showing intertidal sand bank and supra-tidal saltmarsh vegetation.

h) Inter-supra-tidal saltmarsh species (*Sarcocornia pillansii*) common to South African estuaries.

Plate 4.1: Kromme Estuary photographs.

4.6.1 Submerged Macrophytes

Submerged macrophytes are primary colonizers of mudflats and sandflats. They are those angiosperms that are rooted in soft subtidal and low intertidal substrata (Day, 1981). The plants’ leaves and stems are completely submerged for most states of tide. They vary in abundance in water ranging from polyhaline (above 30 PSU) to fresh (0 PSU) (Day, 1981). The polyhaline species have a worldwide distribution in sheltered bays and estuaries. *Zostera, Halophila, Ruppia, Potamogeton* and *Zannichellia* are the common temperate genera (Day, 1981). *Zostera capensis* Setch. is the most common submerged macrophyte in permanently open South African estuaries (Edgecumbe, 1980; Lubke and van Wijk, 1988).

Submerged macrophytes help to oxygenate the hypolimnion, i.e. the layer of water in a thermally stratified lake that lies below the thermocline, is noncirculating, and remains perpetually cold (Titus et al., 2004), and increase the depth of the oxidized microzone at the sediment surface (thus reducing phosphate and ammonia release). Submerged macrophytes also play an essential role in nutrient trapping and recycling (Cacador et al., 2000; Titus and Pagano, 2002; Riis et al., 2004; Titus et al., 2004; Lillebo et al., 2006; Figueiredo da Silva et al., 2009). They reduce water movement on the estuary bottom, preventing resuspension of the sediments (Adams et al., 1999; Noges et al., 2003; James et
al., 2004b; Riis et al., 2004) therefore reducing the release of phosphorus (Sondergaard et al., 2003). Numerous studies have shown that high loading of phosphorus leads to high phytoplankton biomass, turbid water and often undesired biological changes (Sondergaard et al., 2003; James et al., 2004a; James et al., 2004b). The latter includes loss of biodiversity, disappearance of submerged macrophytes, fish stock changes and decreasing top-down control by zooplankton on phytoplankton (Sondergaard et al., 2003; Schutten et al., 2004). Hughes and Paramor (2004) reported that the loss of Zostera from the Stour Estuary, England, caused the erosion of 15x 10^6 m^3 of sediment and increased its tidal volume by 30%.

Submerged macrophytes are also an important habitat for invertebrates, fish and birds (Noordhuis et al., 2002; Van den Berg et al., 2003; Booth, 2009; Henninger et al., 2009). Zostera beds provide shelter for juvenile fish and protect them from predators. Submerged macrophytes can be grazed directly, but food for consumer organisms is mostly provided indirectly through their feeding on epiphytic algae growing on plant surfaces (Thayer et al., 1975; Larkum and West, 1990; Walker and McComb, 1992; Adams et al., 1999; Titus et al., 2004; Rolon and Maltchik, 2006; Henninger et al., 2009).

Freshwater impoundment generally reduces the frequency of floods and sedimentary disturbances (Whitfield and Bate, 2007). Den Hartog (1977) has shown that plants such as submerged macrophytes cannot develop or colonize areas where the substrate is constantly being modified by water currents. Therefore, reduced freshwater input into an estuary, and slower current velocity favours submerged macrophyte growth and dominance, as there is a decrease in turbidity and water velocities resulting in a more stable substrate.

The reduction of freshwater inflow into the Kromme Estuary over the past decade has led to an increase in Zostera capensis biomass and its area of distribution (Adams and Talbot, 1992; Wooldridge, 2007). Bezuidenhout (2011), showed, that there has been a steady increase in the area covered by Zostera capensis since 1942 (10.8 ha), 1980 (13.7 ha), 1989 (21.7 ha) and up to 30.98 ha mapped from aerial photographs from 2000. This is a three-fold increase in Zostera. Based on mapping conducted for this study (2017 google earth imagery), the area colonised by Zostera capensis has increased by a further 17 ha in the last 17 years, resulting in an increase from 10.8ha in 1942 to 48ha today, but importantly the increase between 1942 and 2000 (58 years) was 20ha (0,35ha per annum), but the increase in the past 17 years is 17ha (1ha per annum). These more rapid increases in recent times can be attributed to various anthropogenic factors, but most notably reduced flows (which results in a lack of scouring and sedimentary disturbance) a more stable salinity regime, and reduced turbidity. The changes to these physical processes are a result of the construction of the bridge, a reduction in sand input from the Sand River tributary, and the construction of the Mpofu Dam.

Zostera capensis is listed on the South African Red Data List (2017) as Least Concern. According to SANBI “Zostera capensis is locally extinct in Durban Bay as a result of habitat loss due to harbour construction, reclamation and dredging, and at St Lucia due to natural disasters as a result of prolonged drought and closed mouth conditions. It has also been lost from a number of small KwaZulu-Natal estuaries due to coastal development, freshwater abstraction and catchment disturbance which has led to mouth closure and loss of intertidal habitat. Eutrophication of rivers is also a severe threat, leading to increased algal growth, shading and outcompeting this species.”

In addition, Zostera capensis is listed as vulnerable by the IUCN which states that current populations of this species are decreasing, mainly as a result of climate change, pollution and development. This is ironic given the rapid colonisation of the Kromme system by Zostera, which is spreading at a pace akin to an invasive species.
4.6.2 Salt Marsh

Salt marshes comprise emergent herbs, grasses or low shrubs that occur in soils that are inundated and drained by tidal action (Nybakken, 2001). They are highly productive ecosystems and have primary productivity rates comparable with coral reefs and tropical forests in certain areas (Silliman and Bortolus, 2003; Bromberg and Bertness, 2005). Salt marshes occur along the south-eastern, southern and western coasts of South Africa in estuaries, dry river beds and embayments. Species diversity of salt marshes is poor, mostly because of the specialised environment and high salt conditions which create an uninhabitable environment (Nybakken, 2001). Although salt marsh plants are generally associated with euhaline (i.e. fully saline; seawater with a salinity of greater than 30 ppt) conditions, high salinity is not physiologically optimal for them.

Salt marsh plants occur in distinct zones along an elevation and tidal inundation gradient (Davy, 2000; Rogel et al., 2000; Rogel et al., 2001; Bockelmann et al., 2002; Costa et al., 2003; Ursino et al., 2004; Hughes and Paramor, 2004; Perry and Atkinson, 2009). In areas above the normal spring tide is the supratidal zone, which is only inundated with water on an occasional basis. Here slightly salt-tolerant grasses such as *Stenotaphrum secundatum* (H. Walter) Kuntze and *Cynodon dactylon* (L.) Pers. co-exist with *Sporobolus virginicus* (Day, 1981; O’Callaghan, 1994; Adams et al., 1992). *Sarcocornia pillansii* (Moss) A.J.Scott, is also found in this zone together with *Disphyma crassifolium* (L.) L.Bolus and *Plantago crassifolia* Forssk.

The upper intertidal salt marsh zone is found from the extreme high water spring tide level to the mean high water spring level, the vegetation consists of a mixed zone of generally typical salt marsh species: *Sarcocornia decumbens* (Tölken) A.J.Scott, *Limonium scabrum* (Thunb.) Kuntze and *Bassia diffusa* (Thunb.) Kuntze (O”Callaghan, 1994). The lower intertidal salt marsh zone is found between the mean high-water spring and the mean high water neap level, and is characterised by *Sarcocornia perennis* (Mill.) A.J.Scott and *Triglochin bulbosa* L. (Day, 1981; O”Callaghan, 1994). *Spartina maritima* (Curtis) Fernald is found from the bottom of this zone to below mean sea level, which is normally inundated. *Zostera capensis* Setch. grows below mean sea level and thus marks the end of the salt marsh species extent.

Salt marsh plants are important inorganic and organic nutrient sources for estuarine ecosystems (Sousa et al., 2008), although the extent of tidal flushing is important in determining how much of the nutrient is released to the water column (Teal and Howes, 2000). Bacteria and other microorganisms break down the plant material and the “filter-feeders” sieve out the fine organic particles as a food source (Teal and Howes, 2000; Galvan, 2008). In this way the plants offer feeding opportunities to a broad spectrum of animal life, thus playing an essential role in the functioning of the estuarine food web.

Salt marshes and wetlands are important habitats, and their loss can have significant ecological and economic implications. For example, salt marshes provide a critical habitat for resident and migrating wildlife (Montalto and Steenhuis, 2004) and a unique niche for some crustacean and mollusc invertebrates (Bromberg and Bertness, 2005). These organisms are specifically adapted to marshes, and are not found in other parts of the estuary. Salt marsh areas provide feeding areas for fish during flood tides as they enter the marsh creeks to feed off the substrate, or prey on abundant mudprawn (Montalto and Steenhuis, 2004; Bromberg and Bertness, 2005; Rozas et al., 2005).

Salt marsh macrophytes promote sedimentation by reducing velocities and increasing sheet flow. *Spartina* has been known for stabilizing and building up mudflats (Chung et al., 2004). Salt marsh is also important in coastal flood defence (Bromberg and Bertness, 2005), as it offers some protection from wave action.
The ecological function and physical stability of marshes are easily disrupted by, for example, interference with the tidal exchange of water, reclamation or infilling, pollution, dredging or trampling by vehicles or animals (Chapman, 1960; Ungar, 1962; Tolken, 1967; Ungar, 1978; Gray, 1986; Baird et al., 1992; Naidoo and Mundree, 1993; Adams and Bate, 1995).

The large intertidal salt marsh areas within the Kromme Estuary are particularly important, as only 18% of South African estuaries are permanently open, which is conducive to the establishment of salt marsh habitat, and consequently the Kromme salt marshes are considered to be rare (Colloty, 2000). The largest section of salt marsh occurs on the seaward side of the road bridge on the eastern bank (Figure 4.4a & b), approximately 2 km from the mouth. Small isolated salt marshes also occur further upstream on the west bank (4 km from the mouth) and on the east bank about 2 km from the head of the estuary. Salt marshes extend into the middle-upper reaches of the Geelhoutboom tributary.

The loss of salt marsh in the system can mainly be attributed to development on the floodplain i.e. along the edge of the estuary in the middle reaches. There was also some evidence of salt marsh erosion in the middle reaches of the estuary (at the Sand River delta where additional sand shifted the river channel and is now actively eroding the river bank). In addition, boat activity as well as waves caused by easterly and westerly winds also have a wake effect that has led to bank collapse. In addition, lack of freshwater input into the Kromme Estuary has resulted in increased water column salinity that has caused salt accumulation in the intertidal marshes (Adams et al., 1992). This has resulted in large areas of bare ground in the upper intertidal areas due to hypersaline conditions. These bare patches are only colonized by the highly stress tolerant *Salicornia meyeriana*. When an increase in rainfall flushes some of the excess salt from these bare patches during winter there is a decrease in the cover of *Salicornia* and an increase in other salt marsh species.

Other saltmarsh species present in the Kromme Estuary include:

- *Triglochin striata*,
- *Triglochin bulbosa*,
- *Bassia diffusa*,
- *Sporobolus virginicus*,
- *Limonium linifolium*,
- *Disphyma crassifoilium*, and
- *Spartina maritima*

The conservation status of these species is outlined in Table 4.2 below.
Table 4.2: Conservation Status of salt marsh species present in the Kromme River Estuary according to the South African and International Union for Conservation of Nature (IUCN) Red Data Books

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SOUTH AFRICAN RED DATA LIST</th>
<th>IUCN</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarcocornia decumbens</td>
<td>Least Concern</td>
<td>-</td>
<td>This taxon was not selected in any one of four screening processes for highlighting potential taxa of conservation concern for detailed assessment and was hence given an automated status of Least Concern.</td>
</tr>
<tr>
<td>Sarcocornia pillansii</td>
<td>Least Concern</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Salicornia meyeriana</td>
<td>Least Concern</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Triglochin striata</td>
<td>Least Concern</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Triglochin bulbosa</td>
<td>Vulnerable</td>
<td>Least Concern</td>
<td>There are four subspecies of <em>Triglochin bulbosa</em> listed on the South African Red Data List, <em>Triglochin bulbosa</em> L. subsp. <em>bulbosa</em> (Least Concern), <em>Triglochin bulbosa</em> L. subsp. <em>calcicola</em> Mering, Köcke &amp; Kaderiet (Near Threatened), <em>Triglochin bulbosa</em> L. subsp. <em>quarcicola</em> Mering, Köcke &amp; Kaderiet (Vulnerable), <em>Triglochin bulbosa</em> L. subsp. <em>tenuifolia</em> (Adamson) Horn (Vulnerable). Due to the fact that the sub-species occurring in the Kromme Estuary is currently unknown, the precautionary approach has been applied.</td>
</tr>
<tr>
<td>Bassia diffusa</td>
<td>Least Concern</td>
<td>-</td>
<td>This taxon was not selected in any one of four screening processes for highlighting potential taxa of conservation concern for detailed assessment and was hence given an automated status of Least Concern.</td>
</tr>
<tr>
<td>Sporobolus virgicinus</td>
<td>Least Concern</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Limonium linifolium</td>
<td>Near Threatened</td>
<td>-</td>
<td>Many estuaries within the known range of this species are in poor condition (Driver et al. 2012), as a result of infrastructure development, pollution, and upstream damming of rivers, and estuarine ecosystems are poorly protected.</td>
</tr>
<tr>
<td>Disphyma crassifolium</td>
<td>Least Concern</td>
<td>-</td>
<td>Population trend is considered to be stable.</td>
</tr>
<tr>
<td>Spartina maritima</td>
<td>Least Concern</td>
<td>Near Threatened</td>
<td>Threats are generally from the construction of tourist areas and dams.</td>
</tr>
</tbody>
</table>

4.6.3 Reeds and Sedges

Extensive reed and sedge communities are found at freshwater seeps and at the head of estuaries, where there is greater freshwater influence. The dominant plants in this community are rushes such as *Juncus*, or sedges such as *Scirpus*. Mats or swards of grasses, such as *Sporobolus virgicinus* (L.) Kunth or *Stenotaphrum secundatum* (H. Walter) Kunz are common on raised banks or at the edge of reed swamp or salt marshes in South Africa (Lubke and van Wijk, 1988). *Phragmites australis* (Cav.) Trin. Ex Steud. is a common estuarine reed that may also be associated with disturbed areas where the normal saltwater flushing has been arrested (Clark, 1977; Lubke and van Wijk, 1988). It can, however, tolerate salinities close to seawater, unlike plants such as *Typha*, *Scirpus* and *Cyperus*. Salinity restricts the...
distribution of reed and sedge communities in estuaries, although groundwater seepage can play an important role in influencing salinity in marginal reedbeds (Adams and Bate 1999).

Reed and sedge communities serve the valuable ecological function of protecting banks from erosion. Destruction of Phragmites australis (common reed) stands by boating and swimming activities in Europe has been shown to result in costly shore rehabilitation programmes (Weisser and Howard-Williams, 1982). Phragmites-dominated marshes provide a habitat for many birds, invertebrates and fish species (Haslam, 1971). They can remove large quantities of nutrients from the water column and are so effective that they are used as water purification systems in artificial wastewater treatment systems (Wolverton, 1982; Hoffman, 1990; Brix, 1993; Adams et al., 1999; Nemeth and Lakner, 2002; Meers et al., 2005; Tian et al., 2009; Ruiz and Velasco, 2009). Todorovics et al. (2005) showed that reedbed waste water treatment systems have an organic removal efficiency rate similar to that of the conventional activated sludge treatment, plus a higher nutrient retention ability, and are therefore beneficial against eutrophication. Reed and sedge communities have an important utilitarian value, particularly in the rural areas of KwaZulu-Natal (Begg, 1986). The sedge, Juncus kraussii Hochst. is used for the construction of sleeping mats and numerous craftwork products. Hut-building and thatching material is obtained from Phragmites (Adams et al., 1999).

According to Bezuidenhout (2011) a large area (7.2 ha) of Phragmites australis near the village of St. Francis Bay was lost as a result of development. Ignoring the loss of this inland reed bed, there was actually an increase of over 6 ha in the estuary itself. This increase in cover of the reedbeds resulted from an increase in sedimentation due to decreased freshwater input (Adams and Talbot, 1992). Reed beds occur upstream of the road bridge on the south bank, and in small streams and tributaries feeding the estuary in the middle-upper reaches. Reeds can survive tidal inundation with saline water as long as their roots and rhizomes are located in brackish to fresh water (Adams and Bate, 1999). The upper reaches of the Kromme Estuary are rocky and extensive reed beds do not occur there naturally. However, reeds were probably more extensive in the Geelhoutboom tributary prior to the construction of farm dams when the water column salinity was lower (< 15 PSU).

Phragmites australis is listed on both the South African Red Data List (2017) and the IUCN as Least Concern.

4.7 Fauna of The Functional Zone

There is a significant lack of recent literature concerning the ichthyofaunal composition of the Kromme Estuary. However, according to Hanekom and Baird (1984), a total of 24 species have been recorded in this estuary (Table 6.2). Of these 24 species, 7 species occur throughout the estuary, namely Cajjrogobius multifasciatus (Smith), Gilchristea aestuarius (Gilchrist), Gymnogobius giurus (Hamilton-Buchanan), Hepsetia breviceps (Cuvier), Liza dumerili (Steindachner), Liza richardsoni (Smith) and Rhabdosargus holubi (Steindachner). The Species Monodactylus jalcijonnis (Lacepede) and Rhabdosargus holubi occur predominantly in Zostera beds, while the species Diplodus cervinus (Valencienne), Lithognathus lithognathus (Cuvier), Spondylus amarginatum (Cuvier) Gilchristella aestuarius, Liza dumerili, Liza richardsoni and Pomadasys olivaceum usually dominate areas outside of Zostera beds. Species occurring in the highest abundance include L. dumerili, G. giurus, and G. aestuarius.

The conservation status of these species is outlined in Table 4.3 below.
Table 4.3: Conservation Status of fish species recorded in the Kromme River Estuary

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>IUCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinus superciliosus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Caffrogobius multifaciatuus</td>
<td></td>
</tr>
<tr>
<td>Diplodus cervinus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Diplodus sargus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Gilchristella aestuarius</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Glossogobius giurus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Hepsetia breviceps</td>
<td>Not Evaluated</td>
</tr>
<tr>
<td>Heteromycetes capensis</td>
<td>Not Evaluated</td>
</tr>
<tr>
<td>Lichia amia</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Lithognathus</td>
<td>Endangered</td>
</tr>
<tr>
<td>Chelon dumeril</td>
<td>Data Deficient</td>
</tr>
<tr>
<td>Chelon richardsonii</td>
<td></td>
</tr>
<tr>
<td>Chelon tricuspidens</td>
<td></td>
</tr>
<tr>
<td>Monodactylus falciformis</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Mugil cephalus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Myxus capensis</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Pomadasys commersonni</td>
<td>Not Evaluated</td>
</tr>
<tr>
<td>Pomadasys ovivaceum</td>
<td></td>
</tr>
<tr>
<td>Psammogobius knysnaensis</td>
<td></td>
</tr>
<tr>
<td>Rhabdosargus holubi</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Solea bleekeri</td>
<td></td>
</tr>
<tr>
<td>Spondylosoma emarginatum</td>
<td></td>
</tr>
<tr>
<td>Sygnathus acus</td>
<td>Least Concern</td>
</tr>
<tr>
<td>Tachysurus jeliceps</td>
<td></td>
</tr>
<tr>
<td>Sygnathus watermeyeri</td>
<td></td>
</tr>
</tbody>
</table>

Although the Western Cape’s endemic seahorse species *Hippocampus capensis*, commonly referred to as the Kynsna Seahorse, historically occurred in the Kromme Estuary, sightings of this species have not been recorded for many years. This endangered species now only inhabits three estuarine systems along the South African coast, namely the Swartvlei Estuary, Keurbooms Estuary and the Knysna Estuary (Harding, 2017).

One of South Africa’s two *Sygnathus* species, *S. acus* (commonly known as the Longsnout Pipefish), can also be found occurring in low abundance within the coastal and estuarine regions of the Kromme Estuary (Mwale et al., 2014). This unique species generally occurs in warm to cool temperate estuarine systems along the South African Coast and plays an important ecological function in the community structures of vegetated habitats, such as Zostera beds. Most species of *Sygnathus* are susceptible to human disturbance due to their restricted distribution, low mobility, and reproductive rate.

The macrobenthic communities of estuarine substrate are divided into two main groups: suspension- and deposit feeders. The presence/absence of these types of species is strongly related to sediment type. The communities are dominated by crustaceans, *Cleistostoma edwardsii*, *C. algoense*, *Upogebia africana*, *Sesarma catenata* and *Uca urvillei* and the bivalve *Solen cylindraceus*. Other species include: *Glycera tridactyla*, *Tellina gilchristi* and *Macoma ordinaria*. The sediment of the estuary also contains bait species including: the sandprawn, *Callianassa kraussi*, the pencil bait, *Solen capensis* and the bloodworm, *Arenicola loveni*.

According to South African Birding (2008), within just a few hours of bird watching, anywhere between 80 to 160 regularly occurring bird species can be spotted in and around the St Francis Bay area. Commonly spotted species include the African fish eagle (*Haliaeetus vocifer*); African Marsh-Harrier (*Circus ranivorus*); Osprey (*Pandion haliaetus*); Cape Gannet (Morus Capensis); African Black Oyster...

The conservation status of the above listed species are listed in table 4.4 below.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>IUCN</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Haliaeetus vocifer</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Circus ranivorus</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Pandion haliaetus</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Morus Capensis</em></td>
<td>Vulnerable</td>
</tr>
<tr>
<td><em>Haematopus moquini</em></td>
<td>Near Threatened</td>
</tr>
<tr>
<td><em>Ardea goliath</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Platalea alba</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Himantopus</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Anthropoides paradiseus</em></td>
<td>Vulnerable</td>
</tr>
<tr>
<td><em>Neotis denhami</em></td>
<td>Near Threatened</td>
</tr>
<tr>
<td><em>Chlorophoneus olivaceus</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Tchagra</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Macronyx capensis</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Sphenoeacus afer</em></td>
<td>Least Concern</td>
</tr>
<tr>
<td><em>Saxicola torquatus</em></td>
<td>Least Concern</td>
</tr>
</tbody>
</table>

### 4.8 Socio-Economic Importance Of The Kromme Estuary

The open water of the Kromme Estuary is listed as 125 ha (Sowman and Fuggle, 1987). The Kromme Estuary supports many recreational activities including fishing, birding, bait collection, waterskiing, canoeing, boat cruisers, hiking and swimming (Adams, 2001). Tourism is viewed as an important income generator in the area (Davies, 2009 in Sale et al., 2009). There is considerable concern that the recreational capacity of the Kromme River estuary is being exceeded. In 1992, the estimated increase of recreational activities on the river in peak holiday periods was ~400%. Calculations were done using international safe space standards and it was determined that the carrying capacity of the river in terms of power boating and sailing activities is exceeded in peak holiday times. This implies that the river becomes unsafe for public use in these times (ARSC Kromme River Structure Plan, 1992).

Turpie (2006) undertook a more comprehensive hedonic valuation study at the Kromme and Seekoei estuaries in the Eastern Cape, in which data were collected from door-to-door surveys. At the Kromme Estuary, there was at the time of the survey a total of 4,584 erven and 2,555 properties in the Cape St Francis to Kromme River area, of which 45% were occupied by permanent residents. Most households had boats and made use of the estuary. Distance to the estuary was a significant factor determining property prices in the area. Based on the property price premium associated with river-front property, the overall property value contributed by the estuary was conservatively estimated as R578 million. The total property premium for the Kromme Estuary was converted to annual turnover in the real estate sector based on estimated turnover rates of property and the commission accruing to the property sector. In the Kromme study (Turpie, 2006) the R578 million property premium translated to about R17.7 million in terms of direct value added to national income in the real estate sector per annum. As a result, the Kromme Estuary is rated 5th on the list of temperate estuaries in terms of property value attributable to an estuary (Turpie and Clark, 2007).
4.9 Protected Areas

The application area does not fall within any formally protected areas or within any delineated National Protected Areas Expansion Strategy (NPAES) Focus Areas (Figure 6.7). The closest National Park to the application area is the Tsitsikamma National Park (62 km west of the application site) and the Addo Elephant National Park (103 km north east of the application site). The closest protected areas are the Kromme River Mouth Private Nature Reserve (380 m North); the Rebelsrus Private Nature Reserve (6.3 km south west); and lastly the Erma Booyzen Florareservaat Local Authority Nature reserve and Seal Bay Local Authority Nature Reserve (both located approximately 3 km south of the application site). In addition, the Kromme Estuary is identified as an ‘estuarine’ wetland as defined by the National Freshwater Ecosystem Priority Areas (NFEPA). The NFEPA database also defines a number of smaller artificial and natural wetlands which are located around the estuary (Figure 4.6).

The Eastern Cape Biodiversity Conservation Plan (ECBCP, 2019) replaces the ECBCP (2007) in its entirety and provides a map of important biodiversity areas, outside of the Protected Areas network, which must be used to inform land use and resource-use planning and decision making.

The aim of the ECBCP (2019) was to map biodiversity priority areas through a systematic conservation planning process. The main outputs of the ECBCP include Protected Areas (PA), Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA), Other Natural Areas (ONA) and No Natural Habitat Remaining (NNR) for both terrestrial and aquatic ecosystems.

According to the ECBCP the application site falls within a terrestrial and aquatic CBA1 (Table 4.5 and Figure 4.7).

<table>
<thead>
<tr>
<th>Table 4.5: Description of the CBA designations</th>
</tr>
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<tbody>
<tr>
<td><strong>CBA area</strong></td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>CBA1</td>
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<tr>
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Figure 4.6 Critical Biodiversity Areas of St Francis Bay.
Figure 4.7 NEMBA threatened ecosystems in the broader St Francis Bay area
The south-east coast of South Africa is characterised by a particularly dynamic marine environment. The south-east coast of South Africa is a region with relatively high-energy shores, dominated by waves from the south-westerly quarter. The relatively exposed nature of St Francis Bay, together with the complex interaction between coastal and estuarine processes, has resulted in the drastic removal of sediment and the consequent beach erosion observed over the last two decades. Waves along this stretch of coast typically approach from the west-southwest, as a consequence of the prevailing wind, reaching maximum heights of up to 12 m. Variation in wave frequency and intensity is observed during cold fronts which occur on average every three to five days during winter months. The dominant winds approach from the west to south-west, however easterly winds are a common occurrence. Sea surface water temperatures are generally warm, ranging from 22-25°C in February to 18-20°C degrees in August. Deviations from the norm are observed during periods of sporadic upwelling, when sea surface water temperatures may drop to a low of 8°C. Tides are classified as semidiurnal, with the maximum tidal range rarely exceeding 2 m.

The south east orientation of St Francis Bay results in significantly lower and more variable wave energy regimes than the exposed southern oriented coastlines of South Africa (Figure 5.1). This is principally due to this beach being sheltered from the persistent waves and swells generated by west and southwest winds. The predominant south westerly waves, which occur approximately 80% of the time, must angle themselves around the Cape St Francis headland in order to enter the bay, which results in waves that approach the beach at an angle and drive alongshore currents to the east along much of this coast. These wave-driven currents also transport sand in an easterly direction, and in the absence of a sand supply, result in net erosion. Easterly wave events are often generated relatively locally, resulting in short period high waves (known as steep waves) that result in direct erosion of sand off the beach face and into deeper water. Thus, sediment is ‘zigzagged’ up the coast, away from St Francis Bay. This combination of wave events and the lack of a constant sand supply must be addressed in order to provide long-term coastal protection, and reinstate the wide sandy beach that first attracted people to the area (ASR Ltd, 2006).
Estimates for the total amount of sediment moving around Cape St. Francis from west to east vary between 50 and 100 thousand cubic meters per year. Illenberger (2001) estimates a range of 80 – 100,000 m$^3$ per year while the Entech (2002) report gives a wider range of 50 – 100,000 m$^3$ per year. Of this total amount, the transport is divided between wave driven littoral transport along the coast and around the headland, and wind driven (aeolian) transport across Cape St Francis through the headland bypass dune systems. It is believed that the largest fraction of the total sediment transport across the region is through aeolian processes moving sand through the dune fields (ASR Ltd, 2006).

The net shoreline retreat along the St Francis Bay beach has been approximately 30 m to 50 m over the past 30 years. This is a shoreline retreat of between 1m and 1.5m per annum, and is regarded as very significant. This has resulted from increased sediment-carrying capacity within the lower reaches of the Kromme Estuary, resulting in less sediment available to accumulate on the St Francis Bay beach. The increased sedimentation potential of the lower reaches of the river is a direct result of the construction of several dams further upstream, which act as sediment traps.

In 2020, Advisian revised the numerical wave and shoreline modelling to assess the proposed changes to the overall groyne layout of the St. Francis Bay coastal protection scheme. The model was updated using updated bathymetric and topographic data and as a result, more accurate nearshore wave climates were established to assess the shoreline evolution along the project site due to the construction of the coastal protection scheme.

The wave climate in St Francis Bay is considered relatively mild since most of the offshore swell wave energy is substantially reduced in wave height due to the shelter offered by Cape St. Francis, as well as refraction and diffraction effects (Figure 5.2). However, local strong winds can generate strong short-period waves throughout St Francis Bay which enhances the harshness of the coastal environment (Figure 5. 3) (Advisian, 2020).

The reductions in wave heights in the nearshore are due to the combined effects of offshore shoals, refraction, diffraction, bed friction losses and wave breaking.
Figure 5.2 Extreme wave condition and direction illustrating sheltering effects of Cape St Francis. Arrows show the direction of the waves.

Figure 5.3 Simulated wave condition and direction for the strongest easterly wind and swell conditions. Arrows show the direction of the waves.
The sediment transport along the coast is defined by the angle of incidence of the dominant wave direction and the energy in the waves. In order to validate the modelling the shoreline evolution was run for a 45 year modelling period (1975 – 2020) and compared to the current situation (Figure 5.4). The model for St Francis reproduces the historical shoreline changes due to the reduction of available sand supply (damming of the Kromme river and stabilization of Santereme dunes) over the past decades and the effect of the constructed rock revetments sufficiently well to allow its application in the assessment of the proposed coastal protection scheme.

Figure 5.5 illustrates the long-term shoreline evolution (with and without nourishment) in response to the installation of the groynes. The model shows that the construction of the long-term coastal protection scheme will have an impact on the northern coast in terms of creating an erosional environment. However, this effect is considered relatively limited as the length of the groynes do not extend sufficiently far offshore to fully block the entire littoral drift.

In addition, the existing and future imported sand will still travel towards this northern beach area due to longshore processes as long as maintenance nourishment of 6,000 m3/year for the embayments south of the spit and 10,000 m3/year for the remaining embayment at the spit takes place on a regular basis.

The proposed groyne scheme in combination with beach maintenance will provide a continuous supply of sediment of approx. 28,000m3 per year that will be transported towards the northern coastline when the complete solution is implemented. This is considered to be more beneficial to the northern coastline than the current situation (no-go scenario) allowing the St Frances Beach to erode to the extent where negligible sediment transport can occur which would result in the northern beaches experiencing accelerated erosion.
Figure 54 provides the shoreline evolution of St. Francis Bay beach for the 45-year modelling period considered (1975 – 2020).
Figure 5.5 Long term shoreline planform, with the groynes installed, with and without nourishment (2020 – 2045)
6 DESCRIPTION OF THE DUNE AND BEACH SYSTEM

6.1 Beach and Frontal Dune System

On the south bank of the estuary mouth is a sand spit that extends for approximately 900m, and this spit tends to push the mouth channel northwards. For most of its length the sand spit is well vegetated with typical pioneer woody species such as Chrysanthemoides monolifera (Bitou), but the most dominant species is the invasive Acacia, Acacia cyclops (Rooikrans). It is likely that this species was used to stabilise the sand spit, owing to its important function of protecting the seaward canal of the marina (Plate 6.1). It is only about 15m to 25m wide, and on average 6m high.

Plate 6.1 Sand spit to the south of the history mouth vegetated with Rooikrans (2019). Note the canal for the marina to the left.

Plate 6.2 Eroded sand spit and foredune in the vicinity of the marina (2019). Note to the small erosion cliff at the base of the foredune. This is a clear indication an eroding shoreline.
The beach in front of the sand spit system has eroded, and the toe of the foredune is cliffed, and a typical pioneer zone with incipient foredunes is absent (Plate 6.2).

A foredune is entirely absent from the back-beach area due to the severe erosion that has taken place. Rock revetments have been placed immediately above the high-water mark to prevent further shoreline erosion. Aside from two small pocket beaches located at George road and Mary Crescent, where some foredune vegetation is present in the back-beach area behind the HWM, at high tide there is no beach, and wave run-up occurs across the length of the beach face, with the rock revetments dissipating the wave energy (Plate 6.3).

Plate 6.3 Shoreline in the vicinity of Ralph Road, with rock revetments along the HWM (2019). Note the entire absence of a foredune, and wave run-up to the toe of the revetments, due to complete erosion of the foredune and back-beach.

A more natural shoreline is found to the north of the estuary mouth. A relatively large transverse dune system to the north (150m wide, 500m long) defines the northern bank of the estuary. Behind this, and to the north-east is a well vegetated dune cordon of 300m wide, with a small foredune and vegetated transverse dunes. There appears to be very little erosion in these areas.

The erosion of the beaches at St Francis was monitored by Allen Nicolson between January 2017 and March 2018. These surveys provided evidence that the northern part of the sand spit experiences continuous erosion, but that the southern portion showed signs of recovery. Drawing on this information, and numerous older surveys, Advisian analysed the fluctuations in beach profiles over time. By fitting linear trendlines through the data points they determined that there is a long-term erosion trend of between 10 and 20 m over 11 years, indicating an average erosion of between 1.5 and 2 m per year (Advisian, 2018).
The spit has subsequently breached on four occasions in 2020, with the KLM required to implement emergency procedures to close the breach and secure the spit. The images below (Plates 6.4 to 6.9) show and describe the breaches, the repair work (including the completed revetment structure) and the condition of the remaining dune habitat.

Plate 6.4 A breach in the spit showing the loss of vegetation and sand material. The remaining dune habitat is also severely compromised following the storm event (SFPO NPC)

Plate 6.5 Front end loaders reworking the beach material to repair the breach in the spit (SFPO NPC)
Plate 6.6 A repair of the spit in progress with beach material used for the repair (SFPO NPC)

Plate 6.7 The dune spit is now a very narrow strip of habitat with a low cover of vegetation (SFPO NPC)
6.2 Sand River Dune System

The mouth of the Sand River is located 2km upstream of the mouth, on the south bank of the river. The Sand River’s contribution to the freshwater inflow into the Kromme system is negligible. The dominant flow within the Sand River is subterranean, but reduced flows both in the system as well as the Kromme has resulted in a substantial accumulation of sand along this 250m of river bank. The sand mass is approximately 180m wide and 300m long, and has become stabilised by pioneer dune and salt marsh vegetation. Further east the sand has not yet become vegetated, as it is still inundated at high tide. Over time, and with ongoing sand accumulation it is expected that this sand will also become stabilised with dune vegetation (Plate 6.4).
The dune system at the Sand river has become well vegetated say with typical saltmarsh species closer to the river’s edge, giving way to dune slack species in the depressions (Plate 6.5). Further inland woody pioneer species such as *Metalasia muricate* and *Stoebe plumosa* are present (Plate 6.6). There is a clear successional gradient away from the water’s edge, where the vegetation has become well established over time. In some locations the freshwater reed, *Phragmites australis* is present, indicating a source of freshwater close to the surface (Plate 6.11).
Plate 6.11 In the foreground are typical salt marsh species such as *Sarcostemme vimenale* and in the background dune slack species such as *Juncus krausii*.

Plate 6.12 – Pioneer woody dune vegetation, with Phragmites in the foreground.
The sensitivity map was developed by identifying areas of high, medium and low sensitivity using the following to guide the decision-making process (Figure 7.1).

Areas of **high sensitivity** include:
- Areas covered by salt marsh vegetation; and
- Areas classified as threatened ecosystems.

Areas of **moderate sensitivity** include:
- Areas covered by *Zostera capensis*. Although it is acknowledged that based on literature areas colonised by *Zostera capensis* is considered to be of high sensitivity, the extent of this species have increased by almost 40 ha over a period of approximately 80 years as a result of water abstraction upstream of the Kromme Estuary, which has resulted in additional suitable habitat for *Zostera*. This has very likely resulted in the displacement of species such as sand prawns and hermit crabs which generally occupy sand banks within these systems. As a result, it is determined that some loss of this vegetation type within this system would be acceptable;
- Areas covered by reeds and sedges;

Areas of **low sensitivity** include:
- Cultivated land;
- Built-up area; and
- Unvegetated sand banks.

The proposed project must avoid all areas of high sensitivity. Areas considered to be of moderate sensitivity could withstand some loss, however this should be avoided as far as practical.
Figure 7.1: Sensitivity Map of the Kromme Estuary.
8 ESTUARINE IMPACTS

8.1 Estuarine Impact Assessment

The proposed project will impact on the Kromme Estuary. It should be noted that this project does not have a clear construction and operational phase and thus the impacts for these two phases have been combined. The section below assesses the impacts associated with the development of the proposed coastal protection scheme.

In addition, recommended mitigation measures have been included for the construction and operational phases to minimise negative impacts, or increase the potential benefits, associated with the proposed development.

8.1.1 Existing Impacts

EXISTING IMPACT 1: INCREASED ESTUARY BANK EROSION

Cause and Comment
The Kromme Estuary supports many recreational activities including fishing, birding, bait collection, waterskiing, canoeing, boat cruisers, hiking and swimming and as such tourism is viewed as an important income generator in the area.

The banks of the estuary have been eroded in areas, particularly in the middle reaches of the estuary. This can be attributed to boat activity as well as waves caused by easterly and westerly winds. While the evidence of erosion is upstream from the proposed dredging area, it is important to understand that boat traffic does lead to impacts on the estuarine system downstream.

Significance Statement

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Impact</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Probable</td>
</tr>
</tbody>
</table>

EXISTING IMPACT 2: INCREASED SILTATION

Cause and Comment
It is well documented that approximately 130% of the MAR for the system is abstracted in 2 large upstream dams resulting in a reduction in natural flushing of the system. This has led to an increase in sedimentation in the lower reaches of the estuary, which has subsequently been colonised by reeds and sedges and submerged macrophytes. It is understood that occasional freshwater releases from the Mpofu Dam do occur, but it is unlikely that these events result in a significant “flushing” of the estuary.
Significance Statement

EXISTING IMPACT 2: INCREASED Siltation

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
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<tbody>
<tr>
<td>Existing Impact</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Severe</td>
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EXISTING IMPACT 3: Deterioration in Water Quality

Cause and Comment

Water quality issues are mainly related to nutrient status and possible fluctuating temperature and oxygen levels downstream of dams. The estuary is highly regulated by the Churchill and Impofu dams, with no or little environmental releases being made to maintain riverine and estuarine function. According to (Sharler and Baird, 2000) the water quality within the estuary reverts to “normal” following any freshwater input.

Investigations in 1992 (Baird and Pereyra-Lago, 1992) revealed that the water in the canals does not adversely affect the estuarine water quality even though, during the holiday season, there are slightly elevated nutrient levels.

The reduction of freshwater inflow has resulted in the estuarine system becoming marine dominant, with the open mouth regulating the water quality through constant exchange with the marine environment.

Significance Statement

EXISTING IMPACT 4: Increased Salinity

Cause and Comment

The estuary is considered to have a mouth status of permanently open which facilitates regular interaction with marine waters. This, in tandem with the reduced freshwater input results in the estuary being dominated by mostly marine habitats.

This situation has resulted in hypersaline conditions in certain areas of saltmarsh, resulting in a species composition more representative of species more tolerant to elevated salinity levels (i.e. Salicornia sp). During periods of higher freshwater input other saltmarsh species do return. However, without constant freshwater the system reverts to its elevated status quo. This is similar for benthic faunal species which are marine dominant.

Significance Statement
EXISTING IMPACT 5: IMPACT ON SUBMERGED MACROPHYTES

Cause and Comment

The abundance and distribution of *Zostera capensis* within the system has increased over time from approximately 13.7 ha in 1980 to 47.8 ha in 2017. This can be attributed to the construction of the Mpofu and Churchill Dams and the resultant decrease in freshwater input and increased sedimentation. Prior to the construction of the dams the total area covered by *Zostera capensis* was only 10.8 ha.

Therefore, while the system has been modified, the increase in *Zostera* and the ecosystem services it provides has been considered to be a positive impact. Conversely sand habitat for benthic species has been lost.

Significance Statement

EXISTING IMPACT 6: IMPACT ON SALT MARSHES

Cause and Comment

The areas of saltmarsh habitat within the Kromme Estuary have diminished over time. It is anticipated that this is due to development on the floodplain along with evidence of salt marsh erosion in the middle reaches of the estuary due to boat activity as well as waves caused by easterly and westerly winds. In addition, lack of freshwater input into the Kromme Estuary has resulted in increased water column salinity that has caused salt accumulation in the intertidal marshes (Adams et al., 1992), which has resulted in large areas of bare ground in the upper intertidal areas due to hypersaline conditions. These bare patches are only colonized by the highly stress tolerant *Salicornia meyeriana*. When an increase in rainfall flushes some of the excess salt from these bare patches during winter there is a decrease in the cover of *Salicornia* and an increase in other salt marsh species.

Therefore, the existing impacts are expected to adversely affect the salt marsh.

Significance Statement

EXISTING IMPACT 7: IMPACT ON FAUNA

Cause and Comment
The impact on fauna is determined to be both positive and negative. Positive because, as mentioned earlier, the distribution of submerged macrophytes and the increase in sandbank habitat has resulted in an increase in faunal abundance and diversity of species suitable to these types of habitat, such as *Callianassa* spp.

However, as there has been a shift in the system to that of a marine dominated one it is likely that some species have been lost. One such species is the seahorse (*Hippocampus* sp.) which was historically recorded in the Kromme Estuary but is now only recorded in the Swartvlei, Keurbooms and Knysna Estuaries. It is likely that there were many factors leading to the disappearance of the species and not one particular activity or change in the system.

**Significance Statement**

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<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
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**EXISTING IMPACT 8: SOCIO-ECONOMIC IMPACTS**

**Cause and Comment: Social amenities**

The Kromme Estuary supports many recreational activities including fishing, birding, bait collection, waterskiing, canoeing, boat cruisers, hiking and swimming (Adams, 2001). As a result, tourism is viewed as an important income generator in the area (Davies, 2009 in Sale et al., 2009).

**Cause and Comment: Ecosystem Goods and Services**

Estuaries are valuable national assets that provide essential ecosystem services. The ecosystem services provided by estuaries (specifically the Kromme Estuary) include, but are not limited to:

- Inflow of freshwater and nutrients from the rivers upstream to the marine environment;
- Fish nursery habitats for marine fish and invertebrates;
- Regulation of greenhouse gases and opportunities for carbon sequestration;
- A significant buffer against floods as well as sea storms;
- Recreational and tourism areas (e.g. sports fishing, boating, bathing and scenic views);
- Resources for food (e.g. bait harvesting and subsistence fishing);
- Unique and diverse habitats to microalgae, macrophytes, benthic invertebrates and fish; and
- Bird feeding and roosting areas.

**Significance Statement**

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<th>IMPACT</th>
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<th>RISK OR LIKELIHOOD</th>
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8.1.2 Construction and Operational Phase Impacts

As mentioned previously the construction phase is considered to include the dredging associated with the capital works (i.e. the sediment required for the initial beach nourishment).

The operational phase is considered to be when capital material is not being extracted (i.e. no dredging) or when dredging for maintenance purposes is taking place. It is anticipated that maintenance dredging will be of significantly smaller scale than that employed during construction.

**CONSTRUCTION AND OPERATIONAL PHASE IMPACT 1: INCREASE IN SEDIMENTATION AND TURBIDITY**

**Cause and Comment**

During both construction and operation it is likely that there will be suspended sediment (turbidity) in the water column as a result of the dredging activity. Suspended sediment is directly related to the size of the particles where smaller particles remain suspended for longer than particles that are larger. Given that smaller particles remain in suspension for longer it is likely that those particles will be transported further from the source location.

The classification of the sediment in the estuary and particularly those areas identified as being suitable for dredging is considered to be fine to medium sand. The plume generated by the dredging activity is dependent on a number of factors. Those are the volume of finer material (i.e. silt), current speed and the state of the tide. Given that the silt content of the samples taken as part of the sand sourcing study are relatively low and current speeds are low the plume is expected to be limited in its extent. Furthermore the plume will be further limited during low states of the tide and downstream of the R330 road bridge.

Suspended sediment in itself is not necessarily a problem. Estuaries by their nature are systems that have high turbidity from time to time (i.e. flooding events). Similarly, the habitats and species within the estuary are adapted to periods of inundation or periods of high turbidity.

For example many benthic species have adapted to rapid changes in environment. The majority of benthic species are mobile and migrate throughout the sandy substrate. Consequently these species are often also colonisers of newly established areas of suitable habitat as is expected during the development of this project.

Where it might result in an adverse impact is where excessive amounts of finer material settle in areas that limit the ability of the species in those areas to flourish, resulting in a decline in populations.

High levels of suspended sediment reduce the ability of faunal species to hunt/graze as a result of poor visibility. This is particularly relevant for fish species. In addition to high turbidity, high levels of sediment settling may smother vegetation and benthic faunal species.

The following factors were considered when assessing this impact:

- Dredging will require sediment with a fairly large particle size, reducing the potential for this material to remain suspended in the water column for long enough to be distributed a large distance from the dredging area (i.e. < 1000 m);
The larger particle size also means that the sediment will settle close to the source, and hence the adjacent habitats will remain similar to those habitats were the dredge sand is being sourced; and

Estuarine species are able to adapt to short periods of inundation and high turbidity, as this occurs naturally in these systems.

Of the faunal species identified as occurring within the Kromme Estuary, only Lithognathus lithognathus (White Steenbras) has been listed as endangered by the IUCN. Listed floral species include Zostera capensis (sea grass), Triglochin bulbosa, Limonium linifolium and Spartina maritima.

A significant increase in sedimentation and turbidity may have an adverse effect on vegetation within the estuary and particular the submerged macrophyte, Zostera capensis. High deposition of material would smother the plant while high turbidity in the water column would reduce its ability to photosynthesize. A reduction in the distribution of this species, with 5 ha of the 48 ha, is unlikely to be significant as only a small percentage (10%) of their overall coverage is present within the areas targeted to be dredged.

Consequently, this impact is considered to be moderate negative before mitigation.

Mitigation Measures

Mitigation will be considered in the design of the project in the following ways:

- Only the correct size material (course) will be dredged for beach nourishment; and
- Sensitive habitats will be identified and avoided where possible.

Monitoring of sensitive habitats in close proximity to dredging activities must be implemented during both the construction and operational phases of the project. This will reduce impact significance to low negative.

Significance Statement

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<tr>
<th>IMPACT</th>
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<th>SPATIAL SCALE</th>
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<th>RISK LIKELIHOOD</th>
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CONSTRUCTION AND OPERATIONAL PHASE IMPACT 2: IMPACTS ON ESTUARINE VEGETATION COMMUNITIES

Cause and Comment

There are two main causes for the loss of habitat in the estuary. A direct impact will result from the physical removal of sand from the banks and bottom of the river, which could result in the loss of sand banks and the estuarine habitat this provides. An indirect impact will result from the modification of the physical parameters within the estuary (hydrodynamics) which would in turn cause the potential loss of estuarine habitat, especially intertidal habitats.

The lower reaches of the Kromme Estuary are dominated by salt marsh, submerged macrophytes (Zostera) and reed and sedge vegetation communities.
It is likely that the submerged macrophyte and reed and sedge communities will be affected directly by the dredging. This will be through the physical removal of this vegetation either prior to dredging or as a result of the dredging activity. The main species associated with the submerged macrophyte community is *Zostera capensis* which is present in abundance throughout the estuary. Those areas of Zostera that will be lost through dredging are expected to be 10% of the overall distribution of the species.

None of the reed and sedge community are expected to be lost and the expected reduction of intertidal areas is 16%.

Indirect impacts to vegetation habitats may occur through the modification of the hydrodynamics of the lower reaches of the estuary. A hydrodynamic study was carried out to investigate the existing flow conditions (pre-dredging) inside the Kromme River estuary and possible variations in flow post-dredging (Advisian, 2020). The findings suggest that the variation in current speed inside the estuary and along the riverbanks due to dredging would be generally very small. The estuary mouth showed the greatest change in current velocity, a decrease of up to 1.3 m/s and 1.6 m/s for normal river discharge conditions and high river discharge conditions, respectively. These variations in current velocity are expected to be a temporary phenomenon until the bathymetry of the estuary mouth is smoothed out by natural hydrodynamics and morphological evolution over time. Thereafter, the current velocity is expected to return to pre-dredge velocities.

These physical conditions could favour the development of *Zostera* beds should the particle size of the sediment at the mouth be compatible, *Zostera* prefer finer material. However, given the dynamic nature of the mouth it is unlikely that sandbanks will remain stable for long enough to allow *Zostera* to colonise.

In addition, the dredging of the river, and in particular the area around the river mouth has the effect of allowing the water to drain out more effectively, which lowers the low water level (with respect to MSL). Therefore, a reduction in water depth would be observed in the non-dredged areas as a result of the dredging. This may lead to exposure of shallow non-dredged areas inside the estuary during low tides. This is likely to result in an increased intertidal area which would facilitate the development of intertidal habitats, possibly compensating for those lost directly as a result of dredging.

The banks along the middle reaches of the estuary are classified as a threatened ecosystem (Albany Alluvial Vegetation) as legislated by NEM:BA (refer to Figure 4.7). The maximum tidal current outside the main channel (i.e. near to the banks) and in particular on the northern bank close to the river mouth are low (up to 0.2 m/s). The modelling suggested that the dredging would not lead to any significant change in the currents in this area.

Overall, there will only be a 10% reduction in Zostera habitat, and a 16% reduction in intertidal areas. In the context of this estuary, and for the region, these losses are expected to result in an impact of LOW significance after mitigation.

**Mitigation Measures**

The direct loss of vegetation habitats is expected to be minimised through the discreet identification of areas suitable for dredging. It is anticipated that those suitable areas would avoid sensitive habitats (i.e. *Zostera*).

The following mitigation measures must be considered in the design of the project:

- Only the correct size material (course) will be dredged for beach nourishment;
- Sensitive *Zostera* habitats will be avoided where possible;
- Only the required volume of sediment will be dredged;
• Associated equipment will be placed in areas of low sensitivity only; and
• Monitoring of sensitive habitats in close proximity to dredging activities must be implemented during both the construction and operational phases of the project.

Significance Statement

| CONSTRUCTION AND OPERATIONAL PHASE IMPACT 2: LOSS OF ESTUARINE VEGETATION COMMUNITIES |
|----------------------------------------|----------------|-------------|---------------|----------------|----------------|
| IMPACT                  | EFFECT        | TEMPORAL SCALE | SPATIAL SCALE | SEVERITY OF IMPACT | RISK LIKELIHOOD | OVERALL SIGNIFICANCE |
| Without Mitigation       | Medium Term   | Medium Term   | Study Area    | Moderate          | Definite        | MODERATE-            |
| With Mitigation          | Medium Term   | Medium Term   | Study Area    | Slight            | Possible        | LOW-                |

CONSTRUCTION AND OPERATIONAL PHASE IMPACT 3: IMPACTS ON ESTUARINE FAUNAL COMMUNITIES

Cause and comment

Similarly to the impacts on the vegetation communities, faunal communities will be affected directly by the project as well as indirectly.

Direct losses are expected for species associated with the sandbanks and channels. Important species in this habitat include sand prawn (*Callianassa kraussi*), pencil bait *Solen capensis* and bloodworm *Arenicola loveni*.

Direct physical loss would be attributed to the removal of material directly by dredging. Given the type of material required for the project the habitat lost would be that associated with a sandy benthic substrate. This would be a habitat colonised by species adapted to coarse grained sediment - mostly molluscs, crustaceans and polychaetes. Locally important bait species such as mud sand prawn (*Callianassa kraussi*), pencil bait (*Solen capensis*) and the bloodworm (*Arenicola loveni*) populations are likely to decrease as a direct result of the dredging activity. It is not possible to accurately quantify the loss of individuals directly from dredging. However, if one considers the area available for colonisation prior to- and post dredging activity then an assessment can be made. At present 33% of sandbank habitat is expected to be included within the area designated for dredging.

This would only result in a temporary reduction in biomass as these species are expected to return to those areas that have been dredged fairly quickly.

The design of the dredging footprint will be to ensure that some of the habitat for faunal species remains intact. In addition, there are areas within the estuary which contain the faunal species which are not intended to be dredged. Therefore, while there may be an initial reduction in the biomass of benthic species, there will be areas within the estuary with these species that will remain. Those faunal species (birds and fish) who would subsequently feed on these organisms may also be negatively affected. However, there are alternative areas within the estuary in which birds and fish can feed.

Subsequently, prior to mitigation, the impact is anticipated to be moderate negative.

Mitigation Measures

The following mitigation measures must be considered in the design of the project:

• Only the correct size material (course) will be dredged for beach nourishment;
• Only the required volume of sediment will be dredged;
• Associated equipment will be placed in areas of low sensitivity only; and
• Monitoring of sand bank habitats in close proximity to dredging activities must be implemented during both the construction and operational phases of the project.

Significance Statement

<p>| CONSTRUCTION AND OPERATIONAL PHASE IMPACT 3: LOSS OF ESTUARINE FAUNAL COMMUNITIES |
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<th>IMPACT</th>
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<th>RISK LIKELIHOOD</th>
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<tr>
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<td>Definite</td>
<td>MODERATE-</td>
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<tr>
<td>With Mitigation</td>
<td>Medium Term</td>
<td>Study Area</td>
<td>Moderate</td>
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<td>LOW-</td>
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CONSTRUCTION AND OPERATIONAL PHASE IMPACT 4: OVERALL IMPACTS ON THE ESTUARINE FUNCTIONAL ZONE

Cause and Comment

The estuarine functional zone (EFZ) includes the lateral boundaries of an estuary up to the 5 m contour, with the downstream boundary taken as the estuary mouth and the upstream boundary taken as the limits of tidal variation or salinity penetration, whichever penetrates furthest. Protection/rehabilitation of the estuarine functional zone is considered essential for protection of estuarine biodiversity and associated ecological processes. The proposed project is likely to impact on the estuarine functional zone both directly and indirectly:

Direct and indirect impacts include but are not limited to the following:

- The loss of habitat (direct removal of *Zostera capensis*, sandbanks and benthic habitat)
- Increases in turbidity (direct impact) which may result in further loss of habitat as a result of smothering (indirect impact).
- Altering the nutrient dynamics of the system as a result of releasing trapped nutrient from sediments. Previous authors who have studied water quality in the Kromme have concluded that due to the influence and constant flushing of the system through the tidal cycle, water quality is generally good.

Mitigation Measures

Mitigation is similar to that suggested for the loss of vegetation and faunal communities:

- Only the correct size material (course) will be dredged for beach nourishment allowing;
- Sensitive *Zostera* habitats will be avoided where possible; and
- Only the required volume of sediment will be dredged.

Significance Statement

Overall, there will be a 10% reduction in Zostera habitat, a 16% reduction in intertidal areas, and a 33% reduction of sandbank habitat. The combined effect of these changes context are expected to result in an impact of MODERATE significance after mitigation.
CONSTRUCTION AND OPERATIONAL PHASE IMPACT 5: IMPROVEMENTS TO THE RECREATIONAL AMENITIES OFFERED BY THE KROMME

Cause and Comment

The Kromme Estuary supports many recreational activities including fishing, birding, bait collection, waterskiing, canoeing, boat cruises, hiking and swimming (Adams, 2001) with tourism viewed as an important income generator in the area (Davies, 2009 in Sale et al., 2009). St Francis Bay has over 45 tourist establishments offering visitors differing levels of accommodation ranging from 5 Star Guest Lodges to basic Bed & Breakfasts. The St. Francis Golf Links includes a Jack Nicklaus designed golf course and housing estate with over 450 individual housing units. All the above factors combine to make St. Francis Bay a highly attractive beach destination. The various types of tourist accommodation and restaurants provide employment for a large number of individuals with varying levels of skills. Many of the properties in St. Francis Bay are holiday homes, with peak visitation during the December-January period where the population increases to about 20 000. A large number of extra job opportunities are available during this time.

The lower reaches would facilitate more than one activity since each activity could be segregated (i.e. boating lanes, swimming area, etc). This would increase the Kromme’s capacity for water-based activity, improving the recreational amenity of the estuary, and safety of water users.

In addition to the improvement of the amenity created by the dredging activity, the nourishment of the beach would restore the beach amenity. This would promote use of the beach throughout all states of the tide and ensure that beach tourism remains the driver for employment in St Francis Bay.

Although increasing the capacity of the estuary for water-based activity could create conflict between various users, in general this improvement is viewed as a positive impact.

Mitigation measures

The mitigation measures are not only to reduce the potential conflict between various user groups but to enhance the experience for those using the estuary.

A detailed management plan for water based recreational activities should be drafted, implemented and monitored to ensure safety and inclusivity.

Significance statement

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<tr>
<th>IMPACT</th>
<th>EFFECT TEMPORAL SCALE</th>
<th>SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK LIKELIHOOD</th>
<th>OR OVERALL SIGNIFICANCE</th>
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CONSTRUCTION AND OPERATIONAL PHASE IMPACT 6: LOSS OF ACCESS TO PARTICULAR SITES AND RESTRICTIONS ON THE USE OF THE ESTUARY DURING DREDGING OPERATION.

Cause and comment:

The current surface area of sand bank amenity (i.e. the area of sand banks exposed at low tide) is 52 ha. Following the dredging activity (assuming the full extent of the dredging takes place at once) the remaining sand bank area would equate to 51 ha resulting in a net loss of 1 ha. The loss of sand banks, used by both locals and tourists (dog walking, bait collection, etc.) would reduce the area available for these activities. The recent increase in the use of the sandbanks close to the mouth of the estuary is likely as a result of the loss of beach along the frontage. Where dog walkers may have used the beach
previously, they are now using the estuary. The dredging and nourishment of the beach would support this activity again, with the appreciation that there may be short term impacts in availability of space for recreation.

The dredging of the Kromme is likely to result in impacts to those users. The presence of dredging equipment (vehicles, vessels, pumps and pipes) would result in certain areas being designated as off limits. This would reduce the area available for recreational activities. However, this is expected to be limited to the direct working areas which would move as the activities progress. The activities would also be relatively temporary in nature.

Prior to mitigation the impact is expected to be LOW negative.

Mitigation measures

No mitigation measures are required since the impact is deemed to be low. However, the following should be considered as best practice:

- Development and publication of the intended work programme including exclusion areas if any;
- Ensure that recreational areas are available during the works;
- Consider improvement of access to an alternative walking route along the length of the frontage along the beach and estuary; and
- Clear signage of walking routes / recreational areas.

Significance statement

<p>| CONSTRUCTION AND OPERATIONAL PHASE IMPACT 6: LOSS OF ACCESS TO PARTICULAR SITES AND RESTRICTIONS ON THE USE OF THE ESTUARY DURING DREDGING OPERATION |
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<tr>
<td>With Mitigation</td>
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<td>Study Area</td>
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CONSTRUCTION AND OPERATIONAL PHASE IMPACT 7: A REDUCTION / LOSS OF SANDBANKS SUPPORTING FAUNA

Cause and comment

As detailed in Impact 3: Impact on Faunal Communities, there will be a loss of benthic species directly as a result of the dredging. The dredging, depending on the design, may also reduce the access to some of the sandbank features at certain states of the tide. The dredging is likely to reduce the level of the sandbank which may result in it becoming a subtidal feature while also exposing previous subtidal areas. The net loss of intertidal sandbanks for the length of the study area is 1 ha.

Given that the benthic species present are likely to colonise the newly dredged areas fairly quickly, it is not anticipated that these species will not be available to bait collectors, but that the window of opportunity for collection may be reduced.

This impact is only relevant to those areas that are included in the dredging footprint. It is understood that certain sandbank features will remain intact and accessible for bait collection.

Therefore, this is considered to be a low negative impact prior to mitigation. Since this is a low impact no mitigation is required.

Significance statement
CONSTRUCTION AND OPERATIONAL PHASE IMPACT 7: A REDUCTION / LOSS OF SANDBANKS SUPPORTING FAUNA

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CONSTRUCTION AND OPERATIONAL PHASE IMPACT 8: VISUAL INTRUSION OF DREDGING EQUIPMENT, PIPELINES AND GROYNES

Other adverse impacts potentially affecting local communities are the visual impacts associated with the dredging activity. Visually, the presence of vessels on the estuary are unlikely to be considered to be out of the ordinary. However, should the preferred method be via excavator then this may not fit with the current expectation of “normal” activity on the estuary. The presences of pumps and pipes may also not be considered to be “normal”. However, their visibility is expected to be of low significance and will likely only be visible to those in close proximity to dredging activities.

In some cases and based on previous experience the activity attracts spectators.

Similarly, the groynes are infrastructure that could alter the setting of the beach frontage. However, it is not anticipated that the groynes will disrupt the seascape or be visual impediments. There may be restricted views from limited viewpoints (i.e. in the water looking up/down the beach).

Given that part of the appeal of the estuary and beach frontage is its setting and land/seascape this impact is anticipated to be moderate negative prior to mitigation.

**Mitigation Measures**

The mitigation measures will depend on the equipment identified by the contractor for the work. These would include:

- Only absolutely necessary equipment required for the dredging to be at the work site. All other equipment to be stored in an area less intrusive;
- Pumps and pipe placement should take visual disturbance into account for placement during the works;
- Where possible ensure the design of the groynes does not impede the open seascapes view; and
- Where possible ensure the design of the groynes are compatible and blend in.

**Significance Statement**

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT TEMPORAL SCALE</th>
<th>SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Medium Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Definite</td>
<td>MODERATE-</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Medium Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Possible</td>
<td>LOW-</td>
</tr>
</tbody>
</table>

CONSTRUCTION AND OPERATIONAL PHASE IMPACT 9: NOISE DISTURBANCE IMPACTS

**Cause and comment**
It can be expected that there will be an increase in noise levels during the site preparation and construction phase of the project. The increase in noise will be associated with the operation of construction vehicles, dredging and other equipment and labourers.

The noise level associated with the dredging and nourishment activity is expected to be approx. 80 dB at source. Depending on the size of the booster pumps, noise levels are expected to be 92 dB at source, reducing down to 60 dB at 500 m (ICF Jones and Stokes, 2008). To provide context normal conversation is about 60 dB, a lawn mower is about 90 dB, and a loud concert is about 120 dB.

Prior to mitigation a moderate negative impact is anticipated.

Mitigation Measures
- All construction vehicles and equipment to be properly serviced in order to meet the necessary noise level requirements;
- Restriction of work to daylight hours;
- Programming of works close to noise sensitive residential properties should considered to avoid holiday periods
- Restriction of any unnecessary noise e.g. portable radios, vehicle radios, whistles etc.;
- Machinery should be fitted with the required mufflers to reduce noise to acceptable, and notice given to surrounding residents prior to the commencement of construction;
- Adhering to the municipal by-laws regarding noise.

Significance Statement

| CONSTRUCTION AND OPERATIONAL PHASE IMPACT 9: NOISE DISTURBANCE IMPACTS |
|---------------------------------|--------------|-----------------|----------------|-----------------|-----------------|
| IMPACT                          | EFFECT       | TEMPORAL SCALE  | SPATIAL SCALE | SEVERITY OF IMPACT | RISK OR LIKELIHOOD | OVERALL SIGNIFICANCE |
| Without Mitigation              | Medium Term  | Medium Term     | Study Area    | Moderate          | Definite         | MODERATE-          |
| With Mitigation                 | Medium Term  | Study Area      | Moderate      | Possible          |                 | LOW-               |

CONSTRUCTION AND OPERATIONAL PHASE IMPACT 10: IMPACT ON NAVIGATION AND BOATING SAFETY

Cause and comment
The dredging of the estuary and the channels within the estuary would result in larger and deeper channels. This would facilitate vessel navigation of the estuary not only during high tide but during low tide as well. This is considered to be a beneficial impact due to the number of boat owners in the area and tourists who also make use of the estuary for boating.

It is recognised that an increase in vessel traffic may lead to other impacts (i.e. safety, erosion of estuarine banks, etc.).

Mitigation measures
- Enforcement of the management of boating activities and restrictions in place (i.e. no wake zones, etc);
- Identification and publication of buffer areas/safety zones around dredging equipment;
- Development of a dredging programme that takes navigation and peak times into account;
• Development and publication of water safety procedures and enforcement to ensure safety to all users of the estuary.
• Clear channel marking where necessary; and
• Ensure boating activity areas are clearly demarcated.

Significance statement

| CONSTRUCTION AND OPERATIONAL PHASE IMPACT 10: IMPACT ON NAVIGATION AND BOATING SAFETY |
|-----------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| IMPACT                                      | EFFECT TEMPORAL SCALE | SPATIAL SCALE | SEVERITY OF IMPACT | RISK LIKELIHOOD | OVERALL SIGNIFICANCE |
| Without Mitigation                          | Medium Term        | Study Area     | Positive          | Probable        | MODERATE+         |
| With Mitigation                             | Medium Term        | Study Area     | Positive          | Definite        | MODERATE+         |

8.1.3  Decommissioning Phase Impacts

Given the nature of the project there will be no decommissioning phase.

8.1.4  Cumulative Impacts

There are no other known plans or projects in the local area that are likely to contribute to additional impacts as a result.

The impacts described below are those existing impacts that are deemed to have a high negative significance. The cumulative assessment assesses the impact of the project on these.

CUMULATIVE IMPACT 1: INCREASED ESTUARY BANK EROSION

Cause and Comment

The Kromme Estuary supports many recreational activities including fishing, birding, bait collection, waterskiing, canoeing, boat cruisers, hiking and swimming and as such tourism is viewed as an important income generator in the area. The banks of the estuary have been eroded in areas, particularly in the middle reaches of the estuary. This can mainly be attributed to boat activity as well as waves caused by easterly and westerly winds.

While the evidence of erosion is upstream from the proposed dredging area, increasing the area available for boat activity in the lower reaches could lead to additional erosion in the lower and middle reaches of the estuary due to increased boats and duration of boating through more states of the tide. Although the wake generated by boats is potentially less than that which is generated by the easterly and westerly winds, it may contribute to further bank erosion.

Mitigation measures:

• Enforcement of the management of boating activities and restrictions in place (i.e. no wake zones, etc);
• Design dredging areas that leave the bank of the estuary intact as far as possible;
• Clear channel marking where necessary; and
• Ensure boating activity areas are clearly demarcated.

Significance Statement
9 DUNE AND BEACH IMPACT ASSESSMENT

9.1 Introduction

The ecological value of dune systems has been described in Section 1.3, and the concerns relating to the erosion of the beach and associated dune system was discussed in the scoping report and in the report titled “The St Francis Bay Beach Long-term Coastal Protection Phase 2 report of 2018 (Advisian, 2018). The dune ecosystem was described in Chapter 6.

Although the primary motivation for the project is to improve the dune and beach ecosystems, which would result in a number of positive impacts, the project will also have some negative consequences. These are all discussed below.

9.1.1 Existing Impacts

EXISTING IMPACT 1: ONGOING EROSION LEADING TO SPIT BREACH IMPACTS

Cause and Comment:

In 2020 the spit breached four times, resulting in property and marina infrastructure being exposed directly to the waves and storm surges. This resulted in damage to property in the marinas. This was a natural consequence of the long-term erosion of the beach. The fact that it occurred four times in one year indicates that breaching will continue, and that exceptionally high seas or strong wave attack is no longer required to cause a breach. Spring tides and slightly higher waves is all that is now required to breach the sand spit.

The breaches in the spit were as a result of erosion of the foredune habitat and associated loss of vegetation which is now no longer present in certain areas.

The Kouga municipality repaired the breaches in the spit through the placement of sand material from other areas along the beach and the construction of revetments along parts of the frontage to provide additional protection.

Significance Statement

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>TEMORAL SCALE</th>
<th>SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Probable</td>
<td>MODERATE-</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Possible</td>
<td>LOW-</td>
</tr>
</tbody>
</table>

EXISTING IMPACT 2: ONGOING EROSION TO THE BEACHES TO THE NORTH

Cause and Comment:
The reduction of sediment into St Francis Bay has resulted in significant erosion, to the point that in 2020 the spit breached and the beaches have all but disappeared. It has been established that the longshore drift, which transports sediment, is in a northerly direction. With no further introduction of sediment (i.e. very little remaining on the beaches) into the system it is expected that erosion will continue and possibly accelerate along the beaches to the north.

Erosion to the beaches to the north will result in a reduced beach width and the loss of dune habitat. There is limited infrastructure immediately north of the Kromme River. Ecologically the dune ecology is intact and forms part of the Kromensee Nature Reserve resulting in a MODERATE negative impact.

### Significance Statement

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>TEMPORAL SCALE</th>
<th>SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Impact</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Moderately severe</td>
<td>Probable</td>
<td>MODERATE-</td>
<td></td>
</tr>
</tbody>
</table>

9.1.2 **Construction Phase Impacts**

**CONSTRUCTION PHASE IMPACT 1: LOSS OF DUNE VEGETATION ON THE VEGETATED SAND BANK AT THE SAND RIVER MOUTH**

**Cause and Comment**

The Sand River flows under the surface of the dune system, and reduced flows from this system has resulted in the steady build-up of a now vegetated dune system on the west bank of the Kromme Estuary. This area will be used as a source of sand, and this will necessitate the removal of this pioneer dune vegetation. Eventually this will result in a sand bank similar to the one at the mouth.

It is evident from aerial photographs (Figure 4.5) that this sand bank has been present since 2004 (and probably earlier) and that vegetation cover has steadily increased over time. This is supported by the observed development of a pioneer dune scrub community. However, it is postulated that under normal flow conditions this sand bank would not have been as aggressively colonised by dune species as has occurred, due to reduced flows and infrequent flooding resulting in a more stable habitat.

Since this vegetation is indigenous, and exhibits a clear successional gradient, its loss will result in an impact of MODERATE significance, despite the fact that it has established as a result of altered flow regimes in the Kromme. It is not possible to mitigate this impact.

### Significance Statement

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>TEMPORAL SCALE</th>
<th>SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Probable</td>
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<td></td>
</tr>
<tr>
<td>With mitigation</td>
<td>Long Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Probable</td>
<td>MODERATE -</td>
<td></td>
</tr>
</tbody>
</table>
CONSTRUCTION PHASE IMPACT 2: DISTURBANCE TO DUNE VEGETATION ON THE SAND SPIT AND OTHER FOREDUNES DURING CONSTRUCTION.

Cause and Comment
The south bank of the estuary mouth has a sand spit that forms a narrow barrier dune between the sea, the estuary and the marina canal. For most of its length it is well vegetated with typical pioneer woody species such as *Chrysanthemoides monolifera* (Bitou), but the most dominant species is the invasive *Acacia*, *Acacia cyclops* (Rooikrans).

An access road has already been constructed between the Aldabara parking area and the beach in front of the spit by the municipality, which enabled them to carry out emergency repairs when the spit breached. It was used for access for construction equipment and the delivery of rock used in the emergency revetment. This access road will be retained and can be used during construction of the long term solution.

Since much of this vegetation is not indigenous, and the areas disturbed are likely to be localised, The impact of construction on the sand spit will be LOW before and after mitigation, as the breaching of the spit, and the activities required to repair the breach have already resulted in the loss of foredune vegetation and habitat.

Mitigation measures
- Enforcement all provisions contained in the Construction EMP
- Do not allow any laydown areas within the sensitive foredune area.
- Limit access across the foredunes to four access points in total, where each groyne will be located. The access point where the sand spit starts (possibly at the Aldabara Road parking area) will need to serve the first two groynes. The second two will require access from Peter Crescent and at George road; and the final one at the Ralph Road parking area. These parking areas must also be used as laydown areas.
- Limit pedestrian access to these same points.
- Disallow workers from accessing the foredune areas.

Significance Statement

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT TEMPORAL SCALE</th>
<th>EFFECT SPATIAL SCALE</th>
<th>SEVERITY OF IMPACT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Short Term</td>
<td>Study Area</td>
<td>Slight</td>
<td>Probable</td>
<td>LOW-</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Short Term</td>
<td>Study Area</td>
<td>Slight</td>
<td>Probable</td>
<td>LOW -</td>
</tr>
</tbody>
</table>

CONSTRUCTION PHASE IMPACT 3: EFFECTS OF GROYNE CONSTRUCTION ON THE BEACH AND NEARSHORE AREA.

Cause and Comment
Groynes will be constructed from above the high-water mark, and into the nearshore area below the low tide mark. They will be 170 to 200m in length. There is no detail yet on the method of construction,
but it is likely that the groynes will be constructed by placing rock fill at the start of the groyne, and advancing seaward. This construction approach will be disruptive to both the beach and nearshore area, and will require vehicle access along the beach.

During the construction phase ecological impacts on the beach and nearshore areas is likely to be significant, and will be difficult to mitigate. However, since the beach and nearshore ecosystems are resilient to nature perturbations, the impact is considered to be of MODERATE significance, both before and after mitigation, as effective mitigation will be difficult.

Mitigation measures
- Enforcement all provisions contained in the Construction EMP;
- Implement all mitigation measures mentioned above; and
- Do not allow any laydown areas within the sensitive foredune area.

Significance Statement

| CONSTRUCTION PHASE IMPACT 3: EFFECTS OF GROYNE CONSTRUCTION ON THE BEACH AND NEARSHORE AREA. |
|---------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| IMPACT                                                        | EFFECT          | RISK OR LIKELIHOOD | OVERALL SIGNIFICANCE |
|                                                              | TEMPORAL SCALE  | SPATIAL SCALE    | SEVERITY OF IMPACT |
| Without mitigation                                           | Short Term      | Study Area       | Moderate          | Probable        | MODERATE+       |
| With mitigation                                              | Short Term      | Study Area       | Moderate          | Probable        | MODERATE -      |

9.1.3 Operational Phase Impacts

OPERATIONAL PHASE IMPACT 1: ACCRETION AND RESULTANT WIDENING OF THE BEACHES AS A RESULT OF BEACH NOURISHMENT SCHEME

Cause and Comment
The construction of groynes, coupled with sand nourishment will increase the width of the beach, and to some extent restore the habitat to what it was previously. This is regarded as an ecological impact of MODERATE positive significance, and equates to habitat restoration. The social benefit of this is regarded as being of HIGH positive significance. No mitigation is required.

Significance Statement

| OPERATIONAL PHASE IMPACT 1: ACCRETION AND RESULTANT WIDENING OF THE BEACHES AS A RESULT OF BEACH NOURISHMENT SCHEME |
|-----------------------------------------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| IMPACT                                                            | EFFECT          | RISK OR LIKELIHOOD | OVERALL SIGNIFICANCE |
|                                                                  | TEMPORAL SCALE  | SPATIAL SCALE    | SEVERITY OF IMPACT |
| Ecological benefit: Without and with mitigation                  | Permanent       | Study Area       | Moderate          | Probable        | MODERATE+       |
OPERATIONAL PHASE IMPACT 2: STABILISATION OF THE SHORELINE AND PROTECTION FROM STORM SURGES AND SEA-LEVEL RISE.

Cause and Comment
The construction of groynes, coupled with sand nourishment will increase the width of the beach and will stabilise the shoreline and protect the foredunes from wave attack from storm surges, and reduce the current undercutting and collapse of the foredune ridge. It will also protect associated social infrastructure. This is regarded as a social impact of HIGH positive significance, especially since the spit breached on four occasions during 2020.

No mitigation is required.

Significance Statement

OPERATIONAL PHASE IMPACT 3: LONG-TERM IMPROVEMENT TO RECREATIONAL AMENITIES OFFERED BY THE BEACHES

Cause and Comment
The construction of groynes, coupled with sand nourishment will increase the width of the beach, and this result in a significant improvement to the recreational amenities in a coastal town where the focus is on sea, beach and river activities. There is also likely to be resultant economic benefits. This is regarded as a social impact of HIGH positive significance. No mitigation is required.

Significance Statement

OPERATIONAL PHASE IMPACT 4: ACCELERATION OF EROSION AS A RESULT OF THE GROYNES

Cause and Comment
Development of the groynes will alter the hydrodynamic regime through the refraction of waves and altering of local currents, potentially leading to accelerated erosion of the northern bank of the estuary mouth. This impact is expected to be limited to the area immediately north of the northern-most groyne. The design of the beach nourishment is to nourish this area as part of the maintenance
activity. Similarly, the short groyne does not extend sufficiently into the marine environment to have an effect on the northern bank.

Therefore, this impact is expected to have an impact of LOW negative significance since the mitigation for any erosion anticipated in built into the design.

Mitigation measures

- Place sand material immediately north of the northern most groyne to act as sacrificial material.
- Ensure that the adaptive management plan is developed to recognise and mitigate for any accelerated erosion.

Significance Statement

### OPERATIONAL PHASE IMPACT 4: ACCELERATION OF EROSION AS A RESULT OF THE GROYNES

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Permanent</td>
<td>Moderately severe</td>
<td>May Occur</td>
</tr>
<tr>
<td></td>
<td>Study Area</td>
<td></td>
<td>MODERATE-</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Permanent</td>
<td>Slight</td>
<td>May Occur</td>
</tr>
<tr>
<td></td>
<td>Study Area</td>
<td></td>
<td>LOW-</td>
</tr>
</tbody>
</table>

### OPERATIONAL PHASE IMPACT 5: RESTRICTION OF SEDIMENT TRANSPORT TO THE NORTH

Cause and Comment

Development of the groynes will restrict the longshore drift that transports sediment to the north. However, even with the restriction at least 50% of the material (approximately 28 000 m³ per annum) will pass through the scheme. In addition, the beach nourishment and maintenance introduces and new source of sediment which is able to be transported to the north supplying those beaches with sediment.

While the groynes are designed to restrict the movement of sediment and have a negative impact on sediment movement, these stub groynes will allow sediment to move in a northerly direction. The beach nourishment and maintenance will provide the system with a sediment source which is expected to reduce the erosion to the northern beaches under the no-go scenario. Therefore, this impact is considered to result in a negative impact of LOW significance.

Mitigation measures

- Maintain nourishment of at least 6,000 m³/year for the embayments south of the spit and 10,000 m³/year for the remaining embayment at the spit on a regular basis.
- Ensure that the adaptive management plan is developed to recognise and mitigate for any accelerated erosion.

Significance Statement

### OPERATIONAL PHASE IMPACT 5: RESTRICTION OF SEDIMENT TRANSPORT TO THE NORTH

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>EFFECT</th>
<th>RISK OR LIKELIHOOD</th>
<th>OVERALL SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation</td>
<td>Permanent</td>
<td>Moderately severe</td>
<td>May Occur</td>
</tr>
<tr>
<td></td>
<td>Study Area</td>
<td></td>
<td>MODERATE-</td>
</tr>
<tr>
<td>With mitigation</td>
<td>Permanent</td>
<td>Study Area</td>
<td>Slight</td>
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</tbody>
</table>

Estuarine and Dune Assessment
10 MONITORING

10.1 Baseline Data

The objective of baseline data collection is to provide a statistically robust baseline data set that adequately describes the ambient water quality, water flow, water levels and sediment dynamics of the estuary. This data set can be used for comparative purposes during the future phases of the project. The baseline data for estuary must be collected over a period of at least one year (twice during the dry season (beginning and end) and once during the wet season).

Baseline data needs to be collected prior to construction. This includes:

- Sediment contaminant testing – while it is anticipated that the sediment suitable for dredging is unlikely to contain harmful contaminants testing of the sediment is required to establish this. Having collected data prior to construction sediment tested during the dredging would allow comparison to a pre-dredge condition. It is anticipated that samples be taken from those areas earmarked to be dredged. A sample of surface and depth should be taken and analysed for *E. coli* and heavy metals. This is anticipated to be carried out by the dredging contractor periodically throughout the dredging process.

- Bathymetry – the bathymetry data collected in 2020 is likely to be updated by the contractor prior to dredging commencing (i.e. construction phase). This would facilitate the monitoring of the dredging progress and provide a baseline against which the dredging works could be compared. Changes to bathymetry could be analysed should any significant changes to the hydrodynamics of the system be observed during and/or post construction. The bathymetry should cover the mouth area and extend as far upstream as the extent of the extraction.

- Ground truthing the distribution of the habitats identified as part of this study should be considered. Following this, monitoring the sensitive habitats in close proximity to the dredging activities should be carried out to determine die-back as a result of smothering, dredging, loss of habitat. Should these areas be determined to be reducing correction measure should be implemented. This should be carried out by a suitably qualified specialist with the emphasis being on the ability to accurately replicate the activity during the construction phase.

10.2 Construction And Operational Phase Monitoring Parameters

Sediment contaminant testing

To be carried out throughout the construction period to ensure that contaminants are not entering or being released into the water column.

Bathymetry

It is understood that a dredging contractor would collect bathymetry data during the works. However, data should be provided to a suitably qualified and experienced ecological/environmental expert, in a format that can be easily interpreted, to be able to verify the impacts. It is recommended that this monitoring takes place at least annually.

Habitat distribution

Similarly to the bathymetric surveys, habitat distribution should be monitored during construction. Initially, monitoring should be fairly regular (i.e. once every 2 months) to ensure that any suspended sediment that may be settling is not settling in sensitive habitats (i.e. Zostera) at a rate unsustainable for the continuation of that particular habitat. This should be done through the collection of fixed-point photographs and updated distribution mapping.
The outcome of the monitoring should be compiled into an annual monitoring report comparing the monitoring against the baseline data that was collected prior to construction. In addition, there should be comment on the observations and whether they are in line with the impacts identified during the EIA. Should the impacts observed through the monitoring differ from that of the EIA and particularly if adverse, additional mitigation measures should be implemented.

11 CONCLUSIONS & RECOMMENDATIONS

11.1 Conclusions

Table 11.1 provides a summary of the existing and the potential impacts associated with the proposed project.

<table>
<thead>
<tr>
<th>PHASES OF DEVELOPMENT &amp; POTENTIAL IMPACTS</th>
<th>SIGNIFICANCE</th>
<th>WITHOUT MITIGATION</th>
<th>WITH MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXISTING IMPACTS</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Estuary Bank Erosion</td>
<td>MODERATE-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Siltation</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deterioration in Water Quality</td>
<td>LOW</td>
<td></td>
<td></td>
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<tr>
<td>Increased Salinity</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on Submerged Macrophytes</td>
<td>MODERATE+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on Submerged Salt Marsh</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Impact on fauna - increase in sandbank habitat as a result of the impoundments upstream</td>
<td>MODERATE+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on fauna - shift to a marine dominated system</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on Social Amenities</td>
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<td></td>
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<tr>
<td>Impact on Ecosystem goods and services</td>
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</tr>
<tr>
<td>Impact on infrastructure and dune habitat as a result of a breach in the spit</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ongoing erosion to the beaches to the north</td>
<td>MODERATE-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONSTRUCTION AND OPERATIONAL PHASE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in Sedimentation and Turbidity</td>
<td>MODERATE-</td>
<td>LOW-</td>
<td></td>
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<tr>
<td>Loss of Estuarine Vegetation Communities</td>
<td>MODERATE-</td>
<td>LOW-</td>
<td></td>
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<tr>
<td>Loss of Estuarine Faunal Communities</td>
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<td></td>
</tr>
<tr>
<td>Impacts on the Estuarine Functional Zone</td>
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<td>MODERATE-</td>
<td></td>
</tr>
<tr>
<td>Improvements to the Recreational Amenities Offered by the Kromme</td>
<td>MODERATE+</td>
<td>HIGH+</td>
<td></td>
</tr>
<tr>
<td>Loss of Access to Particular Sites and Restrictions on the use of the Estuary during Dredging Operation</td>
<td>LOW-</td>
<td>LOW-</td>
<td></td>
</tr>
<tr>
<td>A Reduction / Loss of Sandbanks Supporting Fauna</td>
<td>LOW-</td>
<td>LOW-</td>
<td></td>
</tr>
<tr>
<td>Visual Intrusion of Dredging Equipment and Pipelines</td>
<td>MODERATE-</td>
<td>LOW-</td>
<td></td>
</tr>
<tr>
<td>Noise Disturbance Impacts</td>
<td>MODERATE-</td>
<td>LOW-</td>
<td></td>
</tr>
<tr>
<td>Impact on Navigation and Boating Safety</td>
<td>MODERATE+</td>
<td>MODERATE+</td>
<td></td>
</tr>
<tr>
<td>Loss of Dune Vegetation on The Vegetated Sand Bank at The Sand River Mouth</td>
<td>MODERATE-</td>
<td>MODERATE-</td>
<td></td>
</tr>
<tr>
<td>Disturbance to dune vegetation on the sand spit and other foredunes during construction</td>
<td>LOW-</td>
<td>LOW-</td>
<td></td>
</tr>
</tbody>
</table>
The dredging of the Kromme Estuary may result in significant negative impacts. However, with considered mitigation those impacts can be reduced to as low as reasonably practicable. While there are sensitive habitats with species deemed vulnerable and near threatened the loss of these species is anticipated to be a small area of their overall distribution within the Kromme Estuary and even smaller proportions regionally. The species that will be directly lost (benthic organisms) as a result of the dredging activity are not sensitive species and while their abundance may be reduced initially it is expected that these species will return and inhabit newly dredged areas. Alternative locations for birds and fish are available throughout the estuary system, since there is similar habitats upstream and along the beach in St Francis Bay.

Changes in the hydrodynamic environment are expected. The dredging of the river, and in particular the area around the river mouth has the effect of allowing the water to drain out more effectively, which lowers the low water level (with respect to MSL). It is assumed that this low water level will be a variable phenomenon in any case given the dynamic nature of the river mouth which will govern this low tide level. However, this may lead to exposure of shallow non-dredged areas within the estuary during low tides. The sandbanks exposed under existing conditions is calculated at 52 ha. Following the dredging activity (assuming the full extraction volume) the exposed sandbanks equate to 51 ha (See the Sand Sourcing Specialist Report for more information).

In addition, the maximum tidal current velocity throughout the simulation period confirm that the currents outside the main channel (i.e. near to the banks) and in particular on the northern bank close to the river mouth are low (up to 0.2m/s) and that the dredging would not lead to any significant change in the currents in this area. Similarly, based on the strong flow (maximum current speed of 1.8m/s at the estuary mouth observed from the model studies) the estuary mouth is not expected to close.

The estuarine functionality, while impacted, will remain intact. In order to ensure this impact is monitored CES have recommended regular bathymetry surveys. In addition to the surveys, CES recommend the development of an adaptive management plan. This plan would outline the environmental monitoring required during the construction and operational phases of the project and recommend appropriate mitigation measures depending on the results of the monitoring and the impacts observed.

Those areas of sand bank that are vegetated with dune vegetation (i.e. Sand River) do occur within the estuary and within those areas expected to be dredged. Since this vegetation is indigenous, and exhibits a clear successional gradient, its loss will result, despite the fact that it has established as a result of altered flow regimes in the Kromme. However, it is postulated that under normal flow

| Effects of Groyne Construction on The Beach and Nearshore Area | MODERATE- | MODERATE- |
| Accretion and Resultant Widening of The Beaches as A Result of Beach Nourishment Scheme | MODERATE- | HIGH+ |
| Stabilisation of The Shoreline and Protection from Storm Surges and Sea-Level Rise | VERY HIGH+ |
| Long to Improvement to Recreational Amenities Offered by The Beaches | VERY HIGH+ |
| Acceleration of erosion as a result of the groynes | MODERATE- | LOW- |
| Restriction of Sediment Transport to the North | MODERATE- | LOW- |
| DECOMMISSIONING PHASE | None | - |
| CUMULTIVE IMPACTS | Increased Estuary Bank Erosion | MODERATE- | LOW- |
conditions this sand bank would not have been as aggressively colonised by dune species as has occurred, due to reduced flows and infrequent flooding resulting in a more stable habitat.

The construction of the groynes, as well as activities associated with beach nourishment will require access over the foredunes in selected areas, and damage to the foredunes and the loss of some vegetation is inevitable. During 2020 the spit has breached a number of times and the Kouga Municipality have had to implement their emergency procedures which have required repair of the breach through closing the breaches with sand and the construction of an emergency revetment. Therefore, since the areas are mostly disturbed and likely to be localised, the impacts are not expected to be significant.

The nourishment of the beach along the St Francis Bay frontage will provide additional habitat for the development of dune species. It will also stabilise the shoreline and protect the foredunes from wave attack from storm surges. These are seen as beneficial impacts.

From a socio-economic perspective the restoration of the beach amenity and additional area within the lower reaches of the estuary are seen as beneficial impacts of the dredging. The visual and noise disturbance impacts as a result of the dredging and potential pumping of sediment can be suitably mitigated to reduce the impacts that may arise from the dredging activity.

Based on this assessment there are no fatal flaws.

11.2 Recommendations

It is recommended that the following Construction Phase and Operation Phase mitigation measures are included in the Environmental Management Programme (EMPr):

Table 11.2: Mitigation measures for inclusion in the EMPr and EA.

<table>
<thead>
<tr>
<th>MITIGATION MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only the correct size material (course) will be dredged for beach nourishment.</td>
</tr>
<tr>
<td>Sensitive habitats will be identified and avoided.</td>
</tr>
<tr>
<td>Only the required volume of sediment will be dredged.</td>
</tr>
<tr>
<td>Associated equipment will be placed in areas that are deemed not to be sensitive.</td>
</tr>
<tr>
<td>Development and publication of the intended programme of works including work areas.</td>
</tr>
<tr>
<td>Identification and publication of buffer areas/safety zones around dredging equipment.</td>
</tr>
<tr>
<td>Development of a dredging programme that takes navigation and peak times into account.</td>
</tr>
<tr>
<td>Noise attenuation of pumps/pipes associated with the transport of material.</td>
</tr>
<tr>
<td>Consideration of operating dredging equipment during daylight hours only.</td>
</tr>
<tr>
<td>Consider improvement of access to an alternative walking route along the length of the frontage along the beach and estuary.</td>
</tr>
<tr>
<td>Development and publication of water safety procedures and enforcement to ensure safety to all users of the estuary.</td>
</tr>
<tr>
<td>Development of an adaptive management plan.</td>
</tr>
<tr>
<td>Enforcement all provisions contained in the Construction EMP</td>
</tr>
<tr>
<td>Do not allow any laydown areas within the sensitive foredune area.</td>
</tr>
<tr>
<td>Limit access across the foredunes to four access points in total, where each groyne will be located. The access points will need to serve the groynes in proximity. From North to South, they are</td>
</tr>
</tbody>
</table>
expected to be the Aldabara Road parking area, Peter Crescent, George road and Ralph Road parking area. These parking areas must also be used as laydown areas.
Limit pedestrian access to these same points.
Disallow workers from accessing the remaining and intact foredune areas.
REFERENCE LIST


Eastern Cape Biodiversity Conservation Plan (2007).


National Environmental Management: Biodiversity Act (NEMBA, Act No. 10 of 2004).


National Environmental Management: Protected Areas Act (NEMPAA, Act No. 57 of 2003).


CONTACT DETAILS

Name of Company                  Coastal and Environmental Services (Pty) Ltd trading as CES
Designation                     Port Elizabeth Branch
Profession                      Environmental Consultant / Junior Ecological Specialist
Years with firm                 One (1) Year
E-mail                          n.wienand@cesnet.co.za
                                  nicole.wienand@eoh.com
Office number                   +27 (0)41 045 0496
                                  +27 (0)41 393 0700
Nationality                     South African
Key areas of expertise          ➢ Environmental and Ecological Impact Assessments
                                  ➢ Botanical Specialist Studies
                                  ➢ Environmental Auditing/Compliance Monitoring
                                  ➢ GIS Mapping

PROFILE

Ms Nicole Wienand

Ms Nicole Wienand is an Environmental Consultant based in the Port Elizabeth branch. Nicole obtained her BSc Honours in Botany (Environmental Management) from Nelson Mandela University (NMU) in December 2018. She also holds a BSc Degree in Environmental Management (Cum Laude) from NMU. Nicole’s honours project focused on the composition of subtidal marine benthic communities on warm temperate reefs off the coast of Port Elizabeth and for her undergraduate project she investigated dune movement in Sardinia Bay. Nicole’s key interests include marine ecology, botanical specialist assessments, GIS Mapping, the general EIA process, Public Participation Process (PPP) and Ecological Impact Assessments. Since her appointment with CES in January 2019, Nicole has undertaken a number of Ecological Impact Assessments under the guidance of Dr Greer Hawley and Tarryn Martin.
### Employment Experience

**Environmental Consultant, CES**  
07 January 2019 – Present  
- Basic Assessment Reports  
- Ecological Impact Assessments  
- Environmental Audit/Compliance Monitoring  
- GIS Mapping  
- Public Participation  

### Academic Qualifications

**Nelson Mandela University, Port Elizabeth**  
BSc Honours Botany (Environmental Management)  
2018  

**Nelson Mandela Metropolitan University, Port Elizabeth**  
BSc Environmental Sciences  
2015-2017

### Consulting Experience

**Basic Assessments**  
- Duyker Island Prospecting Right, North West Province – Assisting Report Writing  
- ZMY Steel Traders (Pty) Ltd. Steel Recycling Plant, Zone 5 of the Coega SEZ, Eastern Cape Province – Basic Assessment Report;  
- Fairview Sand Mine near Port Alfred, Eastern Cape Province – Basic Assessment Report;  
- Kareekrans Boerdery Agricultural Development near Kirkwood, Eastern Cape Province – Report Writing; and  

**Ecological Assessments**  
- ZMY Steel Traders (Pty) Ltd., Steel Recycling Plant, Zone 5 of the Coega SEZ, Eastern Cape Province;  
- Kareekrans Boerdery Agricultural Development near Kirkwood Eastern Cape Province, Ecological Impact Assessment and Report Writing;  
- Sitrusrand Dwarsleegte Farm Citrus Development near Kirkwood, Eastern Cape Province – Ecological Impact Assessment and Report Writing;  
- Uitsig Boerdery Trust Citrus Development near Kirkwood, Eastern Cape Province – Ecological Impact Assessment and Report Writing;  
- Mosselbankfontein Coastal Dune and Ecological Impact Assessment near Witsand, Western Cape Province – Ecological Impact Assessment and Report Writing;  
- Nomzamo Citrus Farm Development near Kirkwood, Eastern Cape Province – Ecological Impact Assessment and Report Writing; and  
- Mangrove Forest Survey for the Kenmare Biodiversity Management Plan, Topuito, Mozambique.

**Environmental Auditing**  
- Khayamandi Extension on Erven 114, 609, 590 and 24337, Bethelsdorp, within the Nelson Mandela Bay Municipality;
➢ Aberdeen Bulk Water Supply Phase 2, Dr Beyers Naude Local Municipality, Eastern Cape Province, South Africa;
➢ Fishwater Flats Wastewater Treatment Works Refurbishment, Nelson Mandela Bay Municipality, Eastern Cape Province;
➢ The Refurbishment of the Kwanobuhle Wastewater Treatment Plant, Nelson Mandela Bay Municipality, Eastern Cape Province, South Africa; and
➢ Driftsands Sewer Collector Augmentation (Phase II), Within the Nelson Mandela Bay Municipality, Eastern Cape Province.

**Geographical Information Systems (GIS)**

➢ ZMY Steel Traders – Basic Assessment Report and Biophysical Mapping;
➢ Duyker Island – Prospecting Area Mapping & Biophysical Mapping;
➢ Fairview Sand Mine near Port Alfred, Eastern Cape Province – Biophysical and Layout Mapping;
➢ St Francis Coastal Protection Scheme – Kromme Estuary Functional Zone Mapping; Biophysical Mapping; and Sand Source Area Mapping;
➢ Kareekrans Boerdery Agricultural Development – Biophysical and Layout Mapping;
➢ Nomzamo Citrus Farm Development near Kirkwood, Eastern Cape Province - Biophysical and Layout Mapping;
➢ Siyahluma Citrus Farm Development near Addo, Eastern Cape Province – Biophysical and Layout Mapping; and
➢ Sitrusrand Dwarsleegte Farm Citrus Development – Biophysical and Layout Mapping.

**Public Participation process**

➢ Duyker Island Prospecting Right, North West Province St Francis Coastal Protection Scheme;
➢ Fairview Sand Mine near Port Alfred, Eastern Cape Province;
➢ Kareekrans Boerdery Agricultural Development near Kirkwood Eastern Cape Province;
➢ Proposed Coastal Protection Scheme, St Francis Bay, Kouga Local Municipality, Eastern Cape Province; and
➢ Sitrusrand Dwarsleegte Farm Citrus Development near Kirkwood, Eastern Cape Province.

**Social Auditing**

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Nicole Wienand

Date: January 2020
APPENDIX 2: SPECIALIST DECLARATIONS
DETAILS OF SPECIALIST AND DECLARATION OF INTEREST IN TERMS OF REGULATIONS 12 AND 13 OF THE AMENDMENTS TO THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 AS AMENDED.

<table>
<thead>
<tr>
<th>File Reference Number:</th>
<th>(For official use only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEAS Reference Number:</td>
<td></td>
</tr>
<tr>
<td>Date Received:</td>
<td></td>
</tr>
</tbody>
</table>


PROJECT TITLE

**COASTAL PROTECTION SCHEME, ST FRANCIS BAY, KOUGA MUNICIPALITY, EASTERN CAPE PROVINCE**

<table>
<thead>
<tr>
<th>SPECIALIST ¹</th>
<th>Mr Gregory Shaw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person:</td>
<td>Mr Gregory Shaw</td>
</tr>
<tr>
<td>Postal address:</td>
<td>67 African Street, Grahamstown</td>
</tr>
<tr>
<td>Postal code:</td>
<td>6139</td>
</tr>
<tr>
<td>Telephone:</td>
<td>046 622 2364</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:g.shaw@cesnet.co.za">g.shaw@cesnet.co.za</a></td>
</tr>
</tbody>
</table>

*Professional affiliation(s) (if any)*

---

Version 2 January 15 2021
4.2 The SPECIALIST

I, Gregory Shaw, declare that –

General declaration:

- I act as the independent Specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by
interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Amendments to Environmental Impact Assessment Regulations, 2014 as amended.
- I have a vested interest in the proposed activity proceeding such vested interest being:

    

    

    

    

    

    

    

    

Ahaw

Signature of the environmental assessment practitioner:
Coastal and Environmental Services (Pty) Ltd.

Name of company:
4th February 2021

Date:

Signature of the Commissioner of Oaths:
04th February 2021

Date:

Commissioner of Oaths

Designation:

¹ Curriculum Vitae (CV) attached

Official stamp (below).
Annexure 1

CV
GREGORY SHAW  
Curriculum Vitae

CONTACT DETAILS

Name of Company  CES  
Designation  Grahamstown Branch  
Profession  Principal Environmental Consultant  
Years with firm  3 Years  
E-mail  g.shaw@csenet.co.za  
Office number  +27 (0)46 622 2364  
Nationality  South African  
Professional Body  SACNASP, South African Council for Natural Scientific Profession, Professional (Pending)

Key areas of expertise
➢ Marine Ecology  
➢ Environmental and Social Impact Assessment (ESIA)  
➢ Environmental Management and Monitoring  
➢ Project Management

PROFILE

Mr Gregory Shaw

Greg is a principal environmental consultant with more than 10 years’ experience, who has carried out ESIA for a variety of infrastructure developments in Africa and Europe. His experience is with development projects where there is creation or modification of infrastructure, via capital works and complex logistics.

He is able to engage with the full portfolio of diverse stakeholder groups and regulators via meetings, written material, face-to-face workshops, presentation events, negotiation and discussion to achieve mutually agreeable mitigation measures and solutions. As part of many of the ESIA he has been involved in or managed he has been responsible for the development and execution of environmental surveys (and subsequent monitoring programmes), sub-contractor management (including contracting), report writing and project management. In addition, he has been responsible for developing and auditing plans associated with managing large infrastructure projects e.g. Environmental Management Plans (EMP).

Greg forms strong relationships and ensure that the team works together in an integrated way towards the clear common goal, making effective use of time and resources.
GREGORY SHAW  
Curriculum Vitae

EMPLOYMENT EXPERIENCE

November 2016 - Present:
Principal Consultant (EOH Coastal & Environmental Services)  
Grahamstown, South Africa

January 2008 – October 2016:
Senior Consultant (Royal HaskoningDHV)  
Peterborough, United Kingdom

January 2004 – January 2007:
Part-time consultant (Public Process Consultants)  
Port Elizabeth, South Africa

ACADEMIC QUALIFICATIONS

Nelson Mandela Metropolitan University, Port Elizabeth
MSc (Botany)  
2005 – 2007

Nelson Mandela Metropolitan University, Port Elizabeth
BSc (Hons) (Environmental Management)  
2004

University of Port Elizabeth, Port Elizabeth
BSc (Natural Sciences)  
2000 - 2003

COURSES

- 2013 Royal HaskoningDHV Accelerated Development Programme
- 2012 First Aid
- 2012 Handling Conflict
- 2011 Client Relationships
- 2011 Financial Management
- 2010 Report Writing
- 2010 Project Management
- 2010 Effective Communication
- 2010 Knowing Your Business
- 2010 Phase I Ecological Surveying Techniques and Taxonomy
- 2009 CIWEM Structured Training
- 2009 Project Management
- 2008 Sustainable Construction
- 2006 South African Association of Botanists - Annual Seminar
- 2005 Resource Directed Measures
- 2005 Training in Integrated Environmental Management

CONSULTING EXPERIENCE

Environmental consulting experience as project manager or team member is broad and covers a number of key industry sectors (ports, nuclear, renewable energy). The majority of the international ESIs were conducted in accordance with international standards including the IFC Performance Standards and have been reviewed by international Development Finance Institutions.
South Africa

- Nirove Paint Stripping Facility [Project manager]
- Wison Coal to Urea EIA [Project manager]
- St Francis Bay EIA [Project Manager, Marine specialist]
- EOH Powerstation Feasibility Assessment [Project manager]
- Richard’s Bay breakwater refurbishment [Marine specialist]
- KBK Engineers (Sanral) Basic Assessment [Project manager]
- Bayview Wind Energy Facility [Project director]
- Rushmere Noach Attorneys [Project manager and marine specialist]
- TNPA East London Quay 3 Assessment [Environmental specialist]
- TNPA Ballast Water Management Plan [Environmental specialist]
- Fairwood Estate Environmental Authorisation [ESMP author]
- Environmental Scoping Report cc. Erf 2387, Port Elizabeth. Baobab Agencies. [Environmental specialist].
- Proposed Hybrid Residential Development Scoping Report, Port Elizabeth. [Environmental specialist].
- Ingleside Development, Port Elizabeth. [Specialist Review].
- Port of Ngqura Marine Biomonitoring Programme. Coega Development Corporation. [Surveyor / research assistant].
- Construction and Operation of the Deepwater Port of Ngqura EIA. Coega Development Corporation. [Specialist review].

Africa

- Kenmare Mangrove Baseline Assessment (Mozambique) [Lead surveyor]
- Sphinx Energy Solar PV Facilities in Guider & Maroua (Cameroon) [Project manager]
- Olam Cocoa Plantation ESIA (Tanzania) [Project manager, ESIA manager]
- MCA-Malawi RAP Audit [Project Manager, Lead Auditor]
- JCM Power ESMS [Project manager]
- JCM Power Solar Power Station ESIA [Project Manager, Report Author]
- Suni Resources Traffic Impact Assessment [Report author]
- NCCL Isanye Dam EPB (Zambia) [Project manager]
- NCCL Ngoli Dam EPB (Zambia) [Project manager]
- NCCL Kasama Dam ESIA (Zambia) [ESIA manager]
- JCM Power Solar PV ESIA (Cameroon) [ESIA manager]
- Tete Iron Ore Project ESIA (Mozambique) [ESMP]
- Triton Ancuabe ESIA (Mozambique) [Specialist coordination, ESMP]
- Badagry Greenfield Port Development ESIA including management plans (Nigeria) [ESIA and marine specialist]
- Saly Coastal Protection Project ESIA (Senegal) [Marine specialist]
- Port Mole Waterfront Development ESIA including management plans (Gabon) [ESIA manager and marine specialist]
- Bulk Handling Facility ESIA including management plans (Conakry Guinea) [ESIA manager and marine specialist]
- Kamsar Container Terminal ESIA including management plans (Conakry Guinea) [ESIA manager and marine specialist]
Port of Ziguinchor ESIA including management plans (Senegal) [Marine specialist / Reviewer]
Eko Atlantic Shoreline Protection ESIA including management plans (Nigeria) [Marine specialist]
Eko Atlantic Topside Infrastructure ESIA (Nigeria) [ESIA manager]
Construction of a Jetty Facilitating Transfer of Petroleum Products from Ship to Shore (Eritrea) [Environmental Clerk of Works]

United Kingdom

Thamesport Phase IV Quay Extension EIA [Reviewer]
East Lane, Bawdsey Coast Defence Works [Environmental Clerk of Works]
Kilkeel Offshore Wind Farm Feasibility and Scoping Report [Project manager]
Wells Channel Deepening and Jetty Construction EIA [EIA and marine specialist]
Wells Channel Deepening and Jetty Construction Environmental Monitoring Programme (2010-2016) [Project manager and marine specialist]
Trimley Ecological Monitoring Programme (2008 – 2011) [ Marine specialist]
SEAs for the Eastern England Shoreline, required for Shoreline Management Plans [Marine specialist]
River Habitat Survey, Tributary of Car Dyke [Field work and report writing]
Hinkley Point C Environmental Impact Assessment [EIA coordinator and marine specialist]
Harwich Haven Annual Environmental Reporting (2009 – 2011) [Project manager and marine specialist]
Environmental Monitoring and Mitigation Plan / Habitat Regulations Assessment East Lane [Project manager and marine specialist]
Thanet Offshore Wind Farm [Environment Manager]
The Wash Tide Gauge [Consent advisor and marine specialist]
Dogger Bank Creyke Beck A&B, Teesside A&B EIA [Marine specialist]
Kentish Flats Offshore Wind Farm Extension [Consent advisor / environment manager]
Royal National Lifeboat Institute (RNLI) Feasibility [Project manager and marine specialist]
Bacton Gas Terminal Coast Protection Works and Offshore Borrow Area EIA [Consent and marine specialist]
Newhaven East Quay and Port Expansion Area EIA [Marine specialist]
Sizewell C New Nuclear Build Habitats Regulations Assessment [Project manager]
DNV Subsea Cable Installation Guidelines [Marine and Consenting expert]
CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

GREGORY SHAW

Date: January 2020
DETAILS OF SPECIALIST AND DECLARATION OF INTEREST IN TERMS OF REGULATIONS 12 AND 13 OF THE AMENDMENTS TO THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 AS AMENDED.

(For official use only)

File Reference Number:

NEAS Reference Number:

Date Received:


PROJECT TITLE

COASTAL PROTECTION SCHEME, ST FRANCIS BAY, KOUGA MUNICIPALITY, EASTERN CAPE PROVINCE

| SPECIALIST ¹ | Dr Chantel Bezuidenhout |
| Contact person: | Mr Gregory Shaw |
| Postal address: | 67 African Street, Grahamstonw |
| Postal code: | 6139 |
| Telephone: | 046 622 2364 |
| E-mail: | g.shaw@cesnet.co.za |

¹ All specialists named must complete a separate form.

Version 2 January 15 2021
4.2 The SPECIALIST

I, Chantel Bezuidenhout, declare that –

General declaration:

- I act as the independent Specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by

Page 2 of 4
interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;

- I will keep a register of all interested and affected parties that participated in a public participation process; and

- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not

- all the particulars furnished by me in this form are true and correct;

- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and

- I realise that a false declaration is an offence and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Amendments to Environmental Impact Assessment Regulations, 2014 as amended.

- I have a vested interest in the proposed activity proceeding, such vested interest being:

__________________________

__________________________

Signature of the environmental assessment practitioner:

Coastal and Environmental Services (Pty) Ltd.

Name of company:

04th February 2021

Date:

Signature of the Commissioner of Oaths:

04th February 2021

Date:

Commissioner Of Oaths

Designation:

1 Curriculum Vitae (CV) attached

Official stamp (below).
Annexure 1

CV
CONTACT DETAILS

Name of Company: CES – Environmental and Social Advisory Services
Designation: Port Elizabeth Branch
Profession: Principal Environmental Consultant and Branch Manager
Years with firm: 9 Years
E-mail: c.bezuidenhout@cesnet.co.za
Office number: +27 (0)41 585 1715
Nationality: South African

Key areas of expertise:
- Environmental Impact Assessments (including stakeholder engagement such as focus group meetings, meetings with local government officials, etc.)
- Environmental Management Programmes
- Monitoring Programmes
- High level GHG Emissions Assessments
- Land and Natural Resource Use Assessment (liaising with local communities via focus group meetings in regard to land use, including agriculture, natural resources use, etc.)
- Estuarine Assessments
- Team Leader for land surveys completed for a RAP process in Mozambique
- Rehabilitation Assessments
- Mine Closure Reports

PROFILE

Dr Chantel Bezuidenhout

Dr Chantel Bezuidenhout holds MSc and PhD degrees in Botany (estuarine ecology) and a BSc degree in Botany and Geography from NMMU. Chantel has been an Environmental Consultant for approximately 11 years and as such has been focused on environmental management and impact assessment. Chantel is well versed in environmental legislation and has managed a number of environmental impact assessments and management plans for heavy mineral mining in South African and Madagascar, as well as a number of EIAs for open case mines (copper, nickel, graphite) in Zambia and Mozambique. These projects have been completed to international standards (IFC and World Bank), and have been granted authorisation by their host countries. Chantel is also well versed in stakeholder engagement and stakeholder processes, all EIAs that has been managed by Chantel has included community consultations and as such Chantel has been used for various forms of community engagement in rural African settings. Chantel has also been extensively involved in the data collection and report writing for land and natural resource use assessments in both Madagascar and Mozambique. The data gathering component involves expensive community meetings in order to establish land use (including agriculture) and natural resource use within the communities and wider regions. Chantel has recently completed an extensive land survey as part of a Resettlement process for a heavy minerals mine in Mozambique as well as in-kind compensation surveys in Tanzania. She is currently a principal consultant and Branch Manager of the Port Elizabeth Office of EOH CES.
Principal Environmental Consultant, Coastal and Environmental Services  
October 2011–Present

- Project Management
- Report Production (EIR,BAR,EMP2)
- Public Participation, including community meetings, focus group meetings, liaison with government department, etc.
- Specialist Assessments (Estuarine, High Level GHG, Rehabilitation, Mine Closure & Land Natural Resource Use)
- Team Leader for Land Surveys undertaken as part of the Resettlement Process
- Quality Control

Environmental Consultant, CEN IEM Unit  
February 2008 – September 2011

- Project Management
- Report Production (EIR, BAR, EMP2)
- Public Participation

ACADEMIC QUALIFICATIONS

- 2000 - BSc. NMMU Port Elizabeth
- 2001 - BSc. (Hons) NMMU Port Elizabeth
- 2003 – MSc. NMMU Port Elizabeth
- 2011 – PhD. NMMU Port Elizabeth

PUBLICATIONS

PROFESSIONAL EXPERIENCE

Consulting Experience (Selected Projects)

- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed establishment of 2 jetties, improvement of the existing, licensed slipway and stabilization of the river banks on Portion 12 of the Farm Nocton 441 (Gamtoos ferry Hotel). (Port Elizabeth, Eastern Cape Province)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed establishment of a Town Lodge Hotel on Erf 2150, Summerstrand. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed Rezoning and subdivision of Erf 10501 and the remainder of Erf 5023, Walmer, Nelson Mandela Metropolitan Municipality, for the purpose of establishing a residential development. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed rezoning and establishment of a hospital and associated infrastructure and facilities on a portion of the remainder of Erf 1226, Fairview, Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed rezoning of Portion 1 of the Farm Bucklands (No. 108), the Farm SchrikwatersPoort (No. 109) and the remainder of the Farm Bucklands (No. 108) for the development of a Luxury Lodge, Makana Municipal Area, Eastern Cape. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed subdivision of Erf 2686, Parsonsvlei for a Residential Development Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Basic Assessment for the proposed subdivision of Erf 2687, Parsonsvlei for a Residential Development Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2008) Environmental Assessment for the proposed Rezoning and Subdivision of Portions 22 and 40 of the Farm Witteklip No 466, Nelson Mandela Bay Municipality. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2009) Environmental Assessment for the proposed subdivision of the remainder of Erf 1226, Fairview, Port Elizabeth, Eastern Cape for a Residential Development. (Pot Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the establishment of a new 2.5 ML Kruisfontein Reservoir on Erf 2088 and a portion of the remainder of Erf 2, Humansdorp, Kouga Municipality, Eastern Cape. (Port Elizabeth, Eastern Cape)
- CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the proposed extension of an existing 36m lattice mast to a 46m lattice mast on Erf 8917, Uitenhage, Nelson Mandela Bay Municipality, Eastern Cape. (Port Elizabeth, Eastern Cape)
• CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the proposed extension of an existing 36m lattice mast to a 46m lattice mast of Erf 1296, Summerstrand, Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the proposed extension of an existing 36m lattice mast to a 56m lattice mast on Erf 1345, Walmer, Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the proposed rezoning and subdivision of a portion of Erf 1721, Aberdeen, Comdeboo Municipality, Eastern Cape to develop subsidized housing and related community facilities (Lotusville Extension). (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2009) Basic Assessment for the proposed rezoning and subdivision of a portion of Erf 1721, Aberdeen, Comdeboo Municipality, Eastern Cape to develop subsidized housing and related community facilities (Thembalesizwe Extension). (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2010) Environmental Impact Assessment for the proposed stabilization of the river banks on Portion 2 of the Farm Nocton 441 (Adjacent to the Gamtoos Ferry Hotel). (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2010) Environmental Impact Assessment for the proposed construction and upgrading of the new Glen Hurd Road as well as the construction of the Baakens River Bridge, Port Elizabeth, Eastern Cape. (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2010) Environmental Impact Assessment for the proposed subdivision of the remainder of Erf 982, Parsonsplei, Port Elizabeth, Eastern Cape for a Residential development. (Port Elizabeth, Eastern Cape)

• CEN Integrated Environmental Management Unit: (2010) Environmental Impact Assessment for the proposed rezoning and subdivision of erven 1070, 409 and the remainder of Erf 385, Theescombe, Port Elizabeth, Eastern Cape for a residential development. (Port Elizabeth, Eastern Cape)

• Coastal and Environmental Services. Environmental Impact Assessment for the proposed residential development at the existing golf course in Grahamstown, Eastern Cape Province of South Africa (2012).

• Coastal and Environmental Services. Environmental Impact Assessment for the proposed golf course development at Belmont Valley, Grahamstown, Eastern Cape Province of South Africa (2012)

• Coastal and Environmental Services. Basic Assessment for the proposed development of a 13 MW Photovoltaic energy generating facility in the Coega Industrial Development Zone (Zone 12), Port Elizabeth, Eastern Cape Province. Authorization Received 29/02/12.

• Coastal and Environmental Services. Environmental Impact Assessment for the Mooi-Mgeni Transfer Scheme – Phase 2, KwaZulu-Natal Province, South Africa (2012)
• Coastal and Environmental Services. Environmental Impact Assessment for the proposed Kamiesberg Heavy Mineral mine in Namaqualand, Northern Cape Province (2014).

International:
• Environmental Impact Statement for a large scale copper mine in the North-Western Province of Zambia (2012).
• Environmental Impact Statement for a large scale nickel mine in the North-Western Province of Zambia (2014).
• Environmental and Social Impact Assessment for a heavy minerals mine in the Toliara Province, Madagascar (2014).

Specialist Work:
• Land and Natural Mineral Resources Assessment for a heavy minerals mine in the Toliara Province, Madagascar (2013).
• Land and Natural Mineral Resources Assessment graphite mine in Cabo Delgado Province, Mozambique (Ancuabe) (2016).
• Land and Natural Mineral Resources Assessment graphite mine in Cabo Delgado Province, Mozambique (Nicanda Hills) (2016).
• Land and Natural Mineral Resources Assessment heavy minerals mine in Nampula Province, Mozambique (2018).
• High Level GHG Assessment for Kenmare Moma Heavy Minerals Mine, Mozambique (2016).
• High Level GHG Assessment for Ranobe Heavy Minerals Mine, Madagascar (2017).
• Rehabilitation Strategy for a heavy minerals mine in Mozambique (2018).
• Estuarine Assessment for a heavy minerals mine in Nampula Province Mozambique (2018).

Resettlement Work:
• Team Leader for large land survey undertaken as part of the resettlement process for a heavy minerals mine in Mozambique.
• In-Kind Compensation Surveys for bulk infrastructure in Tanzania.
Water use Licence Applications:

- Chantel compiled the Water Use Licence Application for the Zirco Heavy Minerals Mine. The WULA consisted of the following water uses:
  - Section 21(a): Taking water from a water source (borehole);
  - Section 21(b): Storing water (Flood attenuation dam);
  - Section 21(c): Impeding or diverting the flow of water in a watercourse (pipeline and electrical servitude across the Groen River);
  - Section 21(e): Engaging in a controlled activity (irrigation of an on-site nursery with treated effluent);
  - Section 21(g): Disposing of waste in a manner which may detrimentally impact on a water resource (backfilling, brine disposal, dust suppression, run-off from HMC stockpiles, pollution control dam, process water dam, sewage infrastructure and tailings storage facility);
  - Section 21(i): Altering the bed, banks, course of characteristics of a watercourse (pipeline and electrical servitude across the Groen River).

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Chantel Bezuidenhout

Date: 05 March 2020