The Proposed Establishment of an Aquaculture Development Zone in Amatikulu, Kwazulu-Natal

ESTUARY IMPACT ASSESSMENT

Prepared for:

agriculture, forestry & fisheries
Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

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REVISIONS TRACKING TABLE

ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES

Coastal and Environmental Services

Report Title: DAFF aMatigulu Estuary Impact Assessment
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Name	Responsibility	Signature	Date
Amy Lindsay	Estuarine and Coastal Specialist		January 2019
Dr Robert Kyle	Draft Report Review		January 2019
Dr Alan Carter	Final Report Reviewer		January 2019

INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

On 7 April 2017, the Environmental Impact Assessment Regulations promulgated in terms of the National Environmental Management Act (Act no. 107 of 1998 as amended; NEMA) dated 8 December 2014 were amended. In terms of Appendix 6 of the Amended EIA Regulations (2017), a Specialist Report must contain all the information necessary for a proper understanding of the nature of issues identified, and must include–

A SPECIALIST REPORT PREPARED IN TERMS OF THE NEMA (ACT NO. 107 OF 1998) EIA REGULATIONS (2017) MUST CONTAIN -	SECTION OF THE REPORT THAT CONTAINS THE REQUIRED INFORMATION
(a) details of – *(i) the specialist who prepared the report; and* *(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;*	Section 1.1
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 1.2
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.3.7
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5.2
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 8
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 7
(g) and identification of any areas to be avoided, including buffers;	Section 7
(h) 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;	Section 7
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6.4
(k) any mitigation measures for inclusion into the EMPr;	Section 8
(l) any conditions for inclusion in the environmental authorisation;	Section 9.4
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8
(n) a reasoned opinion – *(iii) whether the proposed activity, activities or portions thereof should be authorised;* *(iA) regarding the acceptability of the proposed activity or activities* *(iv) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures should be included in the EMPr, and where applicable, the closure plan;*	Section 9
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	EIR
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	EIR
(q) any other information requested by the competent authority.	N/A

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THE PROJECT TEAM

1.1 Details of specialist

Amy Lindsay M.Sc

(Estuarine and Coastal Specialist)

Amy is a Senior Environmental Consultant who holds an MSc degree in Aquaculture (Stellenbosch University) and a BSc Honours degree in Zoology (University of Johannesburg). Her MSc project investigated the effects of probiotics on the physiological and biochemical development of hatchery-raised dusky kob (*Argyrosomus japonicus*) larvae. Her professional interests lie within coastal and marine ecology as well as the development of sustainable aquaculture in South Africa.

Dr Alan Carter

(Report Reviewer)

Alan has over 25 years of experience in both environmental science and financial accounting disciplines including with international accounting firms in South Africa and the USA. He holds a PhD in Plant Sciences and a BCom Honours degree in financial accounting. Alan is a member of a number of professional bodies including American Institute of Certified Public Accountants (CPA) and Institute of Waste Management South Africa (IWMSA). He is also certified as an Environmental Assessment Practitioner in South Africa (EAPSA) and as an ISO14001 EMS auditor with the American National Standards Institute. Areas of specialization include: impact assessment, coastal management, waste management, climate change and emissions inventories, aquaculture and environmental accounting and auditing. Alan is a registered scientist with SACNASP.

The CVs for each specialist are included in Appendix A.

1.2 Specialist Declaration

- I, Amy Lindsay, declare that, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014:
- 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 the specialist report relevant to this application, 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 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;
- All the particulars furnished by me in this report are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of Section 24F of the Act.

AMY LINDSAY — January 2019

Full Names — Date

- I, Alan Carter, declare that, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014:
- 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 the specialist report relevant to this application, 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 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;
- All the particulars furnished by me in this report are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of Section 24F of the Act.

Full Names — Date

1 INTRODUCTION

1.1 Background

An Environmental Impact Assessment (EIA) is currently underway for a proposed Aquaculture Development Zone (ADZ) to be located within the Estuarine Functional Zone (EFZ) of the aMatigulu estuary. Figure 1.1 indicates the locality of the ADZ and Figure 2.2 indicates the location of the ADZ within the EFZ.

Figure 1.1: Locality map of the aMatigulu-Nyoni estuary

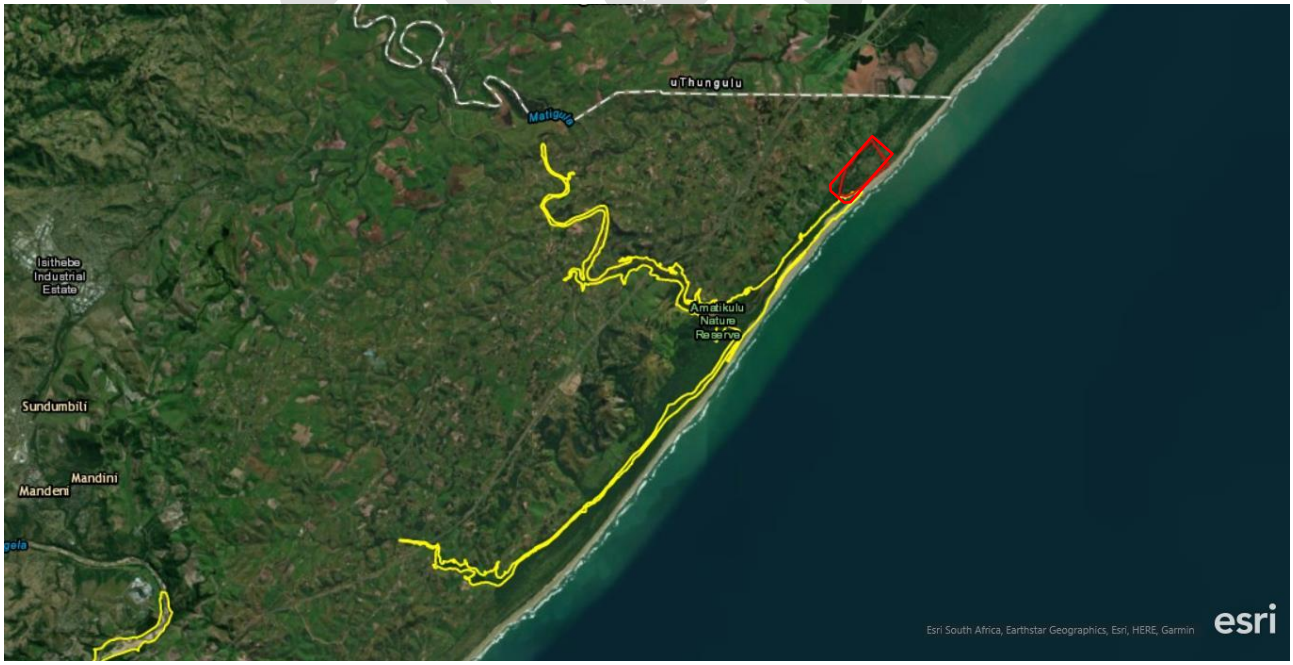

Figure 1.2: The location of the proposed ADZ (red) within the EFZ (yellow)

The proposed ADZ site is approximately 108.37 Ha in size and was previously utilized as an ornamental fish and aquatic plant farm, as well as a prawn farm. The majority of the existing infrastructure is in a state of disrepair. However, the following operations are currently being undertaken on site:

- Amatikulu Pet Products, which consists of an administrative building and a factory facility that manufactures pet products, as well as a pack house and storeroom.
- Amatikulu Aquarium Plants, which consists of a hatchery, workshop, and a number of tunnels and water supply infrastructure for ornamental fish and aquatic plants.
- A water treatment facility.

The proposed ADZ will include the establishment of aquaculture facilities that will be used for the farming of a range of species (Figure 3). The potential species to be culture at the proposed ADZ include:

- Dusky kob;
- Barramundi;
- Scallops;
- Sea cucumbers;
- marine and freshwater ornamental fish and ornamental plants;
- Tilapia;
- Catfish; and
- Nile crocodile.

Phase 1 will comprise the refurbishment of earthen ponds and tunnel-based tank systems that were historically used for prawn and ornamental fish culture (activities will include the installation of water supply for farming, a facility to grow fingerlings, construction of a feed store, other storage facilities and offices).

Phase 2 will entail the extension of the aquaculture facilities and the installation of civil infrastructure that will allow for the establishment of a range of production systems for a range of species. Infrastructure for the ADZ will include administration buildings, storage areas, fish processing and packaging facilities, access roads, electricity and water reticulation, sea water supply and discharge, pump stations, reservoirs and fencing.

It is anticipated that seawater will either be abstracted from the aMatigulu-Nyoni estuary or directly from the outside of the EFZ and that effluent generated from aquaculture activities (combined freshwater and marine) will either be discharged into the estuary or discharged out at sea. As a result, an Estuarine Impact Assessment is required to assess the implications of the activities on the functioning of the aMatigulu estuary.

1.2 Value of Estuaries in South Africa

The National Biodiversity Assessment (NBA, 2011) provides the following definition of an estuary:

"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 sea water 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 and Turpie (2012) described estuaries as valuable national assets that provide essential ecosystem services. These include, but are not limited to, the following:

- Inflow of freshwater and nutrients from rivers to the marine environment;
- Nursery habitats for marine fish and invertebrates;
- Regulation of greenhouse gasses and potential for carbon sequestration;
- A significant buffer against floods and storm surges;
- Recreation and tourism (recreational fishing, boating, bathing, sense of place, etc.);
- Natural resource utilisation (bait collection and subsistence fishing); and

- Unique and diverse habitats for microalgae (e.g. phytoplankton and benthic microalgae), macrophytes (e.g. mangroves, salt marshes, submerged macrophytes, reeds and sedges), benthic invertebrates (crustaceans, and molluscs) and vertebrates (fish, birds, mammals and reptiles).

2 PROJECT ALTERNATIVES

The project alternatives that will be considered for the estuary impact assessment will focus on the abstraction of sea water and the discharge of aquaculture-derived effluent. A detailed description of each of these alternatives is provided below.

2.1 Seawater abstraction

Two options are being proposed for the abstraction of sea water:

- Abstraction from the ocean; and
- Abstraction from the estuary.

The identification of two points is to provide flexibility and options to the developer. The final point of abstraction will have to be determined following the outcome of a feasibility study. Figure 2.1 indicates the location of the two proposed abstraction points associated with the ADZ.

Figure 2.1: A locality map indication the proposed abstraction alternatives

A preliminary sea water demand has been calculated for the operational phase of the proposed Amatikulu ADZ. Table 2.1 below indicated that anticipated seawater abstraction volumes.

Table 2.1: Preliminary sea water demand calculations

Amatikulu sea water aquaculture demand					
Description	Unit	Demand	Population	Kl/day	l/s
Sea water aquaculture	m^3/day	3000	1	3000	69.44
Average Annual Daily Demand (AADD)				3000	69.44
Water losses @ 10% daily				300	6.9
Subtotal (incl water losses)				3300	76.4
Seasonal Peak Factor				1	1
Daily Peak Factor				1	1
Subtotal (incl. Peak Factor)				3300	76.39
Instantaneous Peak				1	1

Amatikulu sea water aquaculture demand					
Description	Unit	Demand	Population	Kl/day	l/s
Total demand				3300	76.39

The total anticipated annual seawater demand for the operation of the Amatikulu ADZ is 1 204 500m^3.

2.2 Seawater discharge

Two options are being proposed for the discharge of effluent derived from aquaculture activities within the ADZ:

- Discharge into the ocean; and
- Discharge into the estuary.

For the sea water drainage from the marine aquaculture tunnels, a 355 mm diameter pipe of approximately 1345 m has been allowed for. The pipeline will run parallel to the marine tunnels and run to the sea water treatment works located in the west of the site.

A 500 m length pipeline has been allowed for from the treatment facility to the ocean. A separate facility for fresh water and seawater effluent treatment was allowed for, although the proposal is for both facilities to discharge in one pipe into the sea or estuary. Figure 2.2 indicates the location of the two proposed discharge points associated with the ADZ.

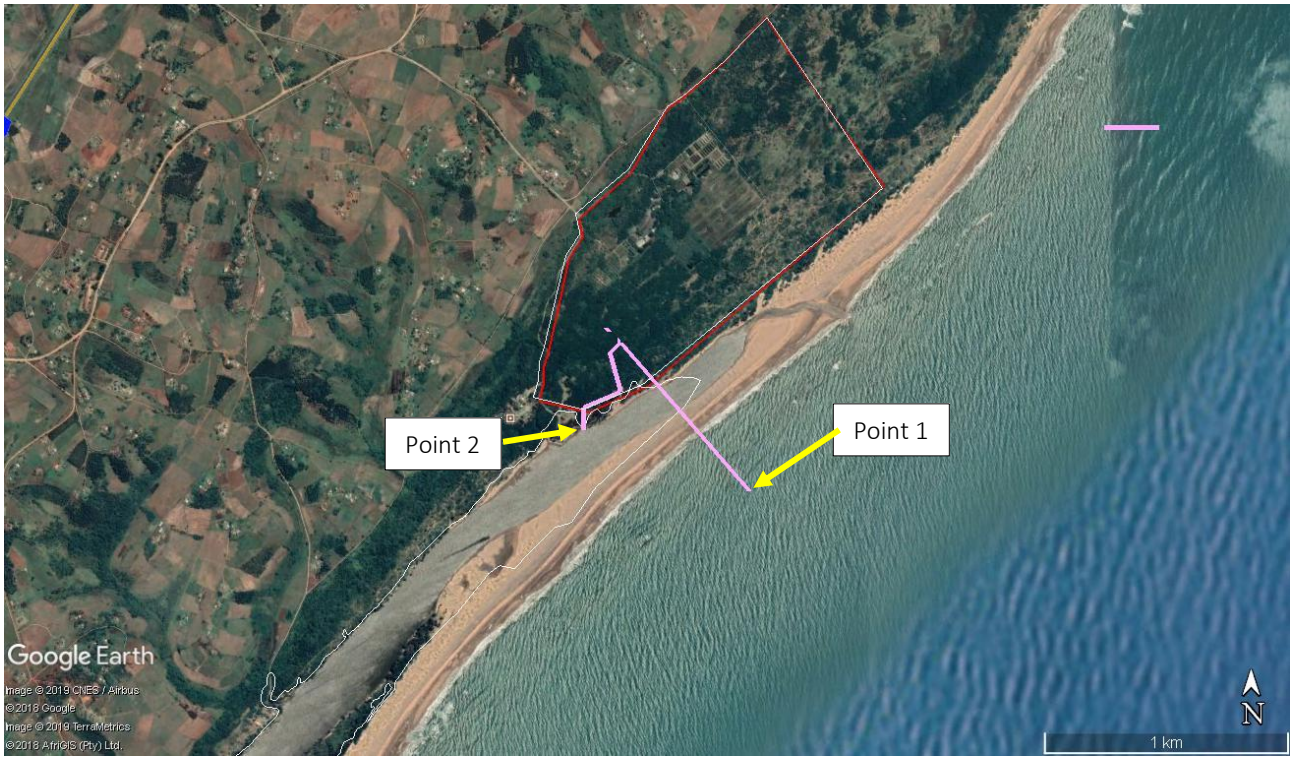

Figure 2.2: A locality map indication the proposed discharge alternatives

Preliminary calculations were done to determine the quantity of both the freshwater and sea water effluent generated. Based on the small flows generated, it is proposed that a drum screen and bio filter combination be used to treat the effluent before it is discharged. Table 2.2 and 2.3 provides the anticipated discharge volumes for freshwater and sea water respectively.

Table 2.2: Preliminary freshwater aquaculture effluent demand calculations

Amatikulu freshwater aquaculture effluent					
Description	Unit	Demand	Population	Kl/day	l/s

Freshwater aquaculture effluent	m^3/day	2400	1	2400	55.56
Average Dry Weather Flow (ADWF)				2400	55.56
Peak factor				1	1.0
Peak Dry Weather Flow (PDWF)				2400	55.6
15% Allowance for Extraneous Flow				276	8.33
Peak Wet Weather Flow (PWWF)				2676	63.9

Table 2.3: Preliminary sea water effluent calculations

Amatikulu sea water aquaculture effluent					
Description	**Unit**	**Demand**	**Population**	**Kl/day**	**l/s**
Sea water aquaculture effluent	m^3/day	2400	1	2400	55.56
Average Dry Weather Flow (ADWF)				2400	55.56
Peak factor				1	1.0
Peak Dry Weather Flow (PDWF)				2400	55.6
15% Allowance for Extraneous Flow				276	8.33
Peak Wet Weather Flow (PWWF)				2676	63.9

The total annual anticipated effluent discharge volumes are 1 953 480m^3 for freshwater and sea water combined.

3 KEY LEGISLATION

A number of key pieces of legislation govern the marine and coastal environment in South Africa. Table 3.1 below describes the relevant legislation pertaining to the aMatigulu-Nyoni estuary.

Table 3.1: Relevant estuarine and coastal legislation

LEGISLATION	DESCRIPTION
National Environmental Management: Integrated Coastal Management Act (ICMA; Act No. 24 of 2008, as amended in 2014)	The ICMA is the key legislative framework that regulates the use of coastal and estuarine resources in South Africa. This is done in order to protect and conserve coastal and estuarine resources while facilitating sustainable and responsible development in coastal and estuarine areas.
National Environmental Management: Biodiversity Act (NEMBA; Act No. 10 of 2004)	The objectives of the NEMBA include the following: • Management and conservation of biological diversity • Use of biological resource in a sustainable manner; • Equitable sharing of benefits arising from bio-prospecting; and • Cooperative governance in biodiversity management and conservation. NEMBA requires that the State must manage, conserve and sustain South Africa's biodiversity and its components and genetic resources, and must implement this Act to achieve the progressive realization of those rights.
National Environmental Management: Protected Area Act (NEMPAA; Act No. 57 of 2003)	NEMPAA aims to protect and conserve the ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.
Marine Living Resource Act (MLRA; Act No. 18 of 1998, as amended in 2000)	The purpose of the MRLA is to provide for the conservation of marine ecosystems, the long-term sustainable utilisation of marine living resources and the orderly access to the exploitation, utilisation and protection of certain marine living resources. It also allows for the provision for the exercise of control over marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa.
Local Government Municipal Systems Act (Act No. 32 of 2000)	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 that each local authority adopts a single, inclusive plan for the development of the municipality and aligns its resources and capacity with the implementation of the plan.
Mandeni Local Municipality IDP	The Mandeni Municipality has identified certain strategic objectives to address challenges which include promoting and facilitating development and investment along the coast in a harmonized and sustainable manner both environmentally, economically and socially. The agricultural sector has been identified as one of the four (4) drivers for economic growth in the KZN province. In Mandeni Municipality, the agricultural sector is dominated by sugar cane farming and forestry, however, the municipality is investigating aquaculture farming in the Dokodweni area.
iLembe District Municipality Biodiversity Sector Plan, as part of the iLembe IDP 2017 - 2022	The Biodiversity Sector Plan for the iLembe District Municipality is a precursor to the Bioregional Plan, with the main objectives being to identify and map critical biodiversity assets in the area, provide associated management guidelines, ensure that aquatic and terrestrial biodiversity targets are met and to conserve the ecological and evolutionary processes that allow biodiversity to persist over time. The key purpose of this BSP is to assist and guide land use planners and managers within the iLembe District and its respective local municipalities, to account for biodiversity conservation priorities in all land use planning and management decisions, thereby promoting sustainable development and the protection of biodiversity, and in turn the protection of ecological infrastructure and associated ecosystem services.
Mandeni Coastal Management Plan	The aim of the Mandeni municipal CMP is to achieve the ICM objectives in the coastal area under municipal jurisdiction, part of which means ensuring consistency with national and provincial objectives. The Mandeni CMP has

	established mechanisms for the comprehensive participation of representatives from all sectors of coastal communities, as well as providing management tools to empower decision-makers to manage and utilise the coast. In addition, the Mandeni CMP provides input into local planning initiatives, such as Integrated Development Plans and Spatial Development Frameworks of the Mandeni Municipality through the associated coastal Development Management Tool.
KwaZulu Natal Coastal Management Programme (draft of May 2017)	The Provincial Coastal Management Programme is a provincial policy directive for the management of the coast through an integrated, coordinated, uniform approach, and includes strategies and plans for the effective implementation of the Integrated Coastal Management Act (24 of 2008). The KwaZulu Natal Coastal Management Programme, which is currently is draft format, aims to provide direction for coastal management in KwaZulu Natal over a five year period and sets out goals and objectives for the achievement of integrated coastal management in the Province.
Integrated Management Plan: Amatikulu Nature Reserve	The Integrated Management Plan (IMP) for Amatikulu Nature Reserve (ANR) is the primary and overarching management document for the nature Reserve for the period 2009-2013. It forms the framework within which the Nature Reserve will be managed and developed towards the achievement of its management objectives. The principles underlying the IMP for the ANR are based on general principles guiding the attainment of sustainability – protecting biodiversity; sound resource management; equitable and appropriate community involvement and beneficiation; the creation of viable and sustainable business opportunities; and clear policies, objectives and operational guidelines.

4 TERMS OF REFERENCE

4.1 Terms of Reference

The Terms of Reference for the Estuary Assessment are as follows:

- Conduct a literature review and desktop assessment of the aMatigulu-Nyoni estuary;
- Provide a physical description of the aMatigulu-Nyoni estuary;
- Conduct a site visit for the ground-truthing of the desktop assessment;
- identify unique and threatened species and sensitive areas;
- Provide a description of the flora and fauna of the aMatigulu-Nyoni estuary;
- Identify and assess the potential impacts related to the proposed ADZ and associated viability of water abstraction and discharge into the aMatigulu-Nyoni estuary; and
- Prescribe mitigation methods (if abstraction and discharge considered viable) to safeguard the estuary as well as a monitoring programme and indicators for the project life cycle; and related alternatives.

5 METHODOLOGY

5.1 Desktop Assessment

A literature review and desktop assessment of the aMatigulu estuary was conducted using information published in the scientific literature and local reports. The information available for the aMatigulu-Nyoni estuary was limited. The following were the primary sources of information:

- Department of Water & Sanitation (DWS). 2015. Resource Directed Measures: Reserve determination study of selected surface water and groundwater resources in the Usutu/Mhlathuze Water Management Area. Amatikulu-Nyoni Estuary Rapid Environmental Water Requirements Determination. Report produced by CRUZ Environmental. Department of Water and Sanitation, South Africa. (2014). Feasibility Study for the Mzimvubu Water Project Reserve Determination: Volume 2: Estuary. 98pp.
- Van Niekerk, L and Turpie, JK. (2012). South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific Research, Stellenbosch.
- Whitfield, A. (1992). A characterisation of Southern African estuarine systems. South African Journal of Aquatic Science. 18:89-103.

5.2 Site investigation

A site investigation was conducted on the 10th of January 2019. The site investigation aimed to ground truth the desktop information as far as possible. The following was conducted as part of the site investigation:

- Visual assessment of the state of the estuary mouth;
- Visual assessment of the general characteristic of the sites where proposed abstraction and discharge will potentially take place;
- Opportunistic sightings of fauna and flora around the estuary; and
- Identification of current threats to the estuary.

It is important to note that no sampling took place during the site investigation.

The estuary mouth was closed on the day the site assessment took place and the site assessment took place during the summer season.

5.3 Impact assessment

5.3.1 Impact rating methodology

CES has used a standard rating scale to assess and quantify the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. Seven factors were considered when assessing the significance of impacts, namely:

- Relationship of the impact to **temporal scales** - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

- Relationship of the impact to **spatial scales** - the spatial scale defines the physical extent of the impact.

- The severity of the impact - the **severity/beneficial scale** is used to evaluate how severe negative impacts would be, or how beneficial positive impacts would be on an affected system (for ecological impacts) or party.

- The severity of impacts can be evaluated with and without **mitigation** to demonstrate how serious the

impact could be if nothing is done about it. The word 'mitigation' means not just 'compensation', but also containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

- The likelihood of the impact occurring - the likelihood of impacts taking place differs between impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

- Each criterion is ranked with score as presented in Table 4.1 to determine the overall significance of an activity. The criterion is considered in two categories, viz. impact of the activity and likelihood of the impact. The total scores recorded for the impact and likelihood are then read off the matrix presented in Table 4.2 to determine the overall significance of the impact. The overall significance is either negative or positive.

- The significance scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of a social nature need to reflect the values of the affected society.

6.3.1.1. Cumulative Impacts

Cumulative impacts affect the significance ranking of an impact because the impact is taken in consideration of both onsite and offsite sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both onsite and offsite pollution activities take place simultaneously, the total pollution level may exceed the standards. For this reason it is important to consider impacts in terms of their cumulative nature.

6.3.1.2. Seasonality

Although seasonality is not considered in the ranking of the significance, it may influence the evaluation during various times of the year. As seasonality will only influence certain impacts, it will only be considered for these, with management measures being imposed accordingly (i.e. dust suppression measures being implemented during the dry season).

Table 5.1: Significance Rating

Temporal Scale (The duration of the impact)	
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 (The area in which any impact will have an effect)	
Individual	Impacts affect an individual.

Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
Project Level	Impacts affect the entire project area.
Surrounding Areas	Impacts affect the area surrounding the development
Municipal	Impacts affect either the Local Municipality, or any towns within them.
Regional	Impacts affect the wider district municipality or the province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
Degree of Certainty (The level of confidence to predict the significance of an impact)	
Definite	More than 90% confident of a prediction outcome based on substantial supportive data.
Probable	Over 70% confident of a prediction outcome, or of the likelihood of that impact occurring.
Possible	Only over 40% confident of a prediction outcome, or of the likelihood of an impact occurring.
Unsure	Less than 40% confident of a prediction outcome, or of the likelihood of an impact occurring.

Table 5.2: Impact Severity Rating.

Overall Significance **(The combination of all the above criteria as an overall significance)**	
VERY HIGH NEGATIVE	VERY BENEFICIAL
These impacts would be considered by society as constituting a major and usually permanent change to the natural and/or social environment that results in **severe** or **very severe** negative effects, or **very beneficial** positive effects. **Example:** The loss of a species would be viewed by informed society as being of VERY HIGH negative significance. **Example:** The establishment of infrastructure in a rural area, which previously had few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH positive significance.	
HIGH NEGATIVE	BENEFICIAL
These impacts are likely to have long term effects on the social and/or natural environment. Impacts rated as HIGH should be considered by society as constituting an important and usually long term change and if highly negative should be viewed in a serious light. **Example:** The loss of a diverse vegetation type that is fairly common elsewhere would have a significance rating of HIGH in the long term, as the area could be rehabilitated. **Example:** The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops) would be HIGH (negative).	
MODERATE NEGATIVE	SOME BENEFITS
These impacts are likely to result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE should be considered by society as constituting a fairly important and usually medium term change. These impacts are not substantial. **Example:** The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.	
LOW NEGATIVE	FEW BENEFITS

These impacts are likely to result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW should be considered by the public and/or specialist scientist as constituting an unimportant and usually short term change. These impacts are not substantial and are likely to have little effect. **Example:** The temporary changes in the water table of a wetland habitat may be considered LOW NEGATIVE because these systems are adapted to fluctuating water levels. **Example:** The increased earning potential of people employed as a result of a development would result in benefits of LOW significance to people who live some distance away.
NO SIGNIFICANCE
There are no primary or secondary effects that are important to scientists or the public. **Example:** A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.
DON'T KNOW
In certain cases it may not be possible to determine the significance of an impact because of the absence of data or limited data. **Example:** The effect of a development on people's psychological perspective on the environment.

5.4 Assumptions and limitations

This report is based on currently available published information and, as a result, the following limitations and assumptions are implicit–

- The data analysed is based on a single site visit that occurred on the 10th of January 2019. Seasonal trends are not assessed.
- Detailed water quality analyses were not conducted. Water quality data was drawn from resources that are publically available from DWS; and
- No sampling was undertaken (e.g. water, fish, invertebrates, macrophytes, etc.)
- The assessment is based on the assumption that the temporarily open/closed state of the estuary mouth will remain throughout the life of the proposed ADZ.

These limitations result in the outcomes of the assessment being based on the best available desktop data. Recommendations for the monitoring of various parameters will be made in the Recommendations section of the report.

6 DESCRIPTION OF THE ENVIRONMENT

This chapter describes the nature, extent and significance of the aMatigulu/Nyoni estuarine resources and functions with regards to the proposed ADZ alternatives. The Chapter has been produced using available desktop and historical information as well as observations made during a site visit conducted on the 10th of January 2018. During this time, the mouth of the aMatigulu/Nyoni estuary was closed.

6.1 Physical and chemical characteristics

6.1.1 Locality and boundaries

The boundaries of an estuary are determined by a number of factors. The upper limits are determined by the limits of tidal variation or salinity penetration, which ever penetrated further. The boundaries can also be determined by the vegetation types found along the banks, where predominantly estuarine vegetation prevails. For the purposes of this report, the boundaries for each estuary was sourced from the 2011 National Biodiversity Assessment (Van Niekerk & Turpie, 2012), which delineated the 5 m elevation contour as the estuary boundary.

The mouth of the aMatigulu estuary is approximately 100 km north east of Durban and 56 km south of Richards Bay. However, the estuarine system comprises of two separate estuaries that join at the mouth. The adjoining estuary is the Nyoni estuary. The combined estuary mouth closes from time to time and is classified as a “temporarily open/closed” estuary. For the purposes of this Estuary Impact Assessment, the geographical boundaries of the aMatigulu-Nyoni estuary are as follows:

Downstream boundary:	29° 4'59.38"S 31°38'40.43"E (but can move to 29° 6'44.54"S 31°37'5.89"E)
Upstream boundary:	aMatigulu arm: 29° 4'1.12"S 31°33'20.90"E
	Nyoni Arm: 29° 8'1.17"S 31°35'45.33"E
Lateral boundaries:	5 m contour above Mean Sea Level (MSL) along each bank

Figure 6.1 indicates the boundaries of the Estuarine Function Zone (EFZ) of the aMatigulu-Nyoni estuary as defined in the National Biodiversity Assessment (NBA, 2011).

Figure 6.1: The Estuarine Functional Zone of the aMatigulu/Nyoni estuary demarcated in yellow

6.1.2 Hydrology

The aMatigulu-Nyoni estuaries falls within the W11C quaternary catchment. The Amatikulu catchment is estimated at 850 to 900 km^2. The aMatigulu river is about 100 km in length while the Nyoni catchment is estimated at 114 km^2 with a river length of about 25 km. The natural Mean Annual Run-off (MAR) has been stated as being 192.27 Million m^3 (DWS, 2016).

The Environmental Water Requirement (EWR) study for the aMatiugulu-Nyoni estuary was finalised in 2016. According to the hydrological data provided for the EWR study, the present day MAR into the aMatigulu-Nyoni estuary is 178.03 Million m^3. This is a decrease of 7% compared to the natural MAR of 192.27 Million m^3. For the purposes of the EWR assessment, the estuary was divided into four zones, as indicated in Figure 6.2. These zones were assessed individually. The proposed ADZ falls within Zone A.

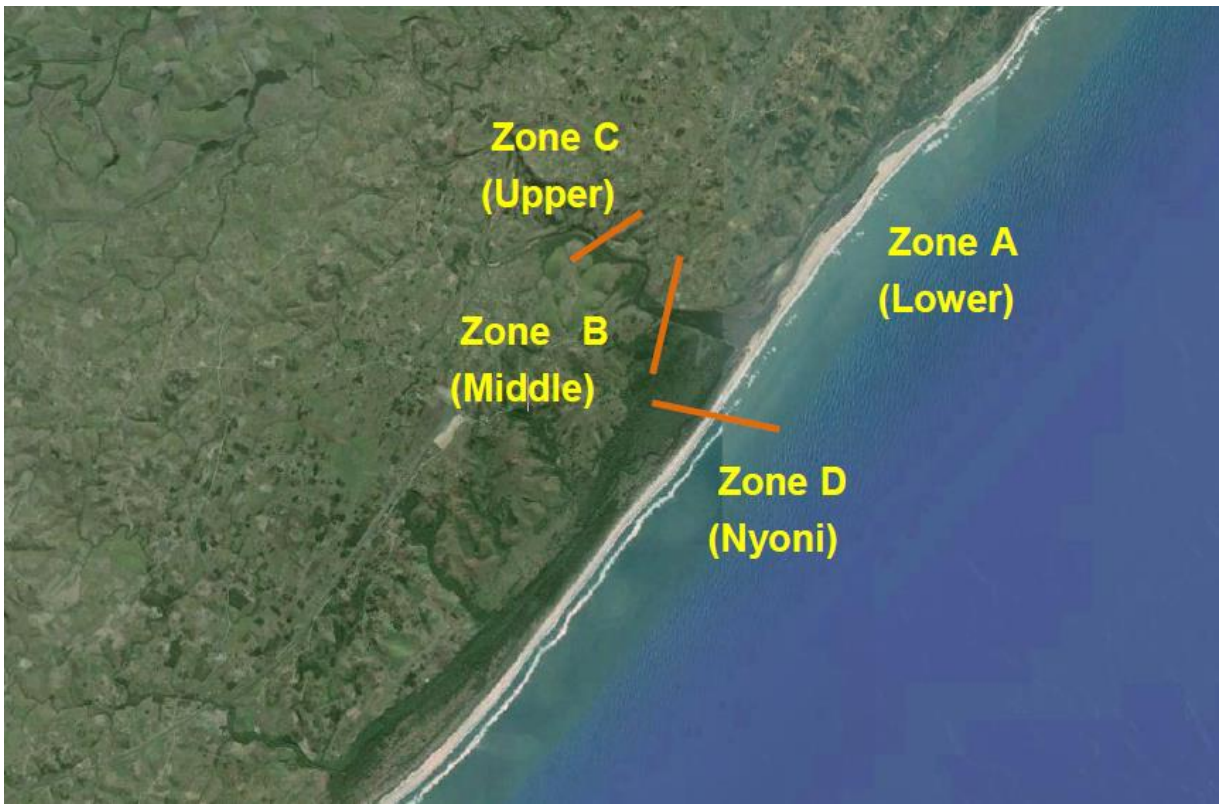

Figure 6.2: The zonation of the aMatugulu-Nyoni estuary for the EWR assessment (2016)

In the EWR rapid desktop assessment, three flow scenarios were assessed. A summary of these scenarios is provided in Table 6.1 below.

Table 6.1: A summary of the flow scenarios assessed in the EWR study

Scenario	Description	MAR (x 10^6m^3)	% Remaining
Reference	Natural flow	192.27	100
Present	Present condition	178.03	93
Scenario 1	An additional 10% reduction in MAR (baseflow abstraction)	160.73	84
Scenario 2	An additional 20% reduction in MAR (baseflow abstraction)	146.65	76
Scenario 3	An additional 30% reduction in MAR (with dam)	126.87	66

By understanding the effects that the various flow scenarios have on the estuary, the impact of the abstraction and discharge of effluent into the estuary can be better understood in terms of how the water chemistry, species composition and physical nature of the estuary is influenced. The volumes of water that are being proposed to be abstracted from the estuary amount to 0.6% of the present condition. While this does not appear to be significant, there will likely be localised impacts on the water chemistry and, as a

result, faunal and flora species composition.

6.1.3 Mouth dynamics

The aMatigulu-Nyoni estuary mouth is highly dynamic with significant variation in the open/closed state and location of the estuary mouth.

The natural situation regarding the aMatigulu-Nyoni estuary is that the aMatigulu and Nyoni estuaries are often joined. When they are joined, they function as one estuary and the mouth position lies to the north of their confluence. When separated, they function as completely independent estuaries. The separation of these two estuaries appears to always be driven by extreme flood events, which do not seem to occur on a regular basis. When these conditions occur, the breaching of the mouth takes place in a southerly position near the confluence of the two systems. Once the flood conditions recede, the Nyoni estuary may become separated from the aMatigulu estuary as has happened in the past.

Ezemvelo KZN Wildlife conducted weekly mouth observation assessments and the available databased indicates that the aMatigulu-Nyoni Estuary was open for about 84% of the time during the period 1993 to 2013 (DWS, 2016). The record also shows that the system is closed for weeks at a time. Figures 6.3 to 6.14 illustrate the variability of the estuary mouth from 1937 until 2018.

The EWR study also assessed three states that the estuary experiences. These are described in Table 6.2 below.

Table 6.1 a summary of the abiotic states that can occur in the aMatigulu-Nyoni estuary

State	Flow range (m3/s)	Description
State 1: Closed	<0.75	The estuary mouth is closed for days to weeks. Zones A, B, and C are well mixed and salinity is brackish throughout. Zones A, B and D have salinity of about 15 (Lower), 5 (Middle) and 5 (Nyoni) respectively, Zone C (Upper) is nearly fresh with some backflooding of estuarine water into the riverine section.
State 2: Open, tidal	0.75 – 10.0	The system shows a marine influence due to reduced freshwater inflow and open mouth state. Zones A (Lower), B (Middle) and C (Upper) have salinity of about 25, 10 and 0 respectively, Zone D is 5.
State 3: Open, freshwater dominated	>10	All zones are fresh, with some tidal pumping on high tides into Zone A (Lower).

The various states that the estuary experiences will impact the quality of the water being abstracted for aquaculture purposes. The salinity can range from being fresh, when the mouth is open with freshwater dominating, to being brackish. This will impact the feasibility of farming marine dominated species in the ADZ.

It is important to highlight the dynamic nature of the estuary mouth with regards to the impact that abstracting and discharging water into the estuary will have on the mouth conditions and water quality of the estuary. Abstraction from the estuary may result in extended periods of mouth closure, which has an impact on the water chemistry as well as an impact on the distribution of vegetation species as brackish water intrudes further into the freshwater zones.

Conversely, the mouth state of the estuary will also affect the abstraction potential for the ADZ (i.e. open mouth conditions result in a drop in water level, therefore exposing the abstraction pipeline and reducing the availability of sea water). Therefore, it may be difficult to select a suitable site for the abstraction of water that provides a reliable volume with the least amount of sedimentation around the abstraction point.

Figure 6.3.: Historical image of the aMatigulu-Nyoni estuary in 1937 (DWS, 2016)

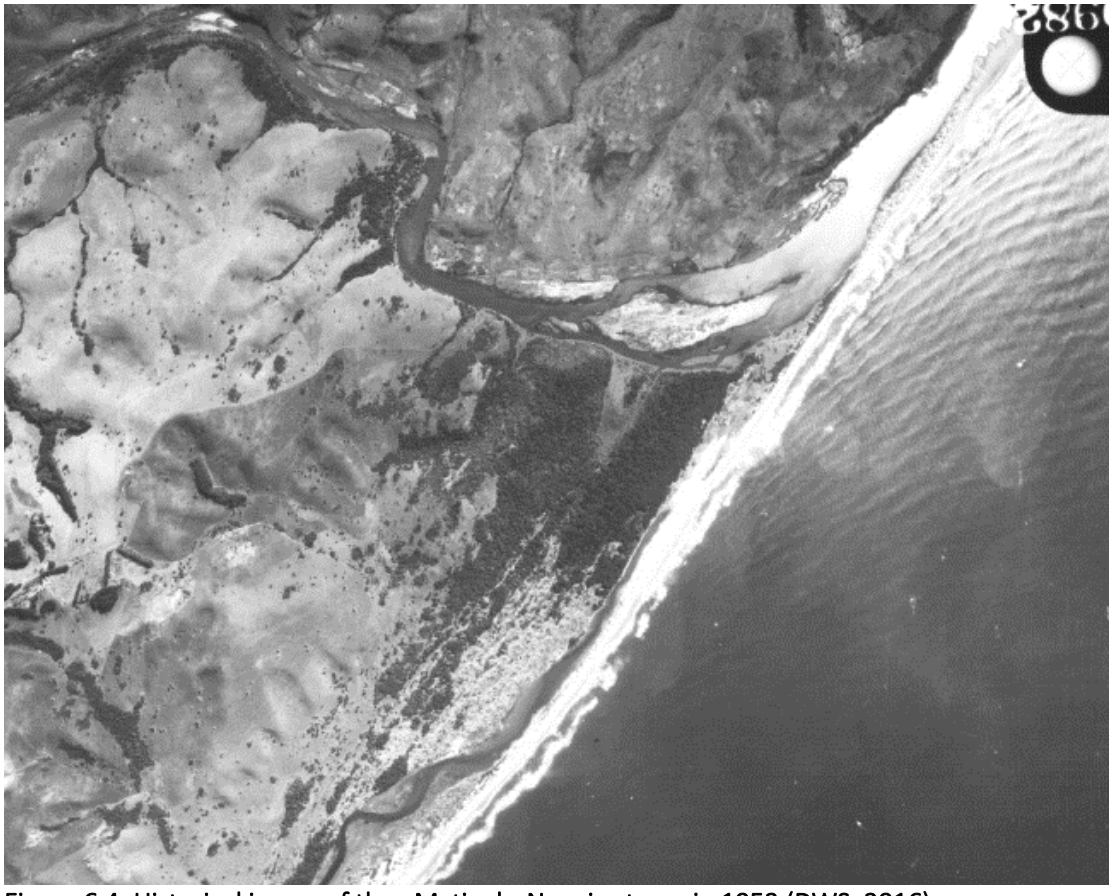

Figure 6.4: Historical image of the aMatigulu-Nyoni estuary in 1953 (DWS, 2016)

Figure 6.5: Historical image of the aMatigulu-Nyoni estuary in 1964 (DWS, 2016)

Figure 6.6: Satellite image of the aMatigulu-Nyoni estuary in February 2006 (Google Earth)

Figure 6.7: Satellite image of the aMatigulu-Nyoni estuary in February 2012 (Google Earth)

Figure 6.8: Satellite image of the aMatigulu-Nyoni estuary in May 2015 (Google Earth)

Figure 6.9: Satellite image of the aMatigulu-Nyoni estuary in February 2016 (Google Earth)

Figure 6.10: Satellite image of the aMatigulu-Nyoni estuary in February 2017 (Google Earth)

Figure 6.11: Satellite image of the aMatigulu-Nyoni estuary in March 2017 (Google Earth)

Figure 6.12: Satellite image of the aMatigulu-Nyoni estuary in November 2017 (Google Earth)

Figure 6.13: Satellite image of the aMatigulu-Nyoni estuary in May 2018 (Google Earth)

Figure 6.14: Satellite image of the aMatigulu-Nyoni estuary in October 2018 (Google Earth)

6.1.4 Water Quality

During the site visit, no water quality samples were collected from the estuary. The description of the water quality is based on available information.

6.2 Biological characteristics

The current biological characteristics of the aMatigulu-Nyoni estuary are discussed in this section.

6.2.1 Vegetation and habitat types

The aMatigulu-Nyoni estuary has high diversity in macrophytes. Below the confluence of the two estuaries the system is typically estuarine when the mouth is open where it is tidal with a strong exchange of seawater. However, when the mouth is closed, the water level can rise significantly. Under closed mouth conditions, higher salinity seawater intrudes into the *Barringtonia racemosa* swamp forests that are found along the Nyoni Estuary (Zone D). The salt water intrusion also inundates the reedbeds, saline lawns and other floodplain areas of the aMatigulu estuary.

The vegetation and habitat types of the aMatigulu and the Nyoni estuaries are very different from each other. The Nyoni estuary is mildly affected by changes in salinity. Howvere, when the mouth closes, the water level does rise which results in backflooding into the Barringtonia swamps. It is likely that the denser saline water from the aMatigulu estuary penetrates the Nyoni estuary as bottom water. This stratification is likely to remain intact as the narrow, tree-lined Nyoni estuary is protected from wind, and hence from wind-induced stirring. Most of the macrophytes along the banks of the aMatigulu-Nyoni estuary (with the exception of the submerged ones) have surface roots in the upper layer of freshwater. Therefore they are only periodically exposed to high saline water.

Figure 6.15 and Table 6.2 provides a summary of the habitat types that were mapped out as part the EWR study that was finalised in 2016. This map was ground truthed as far as possible during the site visit and no major deviations from the map produced for the EWR study were observed.

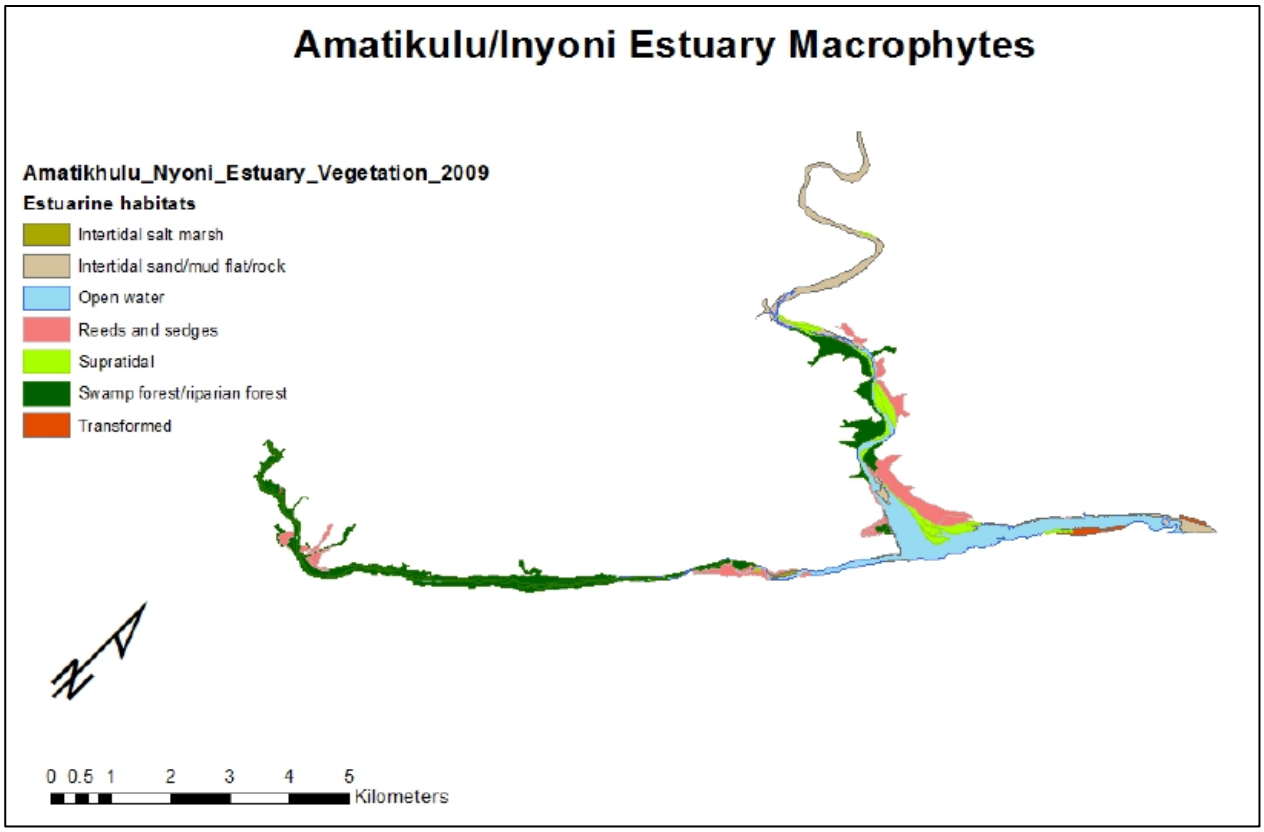

Figure 6.15: The vegetation map of the aMatigulu-Nyoni estuary that was developed for the ERW study (2016)

Table 6.2: Macrophyte habitats and functional groups recorded in the estuary as part of the EWR study (2016)

Habitat type	Description	Area (hectares)
Open surface water area	Habitat available for phytoplankton and submerged macrophytes In some place there are the floating plants *Echinochloa* & *Eichhornia*.	241.3

Intertidal sand and mudflats	Includes small areas of rock	88.1
Salt marsh	Includes intertidal salt marsh (representative species = *Triglochin striata*) and supratidal salt marsh (representative species include *Sporobolus virginicus, Paspalum vaginatum, Canavalia rosea*)	52.2
Swamp forest	*Barringtonia racemosa, Hibiscus tiliaceus, Derris trifoliata*	195.5
Reeds and sedges	*Phragmites australis, Schoenoplectus scirpioides*	99.0
Zostera and other submerged macrophytes	*Zostera capensis, Ruppia cirrhosa, Stuckenia pectinata, Ceratophyllum demersum*	Unknown

The submerged macrophytes (particularly *Ruppia* and *Zostera*) are dependent on extended period of mouth open conditions. The salt marshes (including saline lawns of *Paspalum vaginatum* and *Sporobolus virginicus*) and the reedbeds respond to being flooded, particularly through back-flooding when the estuary water rises after the mouth closes. As long as mouth closure conditions are not excessively prolonged, this is likely to increase productivity (in Zone B, and to a lesser extent Zone A) (DWS, 2016).

In terms of the importance of the presence of *Zostera capensis* beds in the aMatigulu-Nyoni estuary, *Zostera* play an important ecological role stabilizing sediment, preventing erosion, reducing water flow, trapping nutrients and organic materials and providing sheltered habitat for fish and invertebrates. *Zostera* beds also serve as a substrate for epiphytes and periphyton, which is a food source for a variety of other organisms. Due to these ecological services that Zostera provides to coastal zone, it is considered to be among the most productive and valuable ecosystems on Earth (Adams, 2016).

Zostera capensis is listed as vulnerable in the Red Data List of Species (IUCN, 2010; Short et al., 2010). Because it is a keystone species within the coastal environment the loss of seagrass can have significant cascading effects on higher trophic levels and ecosystem functioning (Adams, 2016).

Figure 6.16 provides an indication of the locations where submerged macrophyte beds that have previously been found in relation the location of the ADZ (DWS, 2016). However, during the site assessment no obvious signs of the presence of any *Zostera capensis* beds were noted close to the estuary mouth despite these beds being observed during site investigations during 2013 for the purposes of the EWR study. However, the distribution of *Zostera capensis* in known to be highly dynamic within an estuary (Adams, 2016) and any direct impacts to the estuary as a result of the ADZ will require that the presence or absence of *Zostera capensis* be monitored.

Figure 6.15: An indication of the locations where submerged macrophytes have been recorded (in green)

A species list of the macrophytes observed in the aMatigulu-Nyoni estuary is provided in Appendix A.

6.2.2 Fauna

Mammals and reptiles

The Animal Demography Unit (2019) created a Virtual Museum of African Mammals. Table 6.3 lists nine mammals that could potentially be found within the areas surrounding each of the three estuaries (Grid square 2931BA). The Southern African Reptile Conservation Assessment (SARCA, 2014) identified 5 reptile species that occur within this area. These are listed in Table 6.4.

Table 6.3: Mammals that could potentially occur within the area surrounding the aMatigulu-Nyoni estuary (Animal Demography Unit, 2019)

Family	Genus	Species	Common Name	Red List Category
Bovidae	*Aepyceros*	*melampus*	Impala	Least concern
Bovidae	*Cephalophus*	*natalensis*	Red duiker	Near threatened
Bovidae	*Philantomba*	*monticola*	Blue duiker	Vulnerable
Bovidae	*Redunca*	*arundinum*	Southern reedbuck	Least concern
Bovidae	*Sylvicapra*	*grimmia*	Bush duiker	Least concern
Bovidae	*Tragelaphus*	*scriptus*	Bushbuck	Least concern
Bovidae	*Tragelaphus*	*strepsiceros*	Greater kudu	Least concern
Cercopithecidae	*Crocidura*	*cyanea*	Reddish-grey musk shrew	Least concern
Cercopithecidae	*Chlorocebus*	*pygerythrus*	Vervet monkey	Least concern
Equidae	*Equus*	*quagga*	Plains zebra	Least concern
Felidae	*Leptailurus*	*serval*	Serval	Near threatened
Galagidae	*Galago*	*moholi*	Mohol bushbaby	Least concern
Giraffidae	*Giraffa*	*camelopardalis camelopardalis*	Nubian giraffe	Least concern
Herpestidae	*Herpestes*	*sanguineus*	Slender mongoose	Least concern
Muridae	*Rattus*	*norvegicus*	Brown Rat	Least concern
Mustelidae	*Aonyx*	*capensis*	African clawless otter	Near threatened
Suidae	*Potamochoerus*	*porcus*	Red river hog	Least concern

Table 6.4: Reptiles that could potentially occur within the study site (SARCA, 2014)

Family	Genus	Species	Common name	Red List Category
Colubridae	Philothamnus	natalensis	Eastern Natal Green Snake	Endangered
Elapidae	Naja	subfulva	Brown Forest Cobra	Least concern
Gekkonidae	Hemidactylus	mabouia	Common tropical house gecko	Least concern
Lamprophiidae	Duberria	lutrix lutrix	South African Slug-eater	Least concern
Scincidae	striata	striata	Striped Skink	Least concern

These lists are not comprehensive and no mammal or reptile species were observed during the site assessment.

Fish

CRUZ Enviornmental undertook a fish sampling exercise as part of the ERW study for the aMatigulu-Nyoni estuary. During the study, a total of 65 fish species were recorded. The species list is attached in Appendix A. The icthyofauna that utilise the estuary can be divided into five categories based on their life cycle traits (Whitfield, 1984 & 1998). These categories are as follows:

I - Estuarine species which breed in estuaries
II - Euryhaline marine species which breed at sea but with juveniles that show varying degrees of dependence on estuaries
III - Marine species which occur in estuaries in small numbers but are not dependent on these systems
IV - Euryhaline freshwater species. Includes some species which may breed in both freshwater and estuarine environments
V - Obligate catadromous species which use estuaries as transit routes between the marine and freshwater environments:

The results of the sampling exercise are presented in Table 6.5 below.

Table 6.5: the results of the fish sampling exercise undertaken by CRUZ Environmental in 2013

Category	Number of fish species	Percentage	Typical/dominant species
I	11	17	*Ambassis ambassis* *Eleotris fusca* *Ambassis natalensis* *Glossogobius callidus*
II	39	60	*Acanthopagrus vagus* *Liza macrolepis* *Caranx sexfasciatus* *Gerres methuenei* *Platycephalus indicus* *Solea bleekeri*
III	11	17	*Amblyrhynchotes honckenii* *Epinephalus malabaricus*
IV	2	3	*Oreochromis mossambicus* *Glossogobius giuris*
V	2	2	*Anguilla mossambica* *Myxus capensis*

Table 5.9 indicates that the dominant group are the euryhaline marine species which breed at sea with their juveniles showing varying degrees of dependence on estuaries. They made up 60% of the species recorded. Estuarine species (17%) and marine species not dependent on estuaries (17%) made up the top three groups. The dominance of the former group, in terms of frequency of occurrence, number of species and relative abundance, indicates the importance of this estuary as a nursery habitat for these marine species.

Changes in water chemistry as well as the physical state of the estuary as a result of the abstraction of water and/or discharge of effluent into the estuary may impact on the diversity and distribution of fish species that utilise the estuary.

Birds

The Southern African Bird Atlas Project 2 (SABAP2, 2017) and the surveys that were conducted by CRUZ Environmental in 2013 were used to generate a species list of birds that occur in the area surrounding the aMatigulu-Nyoni estuary (Grid square 2931BA). During the fieldwork conducted by CRUZ Environmental in 2013, 34 bird species were observed. The full species list of birds that occur in the vicinity of the estuary has been included as Appendix B.

However, without a full count being undertaken on a monthly basis over a twelve months period, it is difficult to make any definitive statements regarding the avifauna of the Amatikulu-Nyoni estuarine system (DWS, 2016).

According to the information available from SABAP2, in 2018, the following bird species were recorded that are listed as either Near Threatened, Vulnerable or Endangered (SABAP2, 2019):

Great white pelican - Near Threatened
Cape gannet - Vulnerable
Cape cormorant - Near Threatened
Woolly necked stork - Near Threatened
Southern bald ibis - Vulnerable
African pygmy goose - Near Threatened
Secretarybird - Near Threatened
African crowned eagle - Near Threatened
African march harrier - Vulnerable
African finfoot - Vulnerable
Caspian tern - Near Threatened
Half-collared kingfisher - Near Threatened
Mangrove kingfigher - Vulnerable
Southern ground-hornbill - Vulnerable
Spotted (Natal) ground-thrush - Endangered
Black-throated (wattle-eyed) wattle-eye (flycatcher) - Near Threatened

It is unlikely that the abstraction and/or discharge activities will have a significant impact on the bird species and distribution of the aMatigulu-Nyoni estuary.

Macrobenthic fauna

Currently, the only macrobenthic data that is available for the aMatigulu-Nyoni estuary can be sourced from the EWR study that was finalised in 2016. In this study, subtidal and intertidal macrobenthos were sampled at a number of sites within the estuary.

A total of 27 subtidal macrobenthic species were recorded in 2013. The dominant species were:

- *Brachidontes virgiliae* (brackwater mussel);

- *Tarebia granifera* (quilted melania);
- *Ceratonereis keiskamma* (polychaete);
- *Apseudes digitalis* (tanaid);
- *Corophium triaenonyx* (amphipod); and
- *Grandidierella lignorum* (amphipod).

The benthic composition of the aMatigulu-Nyoni estuary closely resembles that of smaller temporarily open closed systems rather than a permanently open system (DWS, 2016). This is due to the dominance of *C. keiskamma* and *A. digitalis* and the amphipods *C. triaenonyx* and *G. lignorum*.

High densities of the invasive snail, *T. granifera* were recorded in the estuary and is a matter of concern because the relative large body size of these snails results in the snail dominating the macrobenthic biomass in estuary. However, during the site visit, no evidence of *T. grandifera* was observed despite their densities being high at the existing aquaculture facility.

Changes in water chemistry and the physical state of the estuary as a result of abstraction and/or discharge activities associated with the ADZ may alter the species composition and relative biomasses of the macrobenthos of the estuary. A more detailed discussion on the impact of *T. grandifera* is provided later in the report.

Macrocrustacea

Currently, the only data that is available for macrocrustacea for the aMatigulu-Nyoni estuary can be sourced from the EWR study that was finalised in 2016. The study revealed that the aMatigulu-Nyoni estuary supports a diverse prawn community comprising 12 species from four families, the Penaeidae, Alpheidae, Atyidae and Palaemonidae and includes marine spawning, estuarine and freshwater prawns.

The species composition is comparable to that found in other estuarine systems along the northern KwaZulu-Natal coastline, containing 12 of the 13 of the carid and penaeid prawn species expected to occur along the east coast of South Africa. The Mfolozi-Msunduzi system provides nursery habitat for 13 species, while 11 species have been recorded in St Lucia (Kensley 1972, Day et al. 2001, De Freitas 2011). Weerts et al. (2003) recorded 14 prawn species in Richards Bay Harbour, while seven prawn species were reported from the Mhlatuze Estuary adjacent to Richards Bay Harbour (Forbes and Cilliers 1999). Four of the seven penaeid prawn species known to occur along the KwaZulu-Natal coastline (Forbes and Demetriades 2005) were recorded in the aMatigulu-Nyoni estuary during the EWR study in 2013.

Fenneropenaeus indicus, *Penaeus monodon*, *Marsupenaeus japonicus* and *Metapenaeus monoceros* are the four prawn species that contribute to the South African shallow water prawn resource. According to the study conducted in 2013, three of the four commercially important prawn species were found in the aMatigulu-Nyoni estuary.

The prawn community sampled within the estuary was dominated by marine spawning penaieds, *F. indicus, M. monoceros* and *P. monodon* and by the freshwater palaemonid prawn *M. equidens*. These four species made up 79.4% of the prawns recorded in the system.

Prawns are dependent on a number of factors while residing in estuaries (DWS, 2016). These include:

- Salinity;
- access to the marine environment and mouth condition;
- shelter; and
- nutrients in the form of detritus.

For penaeid prawn larvae that recruit into estuaries, salinity is one of the most important environmental factors affecting growth and survival. In contrast to adults, postlarvae of most penaeids can survive estuarine

salinities as they osmoregulate well at lower salinities, generally preferring salinities between 10-20ppt, with survival decreasing below a salinity of 5. Recruitment of penaeid postlarvae into estuaries usually peaks during late spring and summer, with subadults immigrating back to sea in late summer and early autumn (DWS, 2016).

Access to the marine environment during periods of recruitment is also a determining factor affecting the survival of postlarvae when they migrate into estuaries. Extended flooding conditions in summer result in low salinities and can be detrimental to prawn development. This is because larvae are forced out to sea prematurely by the low salinities. *Macrobrachium* larvae also require brackish water for successful development, with most species requiring salinities of around 8ppt.

Shelter, in the form of *Zostera capensis* beds, are preferred habitat for most juvenile prawns and the high densities of *M. equidens*, *F. indicus* and *M. monodon* in the lower reaches of the aMatigulu-Nyoni estuary is likely to be the result of the presence *Zostera* beds in this area that were observed in 2013.

During the site assessment, large numbers of prawns were observed in a number of the inlets into the estuary. However, the species of prawns were not identified. Prawns were observed in the inlet in which abstraction is proposed to take place. Abstracting from this particular inlet will result in the loss of habitat for the prawns that are found within the estuary and the abstraction and /or discharge of effluent onto the estuary will alter the water chemistry of the receiving environment and may impact on larval and post larval prawn development.

The offshore prawn fishery of South Africa is on the verge of collapse due to the alteration of the nursery grounds for shallow water prawns. The main causes for the pressure that is placed on the shallow water prawn nursery grounds are poaching and illegal netting of prawns in rivers and estuaries, deteriorating water quality as well as development and transformation of habitats. In order to aid in restoring this fishery resource, estuaries where prawns are known to use as nursery grounds need to be protected.

6.3 Health Status and Importance

This section discusses the health status and importance of the aMatigulu-Nyoni estuary according to available literature.

6.3.1 Importance of the aMatigulu-Nyoni estuary

The Estuary Importance Score (EIS) takes size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and functional importance of the estuary into account. Biodiversity importance, in turn, is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. Estuary Importance was rated at 76, indicating that the estuary is rated as “Important”.

Table 6.6: Estuary importance scores for the aMatigulu-Nyoni estuary (DWS, 2016)

Criteria	Weight	Score
Estuary size	15	90
Zonal rarity type	10	30
Habitat diversity	25	70
Biodiversity importance	25	89
Functional importance	25	79
Estuary Importance Score		**76**

The Functional Importance of the Estuary is also very high. It serves an important nursery function for marine-living fish, is an important movement corridor for invertebrates and fish breeding in the sea, contributes to detritus, nutrients and sediments to the sea; and plays some role as a migratory stopover for coastal seabirds.

6.3.2 Health Status

The Amatikulu-Nyoni Estuary in its present state is estimated to be 84% similar to natural condition, which translates into a Present Ecological Status (PES) of a B Category. This is mostly attributed to the following factors:

- Recreational activities in the lower reaches, particularly along the shoreline on the sea side, affecting bird abundance;
- Over exploitation of living resources (e.g. poaching and line fishing);
- Agricultural activities in the Estuary Functional Zone causing loss of estuarine habitat; and
- Flow reduction.

The overall current Estuarine Health Score as well as the score with non-flow related pressures removed is given in Table 6.7 below.

Table 6.7: Estuarine Health Index (EHI) scores allocated to the aMatigulu-Nyoni estuary (DWS, 2016)

VARIABLE	ESTUARINE HEALTH SCORE	
	Overall	Excluding non-flow related pressures
HABITAT ASSESSMENT		
Hydrology	79	79
Hydrodynamics and mouth condition	89	89
Water quality	97	99
Physical habitat alteration	93	93
HABITAT HEALTH SCORE	*89*	*90*
BIOLOGICAL ASSESSMENT		
Microalgae	90	91
Macrophytes	80	92
Invertebrates	70	76
Fish	80	88
Birds	75	90
BIOLOGICAL HEALTH SCORE	*79*	*87*
ESTUARINE HEALTH SCORE (average of habitat and biota)	84	89
PRESENT ECOLOGICAL STATE (PES)	B	A/B

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 84% to 89% (see table above), which would raise the health score to an A/B Category. This suggests that non-flow related impacts have played some role in the degradation of the estuary to a B, but flow-related impacts are also driving degradation.

The Recommended Ecological Category (REC) represents the level of protection assigned to an estuary. The Present Ecological State (PES) sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection of an estuary. The PES for the aMatigulu/Nyoni estuary is a B and the estuary is rated as “Important” from a biodiversity perspective.

In addition, the aMatigulu/Nyoni also forms part of the core set of priority estuaries that requires protection to achieve biodiversity targets in the National Estuaries Biodiversity Plan for the NBA. The following recommendations were made in the NBA:

- the minimum Category for the aMatigulu/Nyoni estuary should be an A;
- the system be granted partial no-take protection; and
- 50 % of the estuary margin must not be developed.

However, as some of the changes that have occurred have been described as being irreversible, the Best Attainable State (BAS) is an A/B (+3 points from the category boundary).

Taking into account, the current conditions (PES = B), the reversibility of some impacts, the ecological importance and the national conservation targets, the REC for the aMatigulu/Nyoni estuary is an A/B Category.

The abstraction and discharge of effluent into the estuary map potentially alter the PES of the estuary. As a result the REC will not be attainable should the abstraction of water or discharge of effluent into the estuary take place.

6.3.3 Protected areas

Located on the western bank of the aMatigulu estuary, incorporating the Nyoni estuary, is the Amatikulu nature Reserve. This nature reserve is management by Ezemvelo Wildlife and has an approved Integrated Environmental Management Plan (IEMP). The IEMP required that monitoring of natural resources, compliance and enforcement and alien invasive species be conducted to ensure that the integrity of the reserve as a whole is maintained. While there are no estuary specific actions stipulated in the IEMP, the estuary will be incorporated into the monitoring programmes that have to be implemented.

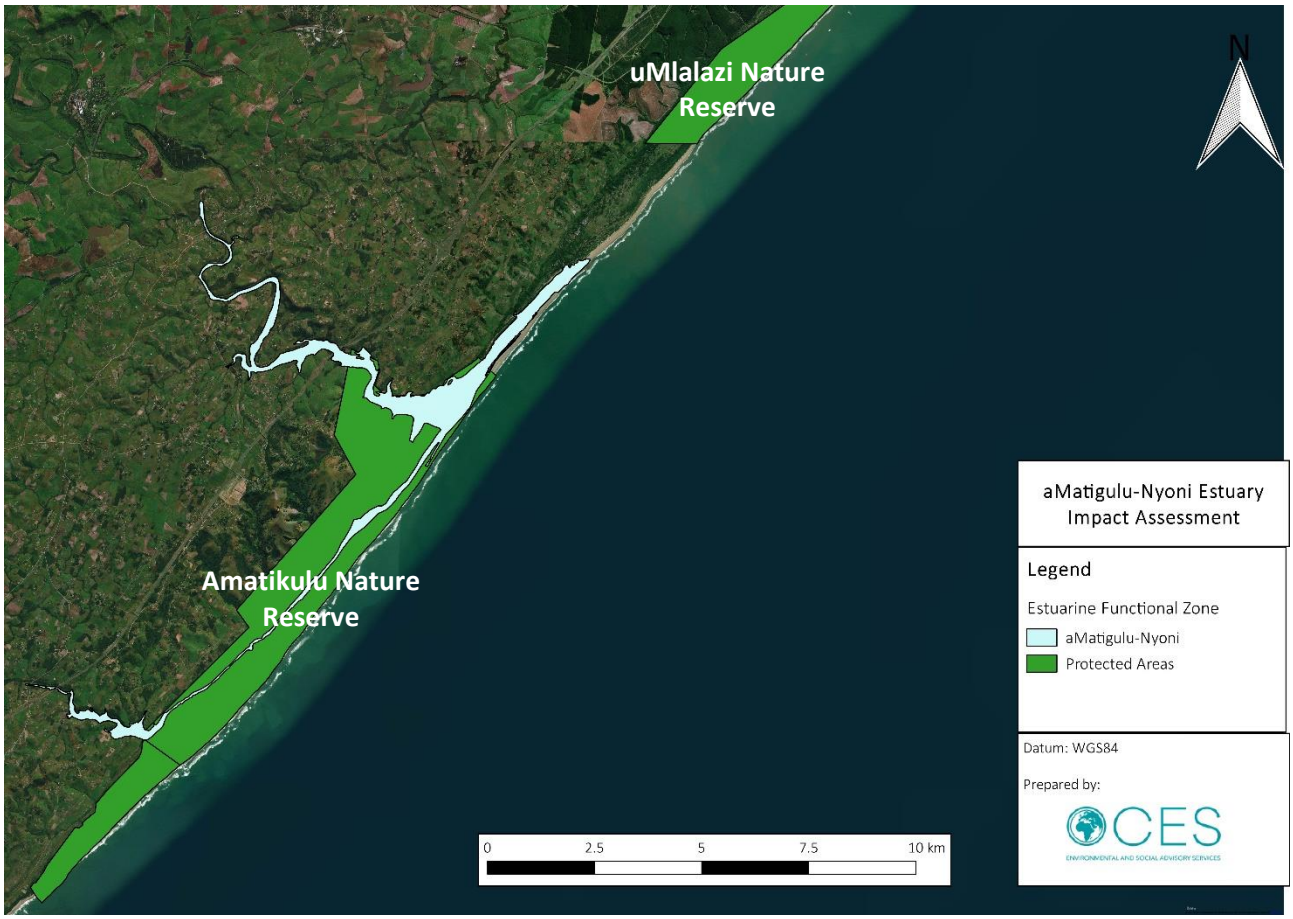

Figure 6.15: Protected Areas located within the study site

The mouth of the aMatigulu-Nyoni estuary is located within the recently gazetted uThukela Banks Marine Protected Area (MPA) (Figure 6.16). The estuary mouth falls within the uThukela Banks Inshore Controlled Zone (TICZ). Within the TICZ, the following activities are prohibited:

- Fishing in any form without a valid permits;

- Fishing activities between 17h00 and 06h00; and
- SCUBA diving without a valid permit.

Discharge activities associated with the proposed ADZ into either the estuary or directly into the sea will impact on the Amatikulu Nature Reserve and the uThukela Banks MPA.

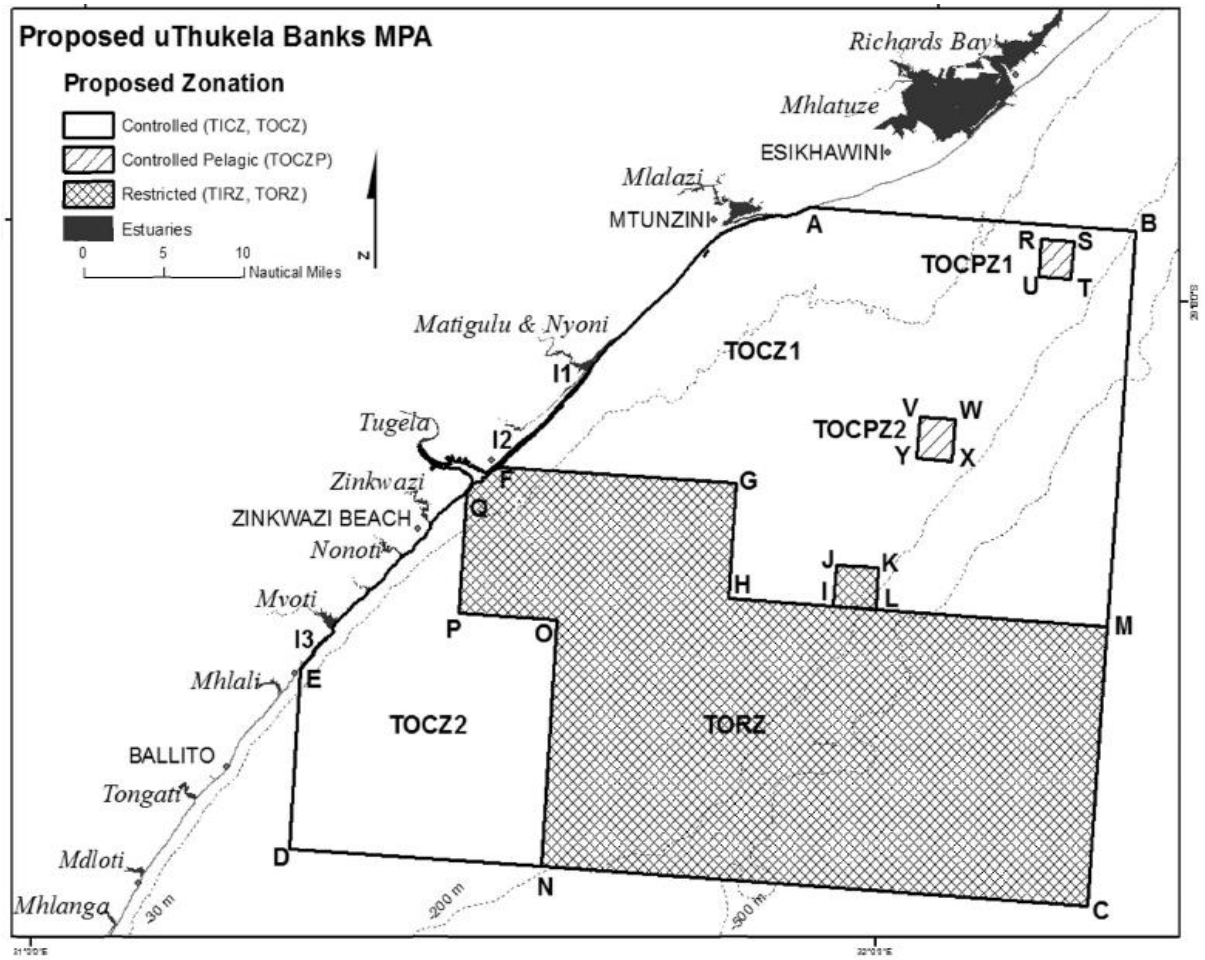

Figure 6.16: The boundaries and zonation of the uThukela Banks Marine Protected Area

6.3.4 KCDM Biodiversity Conservation Management

As part of an initiative to undertake the necessary biodiversity planning in the Province, the Ezemvelo KwaZulu Natal Wildlife (EKZNW) have developed Biodiversity Sector Plan for each District Municipality. The aMatigulu-Nyonie estuary falls within the King Cetswayo District Municipality (KCDM). The KCDM Biodiversity Sector Plan was informed by biodiversity experts who identified a number of important biodiversity areas in the KCDM.

The Biodiversity Sector Plan is a precursor to a bioregional plan. Therefore, the KCDM Biodiversity Sector Plan should be used for all proactive, multi-sectoral planning and reactive decision-making in the DM, in order to successfully achieve biodiversity targets in the long-term. This also applies to any activities that take place as a result of the proposed ADZ.

The key outputs of the Biodiversity Sector Plan is a map of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), collectively known as a "CBA Map", and a set of land-use guidelines that detail acceptable activities permitted in order to achieve the desired state or management objective for each CBA category. The land- use management objectives of each CBA map category is provided in Table 6.8 and the CBA maps with the location of the abstraction and discharge pipelines indicated are provided in Figure 6.17 and 6.18.

Table 6.8: CBA map category and land-use management objectives

Map category	Land-use management objective
Protected Areas (PA)	Maintain in a natural state with limited-to-no biodiversity loss
Critical Biodiversity Areas: • Irreplaceable sites • Optimal sites	Maintain in a natural state with limited-to-no biodiversity loss
Ecological Support Areas: • PA 5km buffer • World Heritage Site (WHS) 10km buffer	Maintain or improve ecological and tourism functionality of a PA or WHS
Ecological Support Areas: terrestrial	Maintain ecosystem functionality and connectivity allowing for some loss of biodiversity.

The areas surrounding and within the aMatigulu-Nyoni estuary have been identified as Irreplaceable Areas. This needs to be taken into consideration with regards to any land-based activities that may be associated with the proposed aquaculture development.

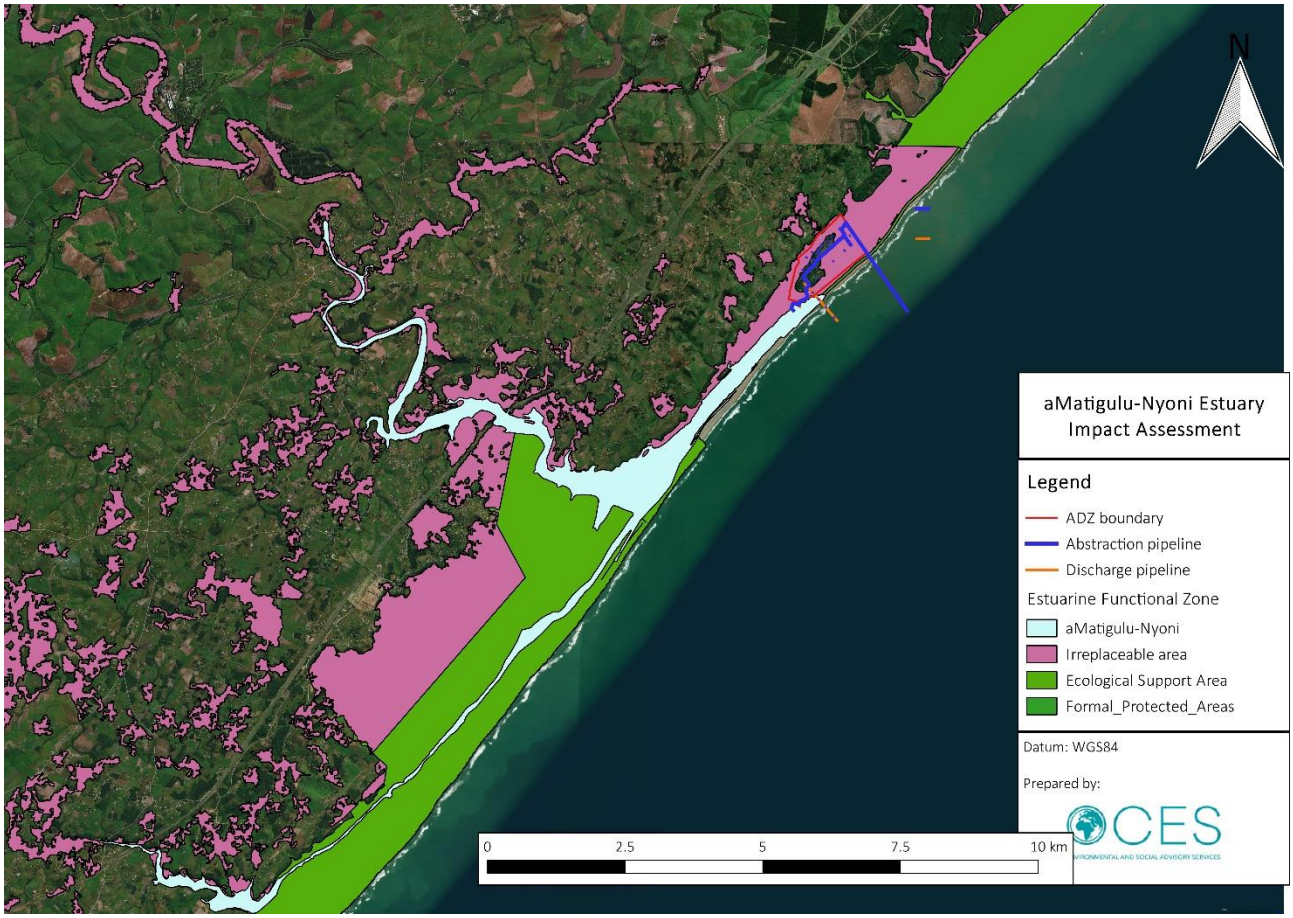

Figure 6.17: A map indicating the Critical Biodiversity and Ecological Support Areas surrounding the greater Amatikulu area

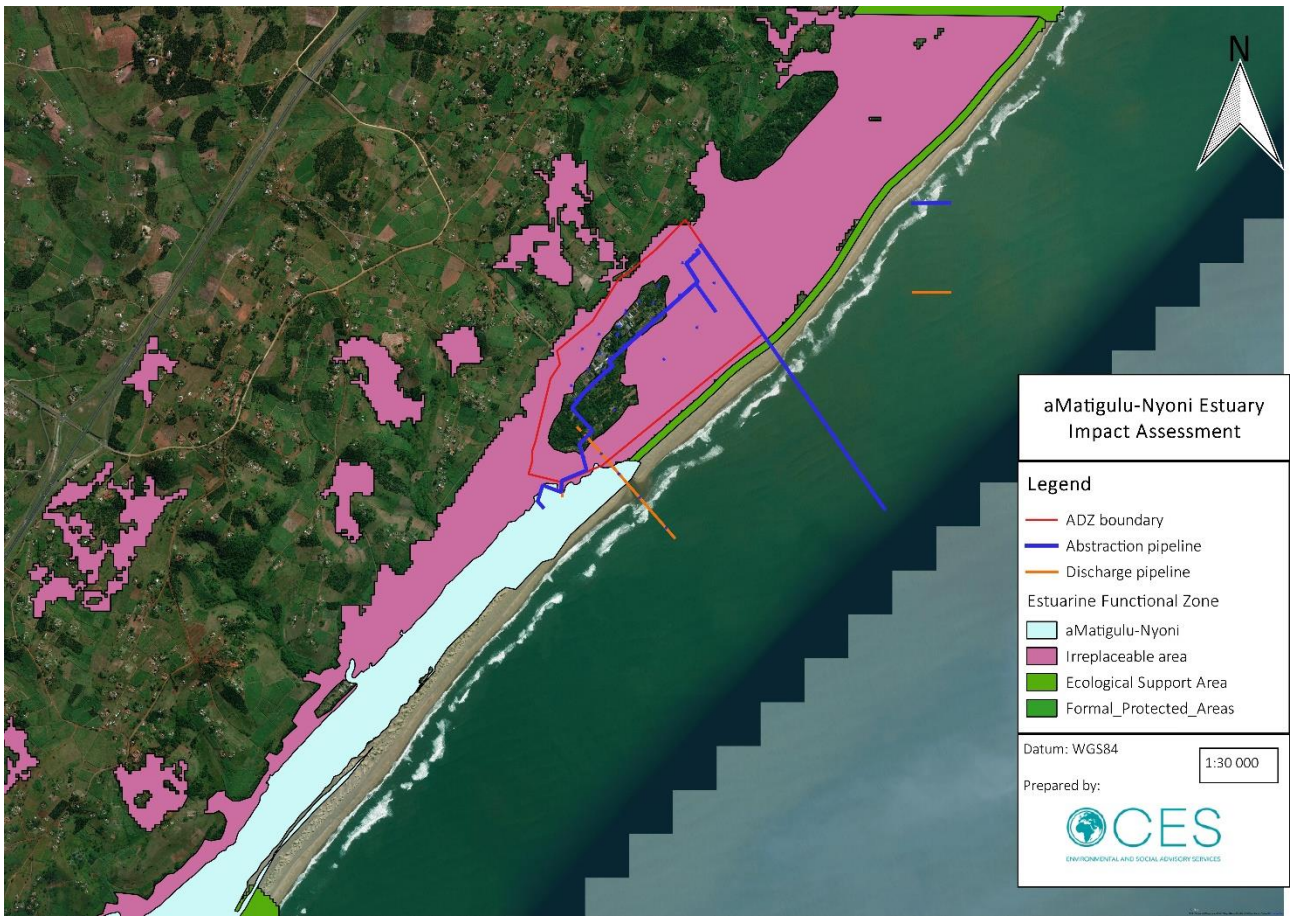

Figure 6.18: A map indicating the Irreplaceable Areas surrounding the proposed abstraction and discharge pipelines

6.3.5 Threatened Ecosystems

The National Department of Environmental Affairs (DEA) published a list of Threatened Ecosystems in terms of the National Environmental Management: Biodiversity Act (GN 1002 of 2011). These ecosystems require protection and the purpose of listing these ecosystems is to reduce the rate of ecosystem and species extinction. The list classifies threatened ecosystems into four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Protected.

Figure 6.19 and Figure 6.20 indicate the extent of the listed Threatened Ecosystem areas surrounding the proposed ADZ and the aMatigulu-Nyoni estuary. Two "Critically Endangered" ecosystems and one "Vulnerable" ecosystem surrounds the proposed ADZ. Table 6.9 below provides a detailed description of each of the listed Threatened Ecosystems relevant to this assessment.

Table 6.9: The listed Threatened Ecosystems surrounding the proposed ADZ and aMatigulu-Nyoni estuary

Vegetation type	Threat status	Remaining natural area	Description
Eshowe Mtunzini Hilly Grassland	CRITICALLY ENDANGERED (F)	7%	13 threatened or endemic plant or animal species. Key biodiversity features include: - One amphibian species, *Hyperolius pickersgilli*; - One bird species, Green Barbet; - three millipede species including *Centrobolus anulatus, Doratogonus montanus* and *Doratogonus natalensis*; - Five plant species for example *Helichrysum woodii, Kniphofia Jeucocephala, Kniphofia littoralis, Kniphofia pauciflora*;

Vegetation type	Threat status	Remaining natural area	Description
			- Two reptile species including *Bradypodion melanocephalum* and *Scelotes inornatus*; and - Six vegetation types Including Ngongoni Veld, Eastern Valley Bushveld, KwaZulu-Natal Coastal Forest, Maputuland Coastal Belt, KwaZulu-Natal Coastal Belt and Zulu land Lowveld.
North coast dune forest	CRITICALLY ENDANGERED (F)	53%	Three threatened or endemic plant and animal species. Key biodiversity features Include: - Two species of millipede including Centrobolus fulgldus and Centrobolus richardi; - One plant species; and - Three vegetation types Including KwaZulu-Natal Dune Forest, Mangrove Forest and Maputuland Coastal Belt.
KwaZulu Natal Coastal Belt	ENDANGERED (A1)	45%	Three endemic plant species. Highly dissected undulating coastal plains which presumably used to be covered to a great extent with various types of subtropical coastal forest. Some primary grassland dominated by Themeda triandra still occurs in hilly, high-rainfall areas where pressure from natural fire and grazing regimes prevailed. At present the KwaZulu-Natal Coastal Belt is affected by an intricate mosaic of very extensive sugarcane fields, timber plantations and coastal holiday resorts, with interspersed secondary *Aristida* grasslands, thickets and patches of coastal thornveld.

The thresholds for the three listed Threatened Ecosystems are described in Table 6.10 below.

Table 6.10: The thresholds for the Listed Threatened Ecosystems identified

Vegetation type	Threat status	Criterion	Threshold
Eshowe Mtunzini Hilly Grassland	CRITICALLY ENDANGERED	F – Priority areas meeting explicit biodiversity targets as defined In a systematic biodiversity plan	Very high irreplaceability and high threat
North coast dune forest	CRITICALLY ENDANGERED	F – Priority areas meeting explicit biodiversity targets as defined In a systematic biodiversity plan	Very high irreplaceability and high threat
KwaZulu Natal Coastal Belt	ENDANGERED	A1 - Irreversible loss of natural habitat	Remaining natural habitat ≤ 60% of original area of ecosystem

The terrestrial habitats associated with these threatened ecosystems are regarded as support areas for the ecological functioning of the aMatigulu-Nyoni estuary in terms of the ecological services they provide in the form of provision of habitat. The construction of the abstraction and or discharge pipelines associated with the ADZ will result in the loss of habitat within these threatened ecosystems.

6.3.6 Existing infrastructure and amenities

A variety of infrastructure exists within the EFZ of the aMatigulu-Nyoni estuary. This infrastructure includes the following:

- Dokodweni Beach where a life guard hut is located within close proximity to the high-water mark. Dokodweni is also a beach that has been granted Blue Flag status as a pilot beach. Blue Flag beach

are required to meet a specified set of criteria that aim to promote good water quality, excellent public access and amenities and to promote tourism. Abstracting water and/or discharging effluent into the estuary will result in the Blue Flag Beach status being revoked, which will impact on local tourism in the area.

- Three public boat launch sites are located around the Dokodweni beach area;
- A number of gravel access roads and parking areas are found leading down to and at the Dokodweni beach;
- There are a few camping facilities located along the length of the aMatigulu-Nyoni estuary (e.g. The Hatchery and the Prawn Shack); and
- The N2 Bridge crosses over the aMatigulu-Nyoni estuary in the middle reaches of the estuary.

Figures 6.19 and 6.20 provide an overview of the location of the existing infrastructure located along the banks of the estuary.

The proposed abstraction and discharge points associated with the ADZ are located in close proximity to the Dokodweni beach area. With regards to the discharge of aquaculture effluent, health and safety risks to public users of the beach may arise. The discharge of effluent into the estuary would then need to meet the Water Quality Standards for Recreational Use before being discharged into the estuary. This will require thorough treatment of the effluent prior to discharge into the estuary. With regards to the abstraction of water in close proximity to the Dokodweni beach, safety risks will be presented to bathers who may choose to bathe in the area close to the abstraction point. Since the area where the abstraction point is proposed is easily accessible by the public, there is also a risk that the infrastructure may become damaged or vandalised.

Figure 6.19: A map indicating the locality of existing infrastructure along the aMatigulu-Nyoni estuary

Figure 6.20: A map indicating the existing infrastructure located towards the mouth of the aMatigulu-Nyoni estuary

6.3.7 Current impacts and threats

The aMatigulu-Nyoni estuary experiences a number of impacts and threats that result from human activities. A Summary of these impacts and threats is provided in Table 6.11 below.

Table 6.11: A summary of the existing threats and impacts on the aMatigulu-Nyoni estuary (DWS, ,2016).

THREAT/IMPACT	DESCRIPTION OF THREAT/IMPACT
Water abstraction and dams (including farm dams)	Mostly small farm dams, off channel storage for Amatikulu Sugar Mill and abstraction of water for the town of Gingindlovu. This results in reduced baseflow in the estuary and subsequently impacts the mouth state and water chemistry.
Infestation by invasive alien plants	There are some alien invasive plants in the catchment that lead to flow reduction such as Phragmites. The invasive plants reduce baseflows and they are high water demand species.
Agricultural and pastoral run-off containing fertilisers, pesticides and herbicides	Some areas within the EFZ are being farmed for sugar cane, which elevates Nitrogen and Phosphate levels and increases macrophyte productivity.
Sugar Mill effluent stored in storage tanks and used for sugar cane irrigation	Diffuse contamination by organic waste and toxic chemicals from the storage tanks reduced the water quality of the estuary.
Municipal WWTW	Sewage effluent discharged into the stream that drains to the Amatikulu river and affects the water quality of the estuary, particularly by increasing the nutrient load and potentially contaminating the systems with *E. coli.*
Bridge(s)	The N2 is located within the middle reaches of the estuary, which has an impact on the flow regime and sedimentation of the estuary.
Low-lying developments	Sugar cane field are located on the flood plain, the clearing of natural vegetation results in increased sedimentation of the estuary.
Recreational fishing	There is limited recreation fishing that occurs within the estuary and, therefore, has a minimal impact on fish populations in the estuary.
Commercial/Subsistence fishing (e.g. gillnet fishery)	High levels of shoreline fishing occurs along the beach and at the mouth of the estuary. This places pressure on the fish stocks coming into the

THREAT/IMPACT	DESCRIPTION OF THREAT/IMPACT
	estuary to utilise it as a nursery ground or feeding area.
Illegal fishing (Poaching)	High levels of gill net fishing occur within the estuary wich impacts on fish stocks.
Bait collection	Prawn pumping for *Callichirus kraussi* almost certainly occurs in the lower reaches of the estuary on the seaside shoreline where numerous colonies occur. Prawn pumping affects the structure of the mud banks and may alter the habitat for the recruitment of new *C. kraussi* generations.
Grazing and trampling of salt mashes	Cattle feed on the salt marches which alters the availability of habitat for the fauna that rely on this habitat type for their survival
Translocated or alien fauna and flora	The aquatic plant *Eichhornia crassipes* and the aquatic snail *Tarebia granifera* have both been translocated into the system. *T. granifera,* although a freshwater species, can tolerate brackish conditions. Altering the water quality of the estuary could extend the range for *T. granifera* resulting in an increase in their distribution throughout the estuary.
Changes in land use within the catchment, and increases in number of people present	The catchment is reasonably intact. However, is very sensitive to changes in agriculture, forestry and also to the settlement of more people in the area. This could severely alter the flow patterns of water, reduce water, add nutrients and add sediments. This includes that abstraction of water and discharge of effluent into the estuary.

6.4 Summary of the description of the environment

This chapter provided a detailed description of the biophysical description of the aMatigulu-Nyoni estuary. This section provides an overview of the important findings of the detailed biophysical description and a summary of the impact that the proposed abstraction and discharge associated with the ADZ may have on each aspect of the estuary 9Table 6.12).

Table 6.12: A summary of the important findings of the detailed biophysical description of the aMatigulu-Nyoni estuary

BIOPHYSICAL PARAMETER	DESCRIPTION
Boundaries and locality of the estuary	• The 5m contour that was delineated in the National Biodiversity Assessment 2011 was used to define the EFZ.
Hydrology	• Natural MAR = 192.27 Million m^3 • Present day MAR = 178.03 Million m^3 (7% difference from natural MAR) • Water to be abstracted from estuary per annum = 1.204 Million m^3 (0.6% of the present day MAR) • Aquaculture effluent to be discharges per annum = 1.953 Million m^3 (1.1% of the present day MAR) • Abstraction from or discharge into the estuary impacts the water chemistry and ecological reserve.
Mouth dynamics	• Estuary mouth is predominantly open (+- 84% per annum) • Mouth position is highly variable • Mouth condition impacts water chemistry and quality as well as water availability.
Water quality	• Abstraction of water from the estuary may alter the chemical nature of the surrounding area, depending on the baseflows and the mouth status of the estuary. • Discharge of effluent into the estuary may result in increased nutrient loading in to the system as well as altering the salinity (freshwater and marine effluent combined)
Vegetation and habitat types	• Open surface water habitat available for phytoplankton and submerged macrophytes is the most prevalent habitat type In some places there are the floating plants *Echinochloa* & *Eichhornia*

BIOPHYSICAL PARAMETER	DESCRIPTION
	• *Zostera capensis* is known to occur in the estuary and is listed as Vulnerable in the Red Data List of Species. Alterations in the mouth condition of the estuary as a result of abstraction or discharge related to the ADZ will impact on the *Z. capensis* beds.
Mammals and reptiles	• Nine potential mammal species, of which one is listed by the IUCN as Vulnerable (Blue Duiker). • Five potential reptile species, of which one of listed by the IUCN as Endangered (Eastern Natal green snake). • Alterations in habitat as a result of the ADZ could negatively impact on the distribution and abundance of these species.
Fish	• 65 species of fish recorded in the estuary. • 60% of these species are euryhaline marine species which breed at sea but with juveniles that show varying degrees of dependence on estuaries. • The aMatigulu-Nyoni estuary is an important nursery area for many fish species. • Changes in water chemistry as well as the physical state of the estuary as a result of the abstraction of water and/or discharge of effluent into the estuary may impact on the diversity and distribution of fish species that utilise the estuary.
Birds	• 34 birds species observed in 2013 • SABAP2 List indicated 250 bird species being recorded in the Grid square 2931BA. • One Endangered species (Spotted (Natal) ground thrush) • Six Vulnerable species. • Nine Near Threatened species. • It is unlikely that the abstraction and/or discharge activities will have a significant impact on the bird species and distribution of the aMatigulu-Nyoni estuary.
Macrobenthic fauna	• A total of 27 subtidal macrobenthic species were recorded in 2013. The dominant species were: – *Brachidontes virgiliae* (brackwater mussel); – *Tarebia granifera* (quilted melania); – *Ceratonereis keiskamma* (polychaete); – *Apseudes digitalis* (tanaid); – *Corophium triaenonyx* (amphipod); and – *Grandidierella lignorum* (amphipod). • Changes in water chemistry and the physical state of the estuary as a result of abstraction and/or discharge activities associated with the ADZ may alter the species composition and relative biomasses of the macrobenthos of the estuary.
Macrocrustacea	• aMatigulu-Nyoni estuary supports a diverse prawn community comprising 12 species from four families. • Three commercially important species recorded in the estuary. • Important nursery estuary for recruitment into the offshore prawn fishery.
Importance of the estuary	• Estuary Importance was rated at 76, indicating that the estuary is rated as "Important". • The Functional Importance of the Estuary is also very high. It serves an important nursery function for marine-living fish, is an important movement corridor for invertebrates and fish breeding in the sea, contributes to detritus, nutrients and sediments to the sea; and plays some role as a migratory stopover for coastal seabirds.

BIOPHYSICAL PARAMETER	DESCRIPTION
Health status	• Present state is estimated to be 84% similar to natural condition. • PES = B. • REC = A/B. • The system be granted partial no-take protection;. • 50 % of the estuary margin must not be developed. • The abstraction and discharge of effluent into the estuary map potentially alter the PES of the estuary. As a result the REC will not be attainable should the abstraction of water or discharge of effluent into the estuary take place.
Protected areas	• Amatikulu Nature Reserve on the eastern banks of the estuary. • The estuary falls within the uThukela Banks MPA. • Discharge activities associated with the proposed ADZ into either the estuary or directly into the sea will impact on the Amatikulu Nature Reserve and the uThukela Banks MPA.
KCDM Biodiversity Conservation Management Plan	• Areas surrounding the proposed ADZ and the estuary are "Irreplaceable Area". • Should be maintained in a natural state with limited-to-no biodiversity loss. • Abstraction and or/discharge into the estuary will alter the natural state of the estuary.
Threatened Ecosystems	• Two "Critically Endangered" ecosystems and one "Vulnerable" ecosystem surrounds the proposed ADZ. • The construction of the abstraction and or discharge pipelines associated with the ADZ will result in the loss of habitat within these threatened ecosystems
Existing infrastructure	• Dokodweni beach amenities and swimming area located adjacent to both the proposed abstraction and discharge points. • Dokodweni beach is a Blue Flag Pilot Beach. Abstraction and/or discharge into the estuary will result in the Blue Flag Beach status being revoked.

7 SITE SENSITIVITY

7.1 Sensitivity map

An estuarine sensitivity map (Figure 7.1 below) was developed based on findings from the desktop information and observations taken during the site visit. Areas were classified into areas of high and moderate sensitivity based on these findings. Areas that have not been identified as either high or moderate sensitivity can be assumed to be low sensitivity.

High Sensitivity

Areas of high sensitivity were based on the following:

- Critically endangered Threatened Ecosystems (North Coast Dune Forest and Eshowe Mtunzini Hilly Grassland) – In terms of the Threatened Ecosystems Regulations, these areas are at high risk of transformation and must be maintained in a natural state. Any alteration to these ecosystems will result in the loss of critical habitats for protected species.
- Irreplaceable Areas that were identified as part of the KCDM Biodiversity Conservation Management Plan – Irreplaceable Areas are to be maintained in a natural state.
- Proposed *Zostera* beds that were observed in the 2013 site assessment as part of the EWR study. *Z. capeni*s is Vulnerable in terms of the Red Data List and, as a critical habitat, need to be protected;
- Protected areas (Amatikulu Nature Reserve);
- Estuary mouth, due to the dynamic nature of the state and position of the mouth. Any alteration to the estuary mouth will significant alter the current state of the estuary, and since the estuary has a PES of a B and a REC of an A/B, any modifications will be in conflict with the PEC and REC; and
- The EFZ -the aMatigulu-Nyoni estuary is a National Priority Estuary and therefore requires protection from further alteration and degradation. The estuary also falls within the recently gazetted uThukela Banks Marine Protected Area.

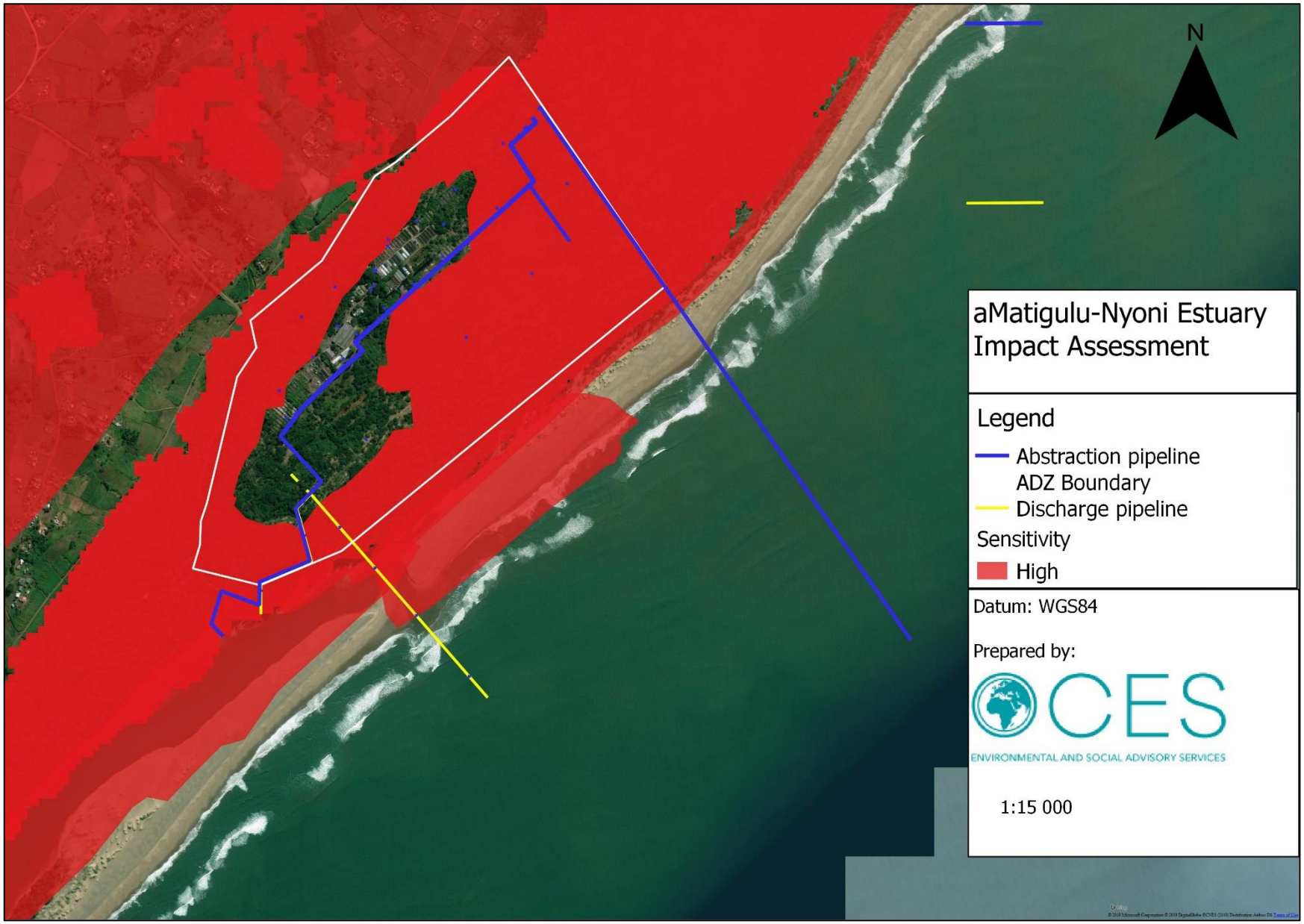

Figure 7.1: Estuarine sensitivity map for the areas surrounding the proposed ADZ

8 MANNER IN WHICH THE ESTUARINE ENVIRONMENT MAY BE AFFECTED

8.1 Issues Identification Matrix

CES has developed a revised rating scale for the Scoping Phase of the EIA process in accordance with the requirement outlined in Appendix 2 of the EIA Regulations 2014 (as amended) (Table 8.1. This scale takes into consideration the following variables:

- Duration
- Extent
- Consequence
- Probability
- Significance
- Reversibility and Mitigation

Duration

The temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

Extent

The spatial scale defines the physical extent of the impact.

Consequence

The consequence scale is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.

Probability

This is the likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Mitigation

The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. Both the practical feasibility of the measure, the potential cost and effectiveness is taken into consideration when determining the appropriate degree of difficulty.

Table 8.1: Evaluation Criteria for Rating Impacts.

Effect	Duration	
	Short term	Less than 5 years
	Medium term	Between 5-20 years
	Long term	More than 20 years
	Extent	
	Localised	The proposed site
	Study Area	The site and its immediate environs

	Regional	District / Municipal and Provincial level
	National	National and International level
	Consequence	
	Slight	Slight impacts or benefits on the affected system(s) or party(ies)
	Moderate	Moderate impacts or benefits on the affected system(s) or party(ies)
	Severe/Beneficial	Severe impacts or benefits on the affected system(s) or party(ies)
	Probability	
	Unlikely	The likelihood of these impacts occurring is slight (low probability)
	May Occur	The likelihood of these impacts occurring is possible (high probability)
	Definite	The likelihood is that this impact will definitely occur
Mitigation	**Mitigation**	
	Easily Achievable	The impact can be easily, effectively and cost effectively mitigated
	Achievable	The impact can be effectively mitigated without much difficulty or cost
	Difficult	The impact could be mitigated but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs
	Very Difficult	The impact could be mitigated but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly

Significance

The above criteria are used to determine the overall significance of an activity. The impact effect (which includes duration; extent; consequence and probability) and the reversibility/mitigation of the impact are then read off the significance matrix in order to determine the overall significance of the issue. The overall significance is either negative or positive and will be classified as low, moderate or high (Table 8.2).

Table 8.2: Description of Issues Level Significance Ratings.

Significance Rate	Description
LOW	The impacts on this issue are acceptable and mitigation, whilst desirable, is not essential. The impacts on the issue by themselves are insufficient, even in combination with other low impacts, to prevent the development being approved. Impacts on this particular issue will result in either positive or negative medium to short term effects on the social and/or natural environment.
MODERATE	The impacts on this issue are important and require mitigation. The impacts on this issue are, by themselves, insufficient to prevent the implementation of the project, but could in conjunction with other issues with moderate impacts, prevent its implementation. Impacts on this particular issue will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.
HIGH	The impacts on this issue are serious, and if not mitigated, they may prevent the implementation of the project (if it is a negative impact). Impacts on this particular issue would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment, and will result in severe effects or if positive, substantial beneficial effects.

The issues level environmental significance scale needs to take the context into account, and at the relevant level. For example, if the issue under consideration is 'changes to the terrestrial biological environment,' the impacts to be considered when assessing this issue might include (1) loss of a particular vegetation type, (2) disruption to, or loss of, faunal habitats, (3) fragmentation of habitats (4) loss of species of conservation concern (if known at the Scoping stage of the assessment, and so on). The evaluation of the significance of the issue therefore relies heavily on the information that is available at the Scoping stage of an EIA, and out of necessity must be broad and value laden. For this reason, impacts need to reflect the values of the affected society.

The evaluation of the issues, as described above, is used to prioritise which issues require mitigation

measures, or which issues might lead to a conclusion that the particular alternative under assessment is not appropriate. Negative issues that are ranked as being of "HIGH" significance will need to be investigated further to determine how the impacts can be minimised, or what alternative activities or mitigation measures can be implemented. For issues identified as having a negative impact of "MODERATE" significance, it would be standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigation measures will then be proposed. For impacts ranked as "LOW" significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.

Issues Level Assessment

The issues identified during the Estuary Impact Assessment for the proposed project lists the environmental issues and resulting impacts that have been identified for the following phases of the project development: planning and design, construction and operation. These impacts have been identified for the proposed abstraction of water from the estuary and proposed discharge of aquaculture effluent into the estuary.

8.2 Impacts identified

Potential impacts on the aMatigulu-Nyoni estuary that were identified during the Planning and Design, Construction and Operational phases are indicated in Table 8.3. These included the consideration of direct, indirect and cumulative impacts that may occur.

Table 8.3: Technical Scope of Issues pertaining to the estuarine environment identified during all phases of the proposed ADZ.

THEME	POTENTIAL ISSUES	• SOURCE OF ISSUE	• POTENTIAL RECEPTORS	PHASE		
				PLANNING & DESIGN	CONSTRUCTION	OPERATIONAL
Environmental Policy	Legal and Policy Compliance	• Licensing & Authorisations • Permitting	• DAFF	X	X	X
Built Environment	Associated Bulk Infrastructure	• Siting and placement • Earthworks	• Aquatic & Terrestrial estuarine environment	X		
	Stormwater management	• Inappropriate planning & maintenance	• Aquatic & Terrestrial estuarine environment	X	X	X
Terrestrial Estuarine Environment	Loss of Natural Vegetation	• Vegetation clearance	• Threatened Ecosystems	X	X	
	Invasion of Alien Vegetation Species	• Habitat disturbance • Vegetation clearance	• Terrestrial estuarine environment	X	X	X
	Erosion Management	• Earthworks • Vegetation clearance	• Erosion prone areas in study area	X	X	X
Aquatic Estuarine Environment	Damage/destruction of aquatic features	• Siting and placement • Earthworks • Construction & operational activities	• Aquatic & Terrestrial environment • Neighbouring community	X	X	X
	Estuary mouth dynamics	• Abstraction of water • Discharge of effluent	• Terrestrial & Aquatic estuarine environment	x		x
	Water chemistry and quality	• Abstraction of water • Discharge of effluent	• Terrestrial & Aquatic estuarine environment	x		x
	Control of aquatic alien species	• Habitat disturbance	• Aquatic estuarine environment	x		X
	Biosecurity	• Aquatic diseases	• Aquatic estuarine environment	X		X
Socio-economic	Tourism	• Blue Flag Beach Status	• Surrounding community	X	X	X

8.3 Impact assessment

The impacts identified in Section 8.2 are assessed in terms of the criteria described in Section 8.1 and are summarised in the tables below (Table 8.4 – 8.6).

Table 8.4: Assessment and mitigation of impacts during the Planning and Design Phase of the development.

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
PLANNING & DESIGN PHASE									
ENVIRONMENTAL POLICY									
Legal and Policy Compliance (NO DECOMMISSIONING)	*Abstraction of water from the estuary* During the Planning and Design Phase, the failure to comply with existing policies and legal obligations in terms of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) National Water Act (No. 36 of 1998) could lead to the project conflicting with local, provincial and national policies, legislation etc. This could result in legal non-compliance, fines, overall project failure or delays in construction activity.	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• Authorisation for the abstraction of water from an estuary must be obtained from the relevant Competent Authority (DEA: Oceans and Coasts). • A coastal lease must also be obtained for the construction of infrastructure within coastal public property.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the failure to comply with existing policies and legal obligations in terms of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) National Water Act (No. 36 of 1998) could lead to the project conflicting with local, provincial and national policies, legislation etc. This could result in legal non-compliance, fines, overall project failure or delays in construction activity.	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• A Coastal Water Discharge permit must be issued prior to any discharge activities taking place. • A coastal lease must also be obtained for the construction of infrastructure within coastal public property.	LOW NEGATIVE
BUILT ENVIRONMENT									
Associated Bulk Infrastructure	*Abstraction of water from the estuary* During the Planning and Design Phase, inappropriate planning and placement of the abstraction pipeline and associated infrastructure could result in poorly functioning abstraction infrastructure or damage to infrastructure. This is a result of the variable nature of the mouth of the estuary resulting in changes in sedimentation regimes and estuarine water levels that could block up the abstraction pipeline.	DIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• Estuarine sediment modelling needs to be conducted in order to determine the most stable and viable abstraction point in the estuary.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, inappropriate planning and placement of the discharge pipeline could result in poor dilution and mixing of aquaculture effluent. This could increase localised eutrophication of the estuary, which will negatively impact on the water quality. The Estuary has a PES of B and a REC of A/B, therefore maintaining good water quality is highly important.	DIRECT	Short term	Study Area	Possible	Severe	HIGH NEGATIVE	• Dispersion modelling needs to be conducted to determine the optimal site for the aquaculture effluent discharge point that will allow for maximum dilution and dispersion of the effluent to prevent major deterioration of the water quality in the estuary.	MODERATE NEGATIVE
Stormwater management	*Abstraction of water from the estuary* During the Planning and Design Phase, inadequate stormwater management designs for the abstraction pipeline could result in increased sedimentation of the estuary, which could impact on the viability of the chosen abstraction point.	INDIRECT CUMULATIVE	Short term	Study Area	Possible	Moderately severe	MODERATE NEGATIVE	• A stormwater management plan must be developed that incorporates that abstraction pipeline. This sotrmwater management plan must be approved by DEA.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, inadequate stormwater management designs for the discharge pipeline could result in increased sedimentation of the estuary, which could impact on mouth state of the estuary.	INDIRECT CUMULATIVE	Short term	Study Area	Possible	Moderately severe	MODERATE NEGATIVE	• A stormwater management plan must be developed that incorporates that abstraction pipeline. This stormwater management plan must be approved by DEA.	LOW NEGATIVE
TERRESTRIAL ESTUARINE ENVIRONMENT									
Loss of natural vegetation	*Abstraction of water from the estuary*	DIRECT	Long Term	Localised	Definite	Severe	HIGH	• The pipeline route must be carefully	MODERATE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	During the Planning and Design Phase, the construction of the pipeline will result in the loss of Critically Endangered vegetation, as per the Threatened Ecosystems Regulations. This will be in conflict with the recommendations to maintain a natural state.						NEGATIVE	chosen to avoid areas that are still in a natural state. Where possible, the pipeline must be routed through areas that have already experienced some degree of transformation.	NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the construction of the pipeline will result in the loss of Critically Endangered vegetation, as per the Threatened Ecosystems Regulations. This will be in conflict with the recommendations to maintain a natural state.	INDIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• The pipeline route must be carefully chosen to avoid areas that are still in a natural state. Where possible, the pipeline must be routed through areas that have already experienced some degree of transformation.	MODERATE NEGATIVE
Invasion of alien vegetation species	***Abstraction of water from the estuary*** During the Planning and Design Phase, inadequate planning and provisioning for the removal and management of alien vegetation throughout all phases of the development could result in the invasion of alien vegetation in both terrestrial and riparian areas.	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• An alien vegetation management plan must be developed and approved by DEA prior to the commencement of the project.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, inadequate planning and provisioning for the removal and management of alien vegetation throughout all phases of the development could result in the invasion of alien vegetation in both terrestrial and riparian areas.	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• An alien vegetation management plan must be developed and approved by DEA prior to the commencement of the project.	LOW NEGATIVE
Erosion Management	***Abstraction of water from the estuary*** During the Planning and Design Phase, the inappropriate layout and design of the abstraction pipeline can will result in the erosion of sediment surrounding the pipeline. This will result in an increase in the sedimentation of the estuary	X	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• All technical designs must be completed by a qualified engineers and erosion mitigation structures (groynes, etc.) must be placed to minimuse the risk of erosion.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the inappropriate layout and design of the discharge pipeline can will result in the erosion of sediment surrounding the pipeline. This will result in an increase in the sedimentation of the estuary	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• All technical designs must be completed by a qualified engineers and erosion mitigation structures (groynes, etc.) must be placed to minimise the risk of erosion.	LOW NEGATIVE
AQUATIC ESTUARINE ENVIRONMENT									
Damage/destruction of aquatic features	***Abstraction of water from the estuary*** During the Planning and Design Phase, the siting of the abstraction point could damage or destroy important habitat features such as *Zostera capensis* beds and could alter the bed and banks of the estuary that provide habitat for a variety of fauna and flora. Estuarine fauna and flora could also be sucked up into the abstraction pipeline.	DIRECT	Medium Term	Study Area	Possible	Moderately Sever	MODERATE NEGATIVE	• *Zostera capensis* beds must be mapped out in detail during the technical design phase in order to ensure that the abstraction pipeline will not directly impact on these habitats. • Ensure that grids are installed at the abstraction point to minimise the risk of estuarine organisms being sucked up into the abstraction pipeline	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the discharge could damage or destroy important habitat features such as *Zostera capensis* beds and could alter the bed and banks of the estuary that provide habitat for a variety of fauna and flora.	DIRECT	Medium Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• *Zostera capensis* beds must be mapped out in detail during the technical design phase in order to ensure that the discharge pipeline will not directly impact on these habitats.	LOW NEGATIVE
Estuary mouth dynamics	***Abstraction of water from the estuary*** During the Planning and Design Phase, the	DIRECT	Medium Term	Study Area	Possible	Severe	HIGH NEGATIVE	• The water requirements for abstraction must be accurately reported when	MODERATE NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	anticipated water requirements for abstraction could result in extended mouth closure conditions of the estuary. This will negatively impact on the water quality and habitat integrity of the estuary and could result in the need for artificial manipulation of the estuary mouth.							applying for the relevant abstraction licenses from DWS. • Water saving technologies must be investigated and adopted in order to reduce the volumes of water required for abstraction. • A Mouth Management Plan must be developed and approved by EDTEA.	
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the anticipated aquaculture effluent discharge volumes could result in extended mouth open conditions of the estuary, converting the estuary from a Temporarily Open/Closed system to a permanently open system. This will result in the alteration of the ecological functioning of the estuary.	DIRECT	Medium Term	Study Area	Possible	Severe	HIGH NEGATIVE	• The maximum volume of effluent to be discharge must be calculated that will have the least impact on the mouth conditions of the estuary. • Water saving technologies must be adopted at the ADZ to further reduce the volumes of effluent that will be discharged.	MODERATE NEGATIVE
Water quality and chemistry	***Abstraction of water from the estuary*** During the Planning and Design Phase, the proposed abstraction volumes could alter the water chemistry and quality of the estuary depending on the state of the estuary mouth. While the volume of water to be abstracted amounts to 0.6% of the present MAR, that volume may be enough to alter the salinity of the lower reaches of the estuary.	INDIRECT	Medium Term	Study Area	Possible	Severe	HIGH NEGATIVE	• Water quality modelling must be conducted to determine the impact of abstracting 1.3 million m^3 of water per annum from the estuary on the water chemistry of the estuary. • Water saving technologies must be adopted at the ADZ to further reduce the volumes of water that will be required.	MODERATE NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the discharge of poorly treated aquaculture effluent will result in the deterioration of the water quality of the estuary. The mixing of freshwater and marine aquaculture effluent will also negatively impact the salinity of the estuary depending on the mouth condition of the estuary. Discharging of effluent into the estuary is in contradiction with the management recommendation made in the NBA and the KCDM Conservation Management Plan.	DIRECT	Short Term	Study Area	Probable	Severe	HIGH NEGATIVE	• A water quality monitoring programme must be developed and approved that ensures that the aquaculture effluent is compliant with the Water quality Standards for Marine Waters.	MODERATE NEGATIVE
Biosecurity	***Discharge of aquaculture effluent into the estuary*** During the Planning and Design Phase, inappropriate planning for the implementation of biosecurity measures could result in the spread of diseases and introduced alien species into the estuary.	DIRECT	Long Term	Study Area	Possible	Severe	HIGH NEGATIVE	• A Biosecurity Management Plan must be developed and approved to ensure that no diseases, alien species or genetically modified organisms enter into the estuary from the ADZ.	MODERATE NEGATIVE
SOCIO-ECONOMIC									
Tourism	***Abstraction of water from the estuary*** During the Planning and Design Phase, The abstraction point could potentially be sited in close proximity to the Dokodweni beach, which is a Blue Flag Pilot Beach. This could have a negative impact on the potential listing of the beach as an approved Blue Flag Beach. This could result in lower numbers of visitors to the beach.	INDIRECT	Long Term	Localised	Possible	Severe	HIGH NEGATIVE	• The siting of the abstraction point must be as far away from the Blue Flag Pilot Beach as possible.	MODERATE NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Planning and Design Phase, the siting of the aquaculture effluent discharge point opposite the Dokodweni beach will impact the water quality of the beach for bathers. This will result in the Blue Flag Pilot Beach status being revoked and a	INDIRECT	Long Term	Localised	Probable	Severe	HIGH NEGATIVE	• A water quality monitoring programme must be developed and approved that ensures that the aquaculture effluent is compliant with the Water quality Standards for Marine Waters.	HIGH NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	decrease in the number of visitors to the beach.								

Table 8.5: Assessment and mitigation of impacts during the Construction Phase of the development.

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
CONSTRUCTION PHASE									
ENVIRONMENTAL POLICY									
Legal and Policy Compliance	***Abstraction of water from the estuary*** During the Construction Phase, failure to adhere to existing policies, regulations, permits, authorisations and legal obligations could lead to the project conflicting with local, provincial and national policies, legislation, etc. This could result in lack of institutional support for the project, overall project failure and undue disturbance to the natural environment.	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• The conditions stipulated in the various authorisations must be incorporated into the EMPr and must be implemented at all times.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, failure to adhere to existing policies, regulations, permits, authorisations and legal obligations could lead to the project conflicting with local, provincial and national policies, legislation, etc. This could result in lack of institutional support for the project, overall project failure and undue disturbance to the natural environment.	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• The conditions stipulated in the various authorisations must be incorporated into the EMPr and must be implemented at all times. •	LOW NEGATIVE
BUILT ENVIRONMENT									
Stormwater management	During the Construction Phase, the inadequate installation and implementation of the recommendations stipulated in the stormwater management plan will result in increased sedimentation into the estuary and possible damage to infrastructure.	INDIRECT	Long Term	Study Area	Possible	Severe	HIGH NEGATIVE	• The recommendations stipulated in the stormwater management plan must be implemented in terms of the correct construction and installation of the required stormwater infrastructure.	MODERATE NEGATIVE
TERRESTRIAL ESTUARINE ENVIRONMENT									
Loss of natural vegetation	***Abstraction of water from the estuary*** During the Construction Phase, the construction of the pipeline will result in the loss of Critically Endangered vegetation, as per the Threatened Ecosystems Regulations. This will be in conflict with the recommendations to maintain a natural state.	DIRECT	Long Term	Localised	Definite	Severe	HIGH NEGATIVE	• The approved pipeline route must be clearly demarcated and no foot traffic or construction activities must occur outside of this demarcated area.	MODERATE NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, the construction of the pipeline will result in the loss of Critically Endangered vegetation, as per the Threatened Ecosystems Regulations. This will be in conflict with the recommendations to maintain a natural state.	DIRECT	Long Term	Localised	Definite	Severe	HIGH NEGATIVE	• The approved pipeline route must be clearly demarcated and no foot traffic or construction activities must occur outside of this demarcated area.	MODERATE NEGATIVE
Invasion of alien vegetation species	***Abstraction of water from the estuary*** During the Construction Phase, the clearing of vegetation within the EFZ will increase the risk of the establishment and invasion of alien vegetation. This will result in further transformation of Critically Endangered ecosystems. Alien invasive vegetation will also contribute to the reduced MAR experienced by the estuary, therefore altering the flow regime as well as the PES of the estuary.	INDIRECT	Long Term	Localised	Possible	Severe	HIGH NEGATIVE	• The conditions stipulated in the approved Alien Vegetation Management Plan must be implemented throughout the construction phase to ensure that alien vegetation does not begin to establish.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, the clearing of	INDIRECT	Long Term	Localised	Possible	Severe	HIGH NEGATIVE	• The conditions stipulated in the approved Alien Vegetation	LOW NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	vegetation within the EFZ will increase the risk of the establishment and invasion of alien vegetation. This will result in further transformation of Critically Endangered ecosystems. Alien invasive vegetation will also contribute to the reduced MAR experienced by the estuary, therefore altering the flow regime as well as the PES of the estuary.							Management Plan must be implemented throughout the construction phase to ensure that alien vegetation does not begin to establish.	
Erosion Management	***Abstraction of water from the estuary*** During the Construction Phase, the excavation and clearing of vegetation for the construction of the pipeline will increase the risk of erosion taking place, which will result in increased sedimentation of the estuary.	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• Erosion control measures, as designed by the engineer, must be implemented throughout the duration of the construction phase to ensure that further sedimentation of the estuary does not take place.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, the excavation and clearing of vegetation for the construction of the pipeline will increase the risk of erosion taking place, which will result in increased sedimentation of the estuary.	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• Erosion control measures, as designed by the engineer, must be implemented throughout the duration of the construction phase to ensure that further sedimentation of the estuary does not take place.	LOW NEGATIVE
AQUATIC ESTUARINE ENVIRONMENT									
Damage/destruction of aquatic features	***Abstraction of water from the estuary*** During the Construction Phase, The construction of the abstraction pipeline within the EFZ will result in alterations to the bed and banks of the proposed location within the estuary. Other features that may be damaged or destroyed include *Zostera capensis* beds. Altering the bed and banks of the estuary reduces the availability of habitat for a variety of fauna and flora that are dependent of the estuary for their survival. The REC for the estuary is an A/B and the alteration of the bed and banks will be in conflict with this.	DIRECT	Long Term	Localised	Definite	Severe	HIGH NEGATIVE	• The area within the estuary that are going to be altered must be clearly marked out and no construction activities must take place outside of this demarcated area. • The demarcated area must be kept as small as technically possible. The area to be affected must be approved by a DEA official in conjunction with the appointed ECO. • *Zostera capensis* beds must be identified prior to construction and no *Z. capensis* bed are to be altered in any way.	HIGH NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, The construction of the discharge pipeline within the EFZ will result in alterations to the bed and banks of the proposed location within the estuary. Other features that may be damaged or destroyed include *Zostera capensis* beds. Altering the bed and banks of the estuary reduces the availability of habitat for a variety of fauna and flora that are dependent of the estuary for their survival. The REC for the estuary is an A/B and the alteration of the bed and banks will be in conflict with this.	DIRECT	Long Term	Localised	Definite	Severe	HIGH NEGATIVE	• The area within the estuary that are going to be altered must be clearly marked out and no construction activities must take place outside of this demarcated area. • The demarcated area must be kept as small as technically possible. The area to be affected must be approved by a DEA official in conjunction with the appointed ECO. • *Zostera capensis* beds must be identified prior to construction and no *Z. capensis* bed are to be altered in any way.	HIGH NEGATIVE
SOCIO-ECONOMIC									
Tourism	***Abstraction of water from the estuary*** During the Construction Phase, the construction of the pipeline will temporarily affect the aesthetic quality and sense of place of the estuary. This will result in fewer visitors to the area due to the movement of construction vehicles and workers.	DIRECT	Short Term	Study Area	Possible	Severe	HIGH NEGATIVE	• The construction site must be kept as small as possible with proper waste management practices being adopted. Construction must only take place between 07:00 and 17:00 on weekdays of possible.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary	DIRECT	Short Term	Study Area	Possible	Severe	HIGH	• The construction site must be kept as	LOW

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	During the Construction Phase, the construction of the pipeline will temporarily affect the aesthetic quality and sense of place of the estuary. This will result in fewer visitors to the area due to the movement of construction vehicles and workers						NEGATIVE	small as possible with proper waste management practices being adopted. Construction must only take place between 07:00 and 17:00 on weekdays of possible.	NEGATIVE

Table 8.6: Assessment and mitigation of impacts during the Operational Phase of the development.

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
OPERATIONAL PHASE									
ENVIRONMENTAL POLICY									
Legal and Policy Compliance (NO DECOMMISSIONING)	***Abstraction of water from the estuary*** During the Operational Phase, the failure to comply with existing policies and legal obligations in terms of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) National Water Act (No. 36 of 1998) could lead to the project conflicting with local, provincial and national policies, legislation etc. This could result in legal non-compliance, fines, overall project failure or delays in operational activities.	DIRECT	Long Term	Localised	Possible	Severe	HIGH NEGATIVE	• The applicable conditions stipulated in the various authorisation and permits must be implemented throughout the operational phase of the project. • Any additional activities that may need to be undertaken during the operational phase that have not been authorised will need authorisation from the relevant Competent Authorities.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Operational Phase, the failure to comply with existing policies and legal obligations in terms of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) National Water Act (No. 36 of 1998) could lead to the project conflicting with local, provincial and national policies, legislation etc. This could result in legal non-compliance, fines, overall project failure or delays in operational activities. During the Operational Phase, the failure to comply with existing policies and legal obligations in terms of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) National Water Act (No. 36 of 1998) could lead to the project conflicting with local, provincial and national policies, legislation etc. This could result in legal non-compliance, fines, overall project failure or delays in operational activities.	DIRECT	Long Term	Localised	Possible	Severe	HIGH NEGATIVE	• The applicable conditions stipulated in the various authorisation and permits must be implemented throughout the operational phase of the project. • Any additional activities that may need to be undertaken during the operational phase that have not been authorised will need authorisation from the relevant Competent Authorities.	LOW NEGATIVE
BUILT ENVIRONMENT									
Stormwater management	During the Operational Phase, faulty or damaged stormwater infrastructure may result in contaminated or excessive stormwater from the ADZ entering into the estuary. This will alter the water quality of the estuary.	INDIRECT CUMULATIVE	Short Term	Study Area	Possible	Severe	HIGH NEGATIVE	• Stormwater infrastructure must be continuously inspected and maintained to ensure that it is in a good working order. • Infrastructure that has been identified as being damaged or faulty must be repaired immediately.	MODERATE NEGATIVE
TERRESTRIAL ESTUARINE ENVIRONMENT									
Invasion of alien vegetation species	***Abstraction of water from the estuary*** During the Operational Phase, alien invasive plan species may begin to take over in areas that have been cleared of natural vegetation or have been transformed by human activity. This will result in the further transformation of Critically Endangered Ecosystems.	DIRECT	Long Term	Localised	Probable	Severe	HIGH NEGATIVE	• The approved Alien Vegetation Management Plan must be implemented throughout the operational phase of the project.	MODERATE NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	Discharge of aquaculture effluent into the estuary During the Operational Phase, alien invasive plan species may begin to take over in areas that have been cleared of natural vegetation or have been transformed by human activity. This will result in the further transformation of Critically Endangered Ecosystems.	INDIRECT	Long Term	Localised	Probable	Severe	HIGH NEGATIVE	• The approved Alien Vegetation Management Plan must be implemented as areas are cleared.	MODERATE NEGATIVE
Erosion Management	***Abstraction of water from the estuary*** During the Operation Phase, the damage of destruction of erosion mitigation infrastructure installed around the pipeline can result in the erosion of sediment surrounding the pipeline. This will result in an increase in the sedimentation of the estuary	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• All erosion mitigation infrastructure that has been installed must be inspected on a regular basis for damage. • Any damaged infrastructure must be repaired immediately to prevent further erosion and sedimentation of the estuary.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Operation Phase, the damage of destruction of erosion mitigation infrastructure installed around the pipeline can result in the erosion of sediment surrounding the pipeline. This will result in an increase in the sedimentation of the estuary	INDIRECT	Short Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• All erosion mitigation infrastructure that has been installed must be inspected on a regular basis for damage. • Any damaged infrastructure must be repaired immediately to prevent further erosion and sedimentation of the estuary	LOW NEGATIVE
AQUATIC ESTUARINE ENVIRONMENT									
Damage/destruction of aquatic features	***Abstraction of water from the estuary*** During the Operational Phase, the abstraction of water from the estuary can cause localised alteration of the estuarine habitat. This could potentially include the scouring of the area at the opening of the abstraction pipeline and loss of aquatic life in the vicinity of the opening of the pipeline due to water being pumped out of the estuary (i.e. fish and invertebrates being sucked up into the pipeline).	DIRECT	Long Term	Localised	Probable	Severe	HIGH NEGATIVE	• A suitable grid must be placed over the opening of the abstraction pipeline to prevent, as far as possible, estuarine fauna from being sucked into the pipeline. • The grid must be checked and cleaned on a regular basis to prevent biofouling. • Any estuarine fauna that is found to be alive in the sump must be released back into the estuary immediately. However, if estuarine fauna is found in any of the production systems, that specimen cannot be released back into the estuary due to biosecurity risks. This specimen would then have to either be quarantined or humanely euthanized.	MODERATE NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Operation Phase, the discharge of aquaculture effluent may result in localised erosion of the bed and banks of the estuary. Artificial alteration of the bed and banks of the estuary will result in the deterioration of the PES of the estuary. The REC for the estuary is an A/B and the alteration of estuarine habitats is in conflict with this.	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• The discharge point need to be closely monitored. Site inspections must be conducted once a week for the first month of operation. Thereafter, an inspection of the discharge piint must be conducted once a month to monitor the level of localised erosion of the estuary bed at the discharge point.	HIGH NEGATIVE
Estuary mouth dynamics	***Abstraction of water from the estuary*** During the Operational Phase, the abstraction of water from the estuary will result in the reduction of water volume of the estuary. In order to prevent extended mouth closure conditions, water will need to build up to push through the estuary mouth. In order to allow for this, upstream flows need to replace this volume before being able to push	DIRECT	Long Term	Study Area	Probable	Severe	HIGH NEGATIVE	• The development and approval of a mouth management plan would be recommended mitigation measure provided that there is a high chance of water being made available in the system to ensure effective souring of the estuary mouth once it is opened.	HIGH NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	through. This may result extended mouth closure conditions. However, there is a decreasing tend in the MAR in the catchment and projected extended drought conditions for the near future suggest that annual rainfall trends will also decrease. This the likelihood of the volume that will be abstracted for the ADZ being replaced by upstream flows is minimal.								
	Discharge of aquaculture effluent into the estuary During the Operation Phase, the impact of the volumes of water being discharged into the estuary will depend on the mouth conditions at the time. If the estuary mouth is open, there will be no major impact on the mouth conditions of the estuary. However, if the estuary mouth is closed, the continual discharge of effluent onto the estuary will result in the water level of the estuary increasing, causing backflooding into the upstream sections of the system. This will result in the loss of habitat through inundation as well as the alteration of environmental conditions, particularly water quality (salinity). The estuary has a PES of B and a REC of A/B, therefore any manipulation of the estuary mouth will result in the deterioration of the condition of the estuary and the PES and REC will not be achieved.	DIRECT	Short Term	Study Area	Probable	Severe	HIGH NEGATIVE	• If closed mouth conditions persist, artificial breaching of the estuary is a potential mitigation measure. However, a Mouth Management Plan should be developed and submitted to EDTEA for approval before any breaching activities occur.	HIGH NEGATIVE
Water chemistry and quality	***Abstraction of water from the estuary*** During the Operation Phase, the abstraction of water from the estuary could potentially alter the water chemistry of the estuary. The removal of water from the estuary will result in the replacement of that water loss with either freshwater from the upper reaches of the system, or sea water from the marine environment. Should the estuary mouth be closed or the estuary be freshwater dominated at the time, the salinity of the water will decrease as freshwater is drawn towards to estuary to replace the water that has been abstracted. This will likely alter the faunal and vegetation communities within the lower reaches of the estuary. If the estuary mouth is open and is tidal dominated at that time, the water that will be abstracted will be replaced by high saline sea water. This is likely to impact on the distribution of species found within the estuary that can tolerate brackish conditions. Regardless of the estuary mouth conditions, the water chemistry of the estuary will be altered from its natural state.	DIRECT	Long Term	Study Area	Definite	Severe	HIGH NEGATIVE	• While there are no specific mitigation measure proposed to mitigate the abstraction of water, a comprehensive water quality monitoring programme must be developed and implemented for the duration of the operation phase. • Monthly water quality reports must be submitted the EDTEA for monitoring requirements.	HIGH NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Operational Phase, effluent containing both freshwater and marine aquaculture effluent will be discharged into the estuary. The effluent will alter the water chemistry of the estuary by discharging brackish water into an estuarine systems that varies from being marine dominated to freshwater dominated, depending on the mouth	DIRECT	Long Term	Study Area	Definite	Severe	HIGH NEGATIVE	• The effluent derived from the ADZ must be treated to meet requirements outlined in the National Guideline for the Discharge of Effluent from Land-Based Sources into the Coastal Environment and well as the National Water Quality Standards for Recreational Use due to the swimming	HIGH NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	conditions and the MAR in the Catchment. Water quality will be impacted due to the effluent potentially continuing high levels of nutrients, low oxygen levels and suspended solids. Although the estuary mouth is predominantly open, which allows for the dilution and dispersion of effluent, the estuary has a high water quality health score (EWR, 2016), which contributes to it being allocated a PES of B and a REC of A/B. Discharging aquaculture effluent will significantly degrade the water quality in the estuary and will therefore be in conflict with the PES and REC allocations. The estuary mouth also falls within an Marine Protected Area.							beach being located in close proximity to the proposed discharge point. • A comprehensive water and effluent quality monitoring plan must be developed and implemented that regularly monitors the quality of the effluent as well as the receiving environment. The monitoring plan must also include biotic monitoring.	
Control of aquatic alien species	***Discharge of aquaculture effluent into the estuary*** During the Operational Phase, there is the potential for the introduction of alien aquatic species into the estuary. *Terebia granifera* was previously introduced into the system through the existing facility that is operation. *T. granifera* dominates the systems they enter in terms of biomass due to their size. *T. granifera*, although a predominantly freshwater species, can withstand brackish condition and, due to is very hard shell, is not easily predated by fish and birds. The proliferation of *T. granifera* will result in the alteration of the natural communities of Macrobenthic fauna, decreasing the condition of the estuary.	INDIRECT	Long Term	Study Area	Possible	Severe	HIGH NEGATIVE	• A Biosecurity Management Plan must be implemented that addresses the potential introduction of *T. granifera* into the estuarine environment. Measures such as fine screen and coarse filtration of effluent to filter larvae and juveniles must be included in the management plan. • The monitoring of *T. granifera* must also be included in the comprehensive water and effluent quality monitoring plan.	MODERATE NEGATIVE
Biosecurity	***Abstraction of water from the estuary*** During the Operational Phase, incoming water from the estuary can potentially harbour pathogens such a infective bacteria and fungi. Pathogens that enter the production system could result in massive die-offs of production and boor-stock.	DIRECT	Short Term	Localised	Possible	Severe	HIGH NEGATIVE	• A Biosecurity Management Plan must be implemented that addresses the treatment of incoming water.	LOW NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Operational Phase, ineffectively treated effluent could result in the release of pathogens, invasive species and genetically modified stock into the natural system. This will impact on the natural populations of biota in the estuary with decreases in species abundance and diversity. This will likely allow for alien invasive species to dominate the system over time. Any alteration of the natural state of the estuary is in conflict with the PES and REC assigned to the estuary.	DIRECT	Long Term	Study Area	Possible	Severe	HIGH NEGATIVE	• A Biosecurity Management Plan must be implemented that addresses the treatment of aquaculture effluent.	LOW NEGATIVE
SOCIO-ECONOMIC									
Tourism	***Abstraction of water from the estuary*** During the Operational Phase, the abstraction of water from the estuary, including the noise from the pumps, will result in fewer people visiting the estuary. The Opening of the abstraction pipeline, as well as the pump houses, pose safety risks to people visitng the Dokodweni Beach.	DIRECT	Long Term	Study Area	Possible	Moderately Severe	MODERATE NEGATIVE	• The abstraction point must be clearly marked and cordoned off. Signage must be erected to warn people to avoid the abstraction point as well as the pump house.	MODERATE NEGATIVE
	Discharge of aquaculture effluent into the estuary During the Construction Phase, the discharge of effluent into the estuary will affect people's willingness to swim at the Dokodweni Beach due to	INDIRECT	Long Term	Study ARea	Probable	Severe	HIGH NEGATIVE	• The effluent derived from the ADZ must be treated to meet requirements outlined in the National Guideline for the Discharge of Effluent from Land-	MODERATE NEGATIVE

Issue	Impact Description	Nature of impact	Temporal Scale	Spatial Scale (Extent)	Certainty Scale (Likelihood)	Severity	Significance Pre-mitigation	Mitigation	Significance Post-mitigation
	concerns around water quality. The Dokodweni Beach will also lose its Blue Flag Pilot Beach Status and will not be further considered for full Blue Flag Beach Status due to water quality concerns. This will resul tin a decrease in visitor to the area and potentially the loss of jobs for the appointed life guards that are present there.							Based Sources into the Coastal Environment and well as the National Water Quality Standards for Recreational Use due to the swimming beach being located in close proximity to the proposed discharge point. • A comprehensive water and effluent quality monitoring plan must be developed and implemented that regularly monitors the quality of the effluent as well as the receiving environment. The monitoring plan must also include biotic monitoring.	

9 IMPACT STATEMENT, CONCLUSION AND RECOMMENDATIONS

This Chapter provides an overview of the impact of the proposed ADZ on the aMatigulu-Nyoni estuary as well as a concluding statement summarising the outcome of the impact assessment. Recommendations have been made to be included as part of the EMPr.

9.1 Impact Statement

Table 9.1 provides a summary of the significance of the identified impacts for the pre-mitigation scenario and the post-mitigation scenario for the Planning and Design Phase, Construction Phase and Operational Phase. Table 9.1 indicates that the majority of Impacts that were rated as High Significance can be reduce thought the implementation of the recommended mitigation measures.

Table 8.1: Assessment of pre- and post-mitigation impact significance.

PHASE	PRE-MITIGATION			POST-MITIGATION		
	LOW	MODERATE	HIGH	LOW	MODERATE	HIGH
Planning and Design Phase	0	9	12	11	9	1
Construction Phase	0	2	11	8	3	2
Operational Phase	0	3	15	6	7	5
TOTAL	**0**	**14**	**38**	**25**	**19**	**8**

A number of impacts that were identified as High Significance pre-mitigation cannot be reduced, despite the implementation of proposed mitigation measures. This is due to the sensitive nature of the aMatigulu-Nyoni estuary and the areas surrounding it. The impacts that have been identified as High Significance pre-mitigation that cannot be reduced most mitigation are provided in Table 9.2 below.

Table 9.2: The impacts that were identified that cannot be reduce from High Significance with the implementation of proposed mitigation measures

PHASE	ISSUES	IMPACT DESCRIPTION	PROPOSED MITIGATION MEASURE
Planning and Design Phase	Tourism	***Discharge of aquaculture effluent into the estuary*** During the Planning and Design Phase, the siting of the aquaculture effluent discharge point opposite the Dokodweni beach will impact the water quality of the beach for bathers. This will result in the Blue Flag Pilot Beach status being revoked and a decrease in the number of visitors to the beach.	• A water quality monitoring programme must be developed and approved that ensures that the aquaculture effluent is compliant with the Water quality Standards for Marine Waters.
Construction Phase	Damage/destruction of aquatic features	***Abstraction of water from the estuary*** During the Construction Phase, The construction of the abstraction pipeline within the EFZ will result in alterations to the bed and banks of the proposed location within the estuary. Other features that may be damaged or destroyed include *Zostera capensis* beds. Altering the bed and banks of the estuary reduces the availability of habitat for a variety of fauna and flora that are dependent of the estuary for their survival. The REC for the estuary is an A/B and the alteration of the bed and banks will be in conflict with this	• The area within the estuary that are going to be altered must be clearly marked out and no construction activities must take place outside of this demarcated area. • The demarcated area must be kept as small as technically possible. The area to be affected must be approved by a DEA official in conjunction with the appointed ECO. • *Zostera capensis* beds must be identified prior to construction and no *Z. capensis* bed are to

PHASE	ISSUES	IMPACT DESCRIPTION	PROPOSED MITIGATION MEASURE
			be altered in any way.
	Damage/destruction of aquatic features	***Discharge of aquaculture effluent into the estuary*** During the Construction Phase, The construction of the discharge pipeline within the EFZ will result in alterations to the bed and banks of the proposed location within the estuary. Other features that may be damaged or destroyed include *Zostera capensis* beds. Altering the bed and banks of the estuary reduces the availability of habitat for a variety of fauna and flora that are dependent of the estuary for their survival. The REC for the estuary is an A/B and the alteration of the bed and banks will be in conflict with this	• The area within the estuary that are going to be altered must be clearly marked out and no construction activities must take place outside of this demarcated area. • The demarcated area must be kept as small as technically possible. The area to be affected must be approved by a DEA official in conjunction with the appointed ECO. • *Zostera capensis* beds must be identified prior to construction and no *Z. capensis* bed are to be altered in any way.
Operational Phase	Damage/destruction of aquatic features	***Discharge of aquaculture effluent into the estuary*** During the Operation Phase, the discharge of aquaculture effluent may result in localised erosion of the bed and banks of the estuary. Artificial alteration of the bed and banks of the estuary will result in the deterioration of the PES of the estuary. The REC for the estuary is an A/B and the alteration of estuarine habitats is in conflict with this.	The discharge point need to be closely monitored. Site inspections must be conducted once a week for the first month of operation. Thereafter, an inspection of the discharge piint must be conducted once a month to monitor the level of localised erosion of the estuary bed at the discharge point.
	Estuary mouth dynamics	***Abstraction of water from the estuary*** During the Operational Phase, the abstraction of water from the estuary will result in the reduction of water volume of the estuary. In order to prevent extended mouth closure conditions, water will need to build up to push through the estuary mouth. In order to allow for this, upstream flows need to replace this volume before being able to push through. This may result extended mouth closure conditions. However, there is a decreasing tend in the MAR in the catchment and projected extended drought conditions for the near future suggest that annual rainfall trends will also decrease. This the likelihood of the volume that will be abstracted for the ADZ being replaced by upstream flows is minimal.	The development and approval of a mouth management plan would be recommended mitigation measure provided that there is a high chance of water being made available in the system to ensure effective souring of the estuary mouth once it is opened.
	Estuary mouth dynamics	***Discharge of aquaculture effluent into the estuary*** During the Operation Phase, the impact of the volumes of water being discharged into the estuary will depend on the mouth conditions at the time. If the estuary mouth is open, there will be no major impact on the	If closed mouth conditions persist, artificial breaching of the estuary is a potential mitigation measure. However, a Mouth Management Plan should be developed and submitted to EDTEA for approval before any breaching activities occur.

PHASE	ISSUES	IMPACT DESCRIPTION	PROPOSED MITIGATION MEASURE
		mouth conditions of the estuary. However, if the estuary mouth is closed, the continual discharge of effluent onto the estuary will result in the water level of the estuary increasing, causing backflooding into the upstream sections of the system. This will result in the loss of habitat through inundation as well as the alteration of environmental conditions, particularly water quality (salinity). The estuary has a PES of B and a REC of A/B, therefore any manipulation of the estuary mouth will result in the deterioration of the condition of the estuary and the PES and REC will not be achieved.	
	Water chemistry and quality	*Abstraction of water from the estuary* During the Operation Phase, the abstraction of water from the estuary could potentially alter the water chemistry of the estuary. The removal of water from the estuary will result in the replacement of that water loss with either freshwater from the upper reaches of the system, or sea water from the marine environment. Should the estuary mouth be closed or the estuary be freshwater dominated at the time, the salinity of the water will decrease as freshwater is drawn towards to estuary to replace the water that has been abstracted. This will likely alter the faunal and vegetation communities within the lower reaches of the estuary. If the estuary mouth is open and is tidal dominated at that time, the water that will be abstracted will be replaced by high saline sea water. This is likely to impact on the distribution of species found within the estuary that can tolerate brackish conditions. Regardless of the estuary mouth conditions, the water chemistry of the estuary will be altered from its natural state.	• While there are no specific mitigation measure proposed to mitigate the abstraction of water, a comprehensive water quality monitoring programme must be developed and implemented for the duration of the operation phase. • Monthly water quality reports must be submitted the EDTEA for monitoring requirements.
	Water chemistry and quality	*Discharge of aquaculture effluent into the estuary* During the Operational Phase, effluent containing both freshwater and marine aquaculture effluent will be discharged into the estuary. The effluent will alter the water chemistry of the estuary by discharging brackish water into an estuarine systems that varies from being marine dominated to freshwater dominated, depending on the mouth	• The effluent derived from the ADZ must be treated to meet requirements outlined in the National Guideline for the Discharge of Effluent from Land-Based Sources into the Coastal Environment and well as the National Water Quality Standards for Recreational Use due to the swimming beach being located in close

PHASE	ISSUES	IMPACT DESCRIPTION	PROPOSED MITIGATION MEASURE
		conditions and the MAR in the Catchment. Water quality will be impacted due to the effluent potentially continuing high levels of nutrients, low oxygen levels and suspended solids. Although the estuary mouth is predominantly open, which allows for the dilution and dispersion of effluent, the estuary has a high water quality health score (EWR, 2016), which contributes to it being allocated a PES of B and a REC of A/B. Discharging aquaculture effluent will significantly degrade the water quality in the estuary and will therefore be in conflict with the PES and REC allocations.	proximity to the proposed discharge point. • A comprehensive water and effluent quality monitoring plan must be developed and implemented that regularly monitors the quality of the effluent as well as the receiving environment. The monitoring plan must also include biotic monitoring.

9.2 Conclusion

The aMatigulu-Nyoni estuary has a variety of sensitive features that make development within the vicinity of the estuary a challenge. The general management recommendations made in the various policies, plans and regulations for development that is proposed to occur within the area is to ensure that that the habitat remains in as near a natural state as possible to prevent further degradation and loss of habitat and functioning.

For the purposes of this Estuary Impact Assessment for the proposed Amatikulu ADZ, the biggest impacting factor on the estuary is the proposed abstraction from and discharge into the estuary. This impact assessment did not assess the impact of abstracting from and discharging to the sea as alternatives. Changes in the volume of water in an estuary due to abstraction and discharge has a number of impacts on the ecological functioning of the estuary, including:

- Altering the mouth state of the estuary;
- Changing the water chemistry and quality;
- Influencing the distribution and composition of species of plants and animals in the extent of the system; and
- Alterations in the availability of habitat in the estuary.

It is due to the sensitive nature of estuaries in general, a number of policies, plans and regulations have been adopted to aid in the protection of estuarine habitats to ensure connectivity from freshwater to marine systems. The aMatigulu-Nyoni estuary is directly implicated in many of these plans, highlighting the importance of ensuring the sustainable management and protection of this resource.

Alterations to the physical and biological characteristics of the aMatigulu-Nyoni estuary are in direct conflict with many of the plans, policies and regulations that are currently being implemented as planning tools for habitat and ecosystem protection.

While mitigation measures have been proposed in this report to attempt to reduce the impacts that the abstraction and discharge activities may have on the aMatigulu-Nyoni estuary, the challenge arises where the project can be implemented in such a way that it finds some coercion with the management objectives of the programmes that aim to protect the estuary from further transformation.

9.3 Recommendations

Should the proposed project receive and Environmental Authorisation, the mitigation measures that have been proposed in this report must be incorporated into the final EMPr, which must be implemented and monitored during all phases of the development.

9.4 Proposed management plans to be developed and implemented as part of the final EMPR

In summary, the following plans need to be developed as part of the final EMPr and Project monitoring, incorporating all the issues, conclusions and recommendations of this report:

- Water Quality and Effluent Monitoring Programme, including biotic monitoring;
- Stormwater and Erosion Management Plan;
- Biosecurity Management Plan; and
- Alien Vegetation Management Plan

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