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Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

ALGOA BAY SEA-BASED AQUACULTURE DEVELOPMENT ZONE

BASIC ASSESSMENT PROCESS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998)

Pre-application Basic Assessment Report

March 2019

ANCHOR
research & monitoring

Anchor Research and Monitoring Report No. 1808/1

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Report Prepared for:
Department of Agriculture, Forestry & Fisheries

Report Prepared by:
Anchor Research and Monitoring (Pty) Ltd.
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[1] Contributing authors from previous reports: Melissa Mackay - CapeEAPrac; Prof Jonathan Bloom –Umcebisi Business Advisers (Pty) Ltd; Stephen Stead, Genie de Waal and Heather Stead - Visual Resource Management Africa cc; Professor Peter Britz, Professor Warwick Sauer, Stephen Hosking, Willem Schoonbee, Gavin Johnson – Rhodes University.

PROJECT DETAILS

Objective	Application for Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998)
Applicant	Department of Agriculture, Forestry & Fisheries
Environmental Assessment Practitioner (EAP)	Vera Massie and Dr Barry Clark from Anchor Research & Monitoring (Pty) Ltd
Anchor Project Name	Algoa Bay Sea-Based Aquaculture Development Zone Basic Assessment Process
Anchor Project Number	1808
Report name	Pre-application Basic Assessment Report
Status	Pre-application
Application submission date	Not submitted
Competent Authority Reference	Not currently assigned
Case Officer	Not currently assigned

OVERVIEW OF PROJECT OUTPUTS
BASIC ASSESSMENT REPORT AND APPENDICES

Basic Assessment Report (BAR)	**Pre-Application BAR**, Draft BAR, Final BAR
Appendix A	Details of EAP, Expertise and Declaration
Appendix B	Details of Specialists, Expertise and Declaration
Appendix C	Background Information Document
Appendix D	Specialist studies: 1. Benthic Mapping Assessment for the Proposed Algoa Bay Sea-Based Aquaculture Development Zone (Dawson *et al.* 2019) 2. Dispersion Modelling Study for the Proposed Algoa Bay Sea-Based Aquaculture Development Zone (Wright *et al.* 2019) 3. Marine Specialist Study 2019 (Hutchings *et al.* 2019) 4. Maritime Underwater Heritage Specialist Study (Gribble 2019) 5. Comparative Assessments for the Development of the Proposed Sea Based Aquaculture Development Zone Located within Algoa Bay in the Eastern Cape in South Africa (Rhodes University August 2016) a. Socio-economic Report b. Ecological Report c. Feasibility study
Appendix E	Stakeholder Consultation Report
Appendix F	Environmental Management Programme (EMPr)
Appendix G	Additional Information

COMPLIANCE CHECKLIST

Regulation 326 of NEMA, Appendix 1 Section 3: "Scope of assessment and content of basic assessment reports"

The following table is included as a guide for stakeholders and officials reviewing this report during the commenting and decision-making period. The table below contains the minimum requirements for a Basic Assessment Report as detailed in Sub-section (1) and guides the reader to the relevant Chapter/Sections/Appendices where specific aspects are detailed.

Sub-section	Requirement	Chapter/Section/ Appendix reference
(a)	Details of – (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;	Section 2.5.1 and Appendix A
(b)	The location of the activity, including: (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the (iv) coordinates of the boundary of the property or properties;	N/A Sea space
(c)	A plan which locates the proposed activity or activities applied for as well as associated structures and infrastructure at an appropriate scale; or, if it is— (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Section 3.5
(d)	A description of the scope of the proposed activity, including— (i) all listed and specified activities triggered and being applied for; and (ii) a description of the activities to be undertaken including associated structures and infrastructure	Section 4.2 and Chapter 3
(e)	A description of the policy and legislative context within which the development is proposed including— (i) an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and (ii) how the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments;	Chapter 3 and Chapter 6
(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	Chapter 5
(g)	A motivation for the preferred site, activity and technology alternative;	To be completed
(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including – (i) details of all the alternatives considered (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; (iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and	Section 3.5 and Appendix E (to be completed after the pre-application process), Chapter 7, Chapter 9

Sub-section	Requirement	Chapter/Section/ Appendix reference
	cultural aspects; (v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts— a. can be reversed; b. may cause irreplaceable loss of resources; and c. can be avoided, managed or mitigated; (vi) the methodology used in determining and ranking the nature, significance, (vii) consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; (viii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; (ix) the possible mitigation measures that could be applied and level of residual risk; (x) the outcome of the site selection matrix; (xi) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and (xii) a concluding statement indicating the preferred alternatives, including preferred location of the activity;	
(i)	A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including— (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Section 9.2
(j)	An assessment of each identified potentially significant impact and risk, including— (i) cumulative impacts; (ii) the nature, significance and consequences of the impact and risk; (iii) the extent and duration of the impact and risk; (iv) the probability of the impact and risk occurring; (v) the degree to which the impact and risk can be reversed; (vi) the degree to which the impact and risk may cause irreplaceable loss of (i) resources; and (ii) the degree to which the impact and risk can be avoided, managed or mitigated;	Chapter 9
(k)	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;	Section 9.3
(l)	An environmental impact statement which contains— (i) a summary of the key findings of the environmental impact assessment; (ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Section 10
(m)	Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management	Section 9.3

Sub-section	Requirement	Chapter/Section/ Appendix reference
	outcomes for the development for inclusion in the EMPr;	
(n)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	To be completed
(o)	A description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Chapter 9
(p)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	To be completed
(q)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised;	N/A
(r)	An undertaking under oath or affirmation by the EAP in relation to – (i) the correctness of the information provided in the reports; (ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties;	Appendix A
(s)	Where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	N/A
(t)	Any specific information that may be required by the competent authority; and	N/A
(u)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	N/A

ANCHOR RESEARCH & MONITORING (PTY) LTD

Organisational Background

Anchor Research & Monitoring is part of the Anchor Environmental group of companies. We are based in Cape Town, South Africa, and have a core staff of sixteen professionals with tertiary level qualifications in environmental science and management. We offer ecological and economic expertise to inform management and decision making regarding the use and conservation of natural resources. Our main areas of focus are marine, estuarine and freshwater ecosystems, terrestrial, ecosystems, ecosystem services, livelihoods and socio-economics, resource economics, conservation policy, strategy and planning, natural resource management, environmental management and environmental flows. Our work includes ecological and socio-economic research and baseline studies, environmental impact assessments, environmental management plans and environmental flow assessments. We are experienced in ecological sampling methods, social survey methods, statistics and econometrics, ecological-economic modelling, geographic information systems as well as stakeholder coordination, engagement and maintaining of stakeholder relations.

We see the bigger picture and simplify complex problems to provide rational and pragmatic solutions. Our staff are associates of the University of Cape Town and have produced more than 500 technical reports and we have published have published over 100 scientific papers and regularly participate in international conferences. We have worked on projects throughout southern and eastern Africa. We have our own library of over 1000 books and reports and 6500 published papers, as well as access to the University of Cape Town's library services. We are strong in project management and draw from an excellent network of proven specialists as required.

Relevant Experience

We have considerable experience in the aquaculture sector, including our involvement in drafting legislation, baseline monitoring, environmental impact assessment, stakeholder consultation, application for environmental authorisation, substantive amendment of existing environmental authorisation, and long-term monitoring of the marine environment at impacted precincts.

We are currently conducting the basic assessment process for Diamond Coast Aquaculture and have completed a number of other projects for the South African aquaculture and fisheries sector (e.g. Atlantic Salmon, Southern Cross Salmon, Kleinzee Mariculture, Abagold Ltd, Port Nolloth Seafarms, Viking Fishing, and Molapong Aquaculture). In 2013, Anchor assisted the Department of Environmental Affairs and Development Planning (DEADP) in drafting national standards for the abalone and trout farming industries. The long-term monitoring study in Saldanha Bay and Langebaan Lagoon (annual State of the Bay Report since 2008) annually updates an elaborate section on the aquaculture sector and marine ecological impacts in Saldanha Bay. Refer to the Curricula Vitae of Dr Barry Clark and Vera Massie and Dr Kenneth Hutchings for details on these and other projects (Appendix A).

The proposed structure and composition of the project team is summarised in the table below. All key areas of expertise required for the assignment are encompassed by the qualifications and experience of the project team members including project management, environmental management within the context of marine biodiversity, aquaculture sector, GIS/Spatial planning, experience in the field, and stakeholder consultation. A brief overview of the company (Anchor Environmental) is provided below along with profiles for the core team members. Curricula Vitae for each of the core team members is included as appendices to this tender proposal.

Table 1 Professional Anchor staff to be deployed on the project.

Name of Staff	Area of Expertise	Position Assigned	Task Assigned
Barry Clark	Marine and coastal ecology, natural resource management, Environmental Management,	Project manager	Supervision of deliverables
Vera Massie	Environmental Management, environmental legislation, marine biology, invasion biology, stakeholder consultation	Project coordinator and principal EAP	Overall coordination, execution of deliverables, stakeholder consultation, training of junior staff
Ken Hutchings	Aquaculture, fisheries and marine ecology	Marine ecology and aquaculture specialist	Reviewer of marine biology and ecology related aspects
Megan Laird	Marine and coastal ecology, impact assessment	Marine ecology specialist study	Marine specialist impact assessment.
Amy Wright	Marine and coastal ecology, impact assessment, dispersion and carrying capacity modelling	Dispersion and carrying capacity modelling	Marine specialist impact assessment, project description
Jessica Dawson	Estuarine and benthic ecology, taxonomy	Benthic community analyses and description	Benthic mapping report
Songezo Mtsokoba	Laboratory technician, environmental management	Junior staff, expand skills in environmental management	Support and skills development during all phases of the project.

Summary profiles

Dr Barry Clark

Dr Barry Clark has twenty-one years' experience in estuarine, freshwater, terrestrial and marine biological research and consulting. He has worked as a scientific researcher, lecturer and consultant and has experience in tropical, subtropical and temperate ecosystems. He is presently Director of an Environmental Consultancy firm (Anchor Environmental Consultants) and Research Associate at the University of Cape Town. As a consultant he has been concerned primarily with conservation planning, monitoring and assessment of human impacts on freshwater, estuarine, terrestrial and marine ecosystems, aquaculture and fisheries. Dr Clark is the author of 27 scientific publications in class A scientific journals as well as numerous scientific reports and popular articles in the free press. Geographically, his main area of expertise is southern Africa (South Africa, Lesotho, Namibia, Mozambique, Tanzania, Seychelles, Mauritius and Angola), but he also has working experience from elsewhere in Africa (Cote d'Ivoire, Ghana, Nigeria, Liberia), the Middle East (UAE) and Europe (Azerbaijan).

Vera Massie

Vera earned degrees in marine biology, environmental management and conservation biology from the University of Cape Town. Her training has equipped her to consult on research projects incorporating the maintenance and conservation of marine and estuarine ecosystems. She also consults on the biophysical, socio-economic and legal aspects in the assessment of human impacts on coastal and terrestrial environments in the temperate and tropical regions of South Africa. Working at Anchor Environmental Consultants, she has gained experience in drafting environmental legislation, preparing guidelines and developing frameworks to facilitate successful implementation of legislation. Many of her projects involve the monitoring and evaluation of compliance with environmental laws and their associated regulations across varying economic sectors.

Dr Kenneth Hutchings

Dr Hutchings has research and consulting experience in the fields of fisheries management, mariculture, estuarine research and management, marine and estuarine spatial planning, marine impact assessment, research and conservation strategy development, fishery socio-economic surveys and analyses, biological sampling and life-history analyses of fish (age and growth, reproduction, mortality, migration, diet, ecology), taxonomic methodology, population genetics, fisheries modelling, marine ecotoxicity trials, trace metal pollution and physico-chemical, ecological and biodiversity surveys of marine, estuarine and freshwater habitats. Dr Hutchings is experienced in developing estuarine and coastal management plans and in conducting public participation processes. Dr Hutchings is a research associate of the University of Cape Town's Marine Research Institute. He has excellent verbal and writing communication skills, is competent with most software packages used in scientific research and consulting projects.

He has published 17 scientific papers and compiled more than 50 consulting reports. Dr Hutchings is comfortable working as part of a team in both a leadership and mentoring position or as a team member. Dr Hutchings has participated in international collaborative studies in Angola, Tanzania, Namibia, Sierra Leone and Mauritius and has visited and participated in fisheries in Mozambique, Madagascar, Seychelles, New Zealand and Belize. He was actively involved in commercial fishing around Cape Town for 14 years, has practical experience in several sectors and has good understanding of most commercial fishing methods (line, spear, pole, gill net, trammel, net, beach seine net, trap, longline, trawl and purse-seine). He has personally collected scientific data for the demersal trawl and longline hake fisheries, designed, implemented and managed fishery observer training programmes for line, longline, lobster trap and demersal trawl fisheries. He has project managed and completed two, three-year contract research projects for the South African Department of Environmental Affairs and Tourism (Marine and Coastal Management) and numerous consulting projects for state and private sector clients.

Dr Megan Laird

Dr Megan Laird is a senior consultant at Anchor Environmental Consultants (Pty) Ltd. with four years of experience in managing a broad range of marine and coastal projects in South Africa and Namibia. These include marine and coastal specialist studies for Environmental Impacts Assessments (EIAs) and long-term marine and estuarine environmental monitoring studies. She has also acquired skills in the modelling of effluent that is discharged into the marine environment from land-based sources. She earned degrees in zoology and ecology (BSc, BSc-Honours) and marine biology (PhD) from the University of Cape Town. Dr Laird is the author of numerous scientific publications, consulting reports and popular articles in the free press.

Amy Wright

Amy has earned an MSc degree in biological sciences and BSc. Hons degrees in marine biology and applied biology from the University of Cape Town. Her training has equipped her to consult on research projects incorporating the maintenance and conservation of marine and estuarine ecosystems. Her interests include fisheries management, systems ecology and taxonomy. Amy specialises in fluid dynamic modelling of effluent into both freshwater and marine systems to inform water regulatory guideline compliance and pipeline design. Many of her projects involve monitoring and evaluation, across varying economic sectors. She also conducts biophysical and socio-economic aspects in the assessment of human impacts on temperate and tropical coastal regions of South Africa, is involved in monitoring program development as well as data collection, data management and analysis, and has worked as an invertebrate taxonomist for the De Beers Marine Namibia and the NAMDEB Diamond Corporation Environmental Monitoring Programmes. She is the author of two scientific publications in class A scientific journals as well as numerous popular articles in the free press.

Jessica Dawson

Jessica will shortly submit her PhD in estuarine ecology at the University of Cape Town, where she completed her MSc and Honours degrees in Zoology/Biological Sciences, and a BSc in Marine Biology and Oceanography. Her training included the taxonomic description of three new species and ecological studies on the impact of target species on their environments. This has equipped her to interpret community data, and assist in monitoring and biological assessment reports. She is the author of four scientific publications in peer reviewed journals.

Songezo Mtsokoba

Songezo earned a national diploma and Btech in environmental management from the Cape Peninsula University of Technology. His training has equipped him to understand various aspects of environmental management system and knowledge to identify significance impacts towards the environment and human health. At Anchor Environmental he has gained a rare laboratory technical skill operating a sediment laser defraction machine used for characterising the very fine component of sediment samples collected in the marine environment.

TABLE OF CONTENTS

GLOSSARY

Alien	An organism occurring outside its natural past or present range and dispersal potential including any parts of the organism that might survive and subsequently reproduce (organisms whose dispersal is caused by human action).
Anaerobic conditions	The absence of molecular oxygen or air
Bathymetry	The measured depth of water in oceans, seas, or lakes
Bioaccumulation	The process where the chemical concentration in an aquatic organism achieves a level that exceeds that in the water as a result of chemical uptake through all routes of chemical exposure (e.g. dietary absorption, transport across the respiratory surface, dermal absorption).
Bioconcentration	The intake and retention of a substance in an organism entirely by respiration from water in aquatic ecosystems or from air in terrestrial organisms.
Biomagnification	Synonym: bioamplification or biological magnification. The increasing concentration of a substance, such as a toxic chemical, in the tissues of organisms at successively higher levels in a food chain.
Biosecurity	A set of preventive measures designed to reduce the risk of transmission of infectious diseases, quarantined pests, invasive alien species, and living modified organisms.
Chemical oxygen demand	A measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite.
Chlorophyll	The green pigment found in the chloroplasts of higher plants and in cells of photosynthetic microorganisms (e.g. photosynthetic bacteria), which is primarily involved in absorbing light energy for photosynthesis.
Coliforms	Gram-negative, non spore-forming, oxidase-negative, rod-shaped facultative anaerobic bacteria that ferment lactose (with β-galactosidase) to acid and gas within 24– 48h at 36±2°C. Not specific indicators of faecal pollution.
Endemic	Organisms restricted to a specified region or locality.
Enterococci and faecal streptococci	Enterococci and faecal streptococci both refer to vaguely defined groups of Gram-positive spherical bacteria, some of which are members of the natural flora of various environments. Because of the limited specificity of tests commonly used for these groups, they can, for all practical purposes be considered to be the same.
Environmental Management Programme	A programme for managing potential impacts identified during the approval process.

Escherichia coli	Member of the group of faecal coliform bacteria. It is highly specific to the faeces of warm-blooded animals and cannot multiply in any natural water environment.
Euphotic zone	In a water body, the layer closer to the surface that receives enough light for photosynthesis to occur.
Exotic	See definition of 'Alien'
Fauna	General term for all of the animals found in a particular location.
Flagellum	Plural flagella or flagellums. In protists, a long, whiplike membrane-enclosed organelle used for locomotion or feeding. In bacteria, a long, whiplike proteinaceous appendage, used for locomotion.
Flora	General term for all of the plant life found in a particular location.
Interested and Affected Parties	All stakeholders that have an interest in and/or are affected by the proposed development.
Introduction	Direct or indirect movement of an organism within its past or present range to a range outside its distribution potential.
Invasive	Alien organisms that have naturalised in a new area and expanding their range.
Invertebrate	An animal that has no backbone or spinal column and therefore does not belong to the subphylum Vertebrata of the phylum Chordata
Macrobenthos	Benthic organisms that are big enough to be seen with the naked eye.
Microbial indicator organisms	Micro-organisms that may not pose a major human health risk, but that are indicative of the presence of human pathogens.
Mixing zone	A mixing zone is an administrative construct which defines a limited area or volume of the receiving water where the initial dilution of a discharge is allowed to occur, until the water quality standards are met. In practice, it may occur within the near-field or far-field of a hydrodynamic mixing process and therefore depends on source, ambient, and regulatory constraints.
Native	An organism occurring within its natural past or present range and dispersal potential (organisms whose dispersal is independent of human intervention).
Phytoplankton	Mostly microscopic, single-celled photosynthetic organisms that live suspended in water. Like land plants, they take up carbon dioxide, make carbohydrates using light energy, and release oxygen.
Species	is defined in terms of the National Environmental Management: Biodiversity Act (Act No 10 of 2004), which means a kind of animal, plant or other organism that does not normally interbreed with individuals of another kind, and includes any subspecies, cultivar, variety, geographic race, strain, hybrid or geographically separate population.

Stormwater	Rain that washes off driveways, parking lots, roads, yards, rooftops, and other hard surfaces and s carried away through a system of pipes that is separate from the sewerage system. Stormwater is not treated and is often highly polluted.
Turbidity	The cloudiness or haziness of a fluid caused by large numbers of individual organic and/or inorganic particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.
Upwelling	A process that is induced by offshore winds transporting coastal surface water offshore, which is replaced by rising deep, cold and nutrient-rich water.
Zooplankton	Plankton that is of animal origin.

ABBREVIATIONS

ADZ	Aquaculture Development Zone
BA	Basic Assessment
BAR	Basic Assessment Report
BBBEE	Broad-Based Black Economic Empowerment
CDC	Coega Development Corporation
COD	Chemical Oxygen Demand
CWDP	Coastal Waters Discharge Permit
DAFF	Department of Agriculture Forestry and Fisheries
DEA	Department of Environmental Affairs
DEA:O&C	Department of Environmental Affairs Branch: Oceans & Coasts
DEADP	Department of Environmental Affairs and Development Planning
DEAT	Department of Environmental Affairs and Tourism
DEDT	Department of Economic Development and Tourism
DM	District Municipality
DO	Dissolved oxygen
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
I&AP	Interested and Affected Party
ICMA	National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008)
IDP	Integrated Development Plan
LM	Local Municipality
MCM	Marine Coastal Management
MLRA	Marine Living Resources Act (Act 18 of 1998)
MPA	Marine Protected Area
NEM: WA	National Environmental Management: Waste Act (Act 59 of 2008)
NEM:BA	National Environmental Management: Biodiversity Act (Act No 10 of 2004)
NEM:PAA	National Environmental Management: Protected Areas Act (Act 57 of 2003)
NEMA	National Environmental Management Act (Act 107 of 1998)
NHRA	National Heritage Resources Act
RMZ	Recommended Mixing Zone
SAHRA	South African Heritage Resources Agency

SAMSA	South African Maritime Safety Authority
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
SoE	State owned Enterprise
TSS	Total Suspended Solids
U.S.	United States
UNFAO	United Nations Food and Agriculture Organisation
VIA	Visual Impact Assessment
VRM	Visual Resource Management Africa CC
WWTW	Waste Water Treatment Works

1 INTRODUCTION

The Department of Agriculture, Forestry and Fisheries (DAFF), as the lead agent for aquaculture management and development in South Africa, intends to establish and manage a sea-based Aquaculture Development Zone (ADZ) in Algoa Bay in the Eastern Cape. DAFF recently successfully established the first sea-based ADZ in Saldanha Bay in the Western Cape. A Sea-based ADZ typically consists of a selection of designated precincts that provide opportunities for existing aquaculture operations to expand and new ones to be established. ADZs are intended to boost investor confidence by providing 'investment ready' platforms with strategic environmental approvals and management policies already in place, allowing commercial aquaculture operations to be set up without the need for lengthy, complex and expensive approval processes. It is anticipated that an ADZ will create incentives for industry growth, provide marine aquaculture services and enhance consumer confidence. An ADZ provides economic benefits to the local community through job creation and regional economic diversification.

Aquaculture is one of the sectors that form part of Operation Phakisa under the Ocean's Economy in South Africa. Operation Phakisa is an initiative of the South African government which aims to implement priority economic and social programmes better, faster and more effectively. Operation Phakisa was launched by the President of the Republic in October 2014. The sector offers significant potential for rural development, especially for marginalised coastal communities. The proposed development will provide employment opportunities for the local and regional communities.

In 2009 a Strategic Environmental Assessment (SEA) was undertaken for the entire South African coastline to identify suitable aquaculture precincts. In this assessment the Eastern Cape was highlighted as an area holding potential for the establishment of ADZs. As part of a finer-scale SEA undertaken by DAFF in 2011, two precincts, namely Algoa 1 (near Summerstrand) and 5 (opposite the Addo Elephant National Park) were identified as the most promising options for establishment of an ADZ in this area. Environmental Authorisation (EA) was granted for Algoa 1 on 9 July 2014 following a lengthy Environmental Impact Assessment (EIA) process, which was initiated in 2010. During the appeals process that followed the positive decision, a total of twenty eight (28) substantive appeals were lodged against the decision. In response, the Minister of Environmental Affairs issued a decision on the Appeal suspending the EA to allow for further studies to be undertaken.

In mid-2016, DAFF commissioned three comparative assessments, including a detailed feasibility study (Britz & Sauer 2016b), a socio-economic assessment (Britz *et al.* 2016) and a marine ecological assessment (Britz & Sauer 2016a) for Algoa 1 and 5 (these three studies have been included as stand-alone documents in Appendix D of this Basic Assessment Report). The economic feasibility study (Britz and Sauer 2016b) found that conditions at Algoa 5 were sub-optimal for economic aquaculture and mitigation measures would be impractical or uneconomic to implement, which renders the proposed site not economically competitive. Furthermore, Algoa 5 is located in the middle of the Addo Marine Protected Area (MPA), which was recently approved by cabinet. For the reasons described above, Algoa 5 was screened out and has not taken forward as a potential precinct in the current Basic Assessment process.

DAFF has since withdrawn the original application for environmental authorisation and intends to submit a new application for the development of the ADZ for which a Basic Assessment process is required in terms of the 2014 EIA Regulations (as amended in 2017) of the National Environmental Management Act (Act 107 of 1998) (this application). DAFF intends for the ADZ to accommodate finfish as well as bivalve culture (oysters/mussels) within a combination of precincts.

The precincts considered in this application include one precinct from the previous process (Algoa 1), and two new precincts, designated as Algoa 6 and 7 (Figure 1). Algoa 6, situated near the Port Elizabeth Harbour, was identified but screened out in the scoping phase of the original EIA (2010-2014) which focussed only on finfish culture, and is now been put forward as a suitable site for bivalve production in this new (2019) application process. Algoa 7 is a new precinct located directly in front of the Ngqura harbour that has been identified as a potential site for finfish culture. This site has undergone an internal feasibility assessment in which it was found to be suitable in terms water depth, shipping traffic, and accessibility (i.e. financial considerations). This site overlaps with the recently approved Addo Marine Protected Area (MPA) but the Department of Environmental Affairs Branch Oceans and Coasts has indicated that the affected portion of this site could potentially be excised should Environmental Authorisation be granted for this precinct. Thus, in this application process, two sites, Algoa 1 and 7, are being put forward for finfish culture , while one of these, Algoa 1, along with a third site, Algoa6, is being put forward for bivalve culture (Figure 1).

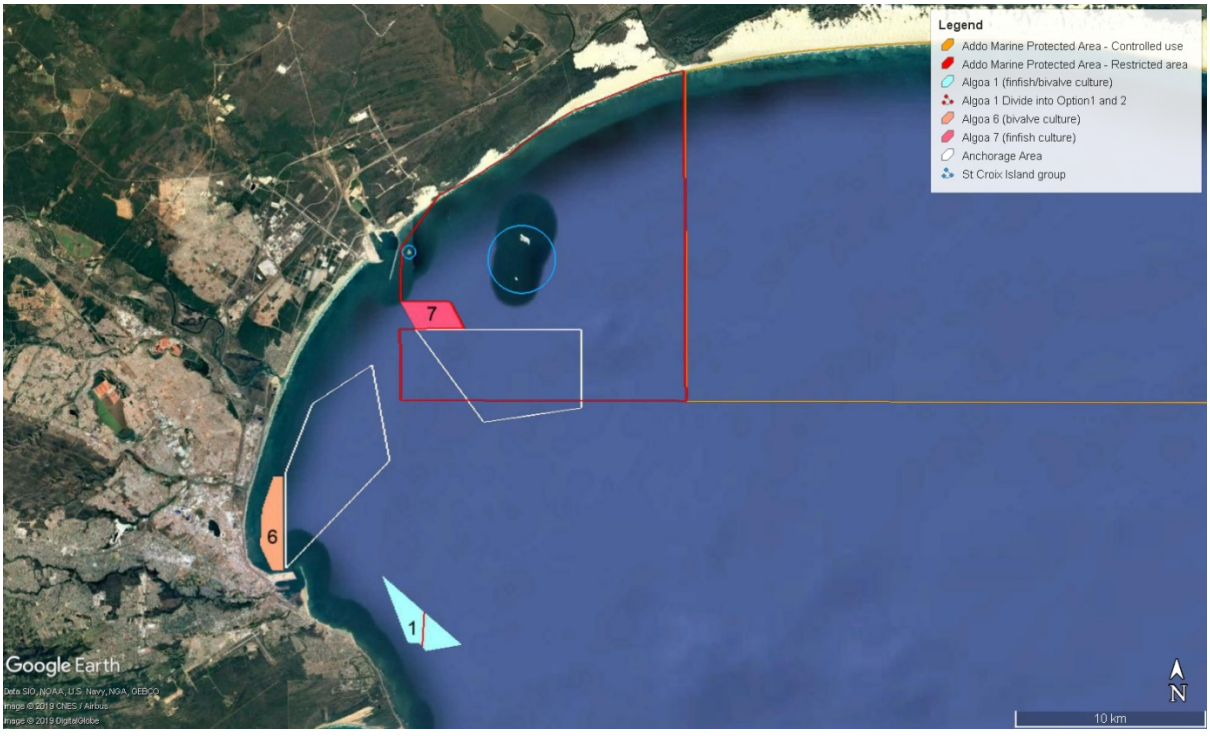

Figure 1 **Precincts considered during the 2019 application for environmental authorisation for a sea-based Aquaculture Development Zone in Algoa Bay, Eastern Cape. Precincts 1, 6 and 7 constitute feasible precincts and have been considered during the present Basic Assessment process. The Department of Environmental Affairs Branch Oceans and Coasts has indicated that Algoa 7 could potentially be excised from the Addo Marine Protected Area should Environmental Authorisation be granted for this precinct.**

DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay. Rather than considering each of the three sites (Algoa 1, 6 and 7) in isolation, three alternative configurations of precincts, Options A, B and C, as outlined in Table 2, are being considered in this Basic Assessment process. Potential environmental impacts associated with each of these options have been assessed in this Basic Assessment Report.

Table 2 Proposed alternative options to be assessed in the Basic Assessment process for the proposed Algoa Bay Aquaculture Development Zone.

Alternative options	Algoa 1	Algoa 6	Algoa 7
A	Finfish & bivalves	Bivalves	Finfish
B	Bivalves	Bivalves	Finfish
C	X	Bivalves	Finfish
D (No-go option)	X	X	X

DAFF appointed Anchor Research & Monitoring (Pty) Ltd (Anchor) to undertake the Basic Assessment (BA) process for the proposed Aquaculture Development Zone. DAFF intends to motivate for an initial pilot phase prior to proceeding with full scale production.

The purpose of this **pre-application Basic Assessment Report** is to:

(1) Describe the process to be followed (focussing on the public participation process and specialist studies);
(2) Describe the affected environment;
(3) Describe the proposed project;
(4) Present the findings of the impact assessment; and
(5) To recommend how the development concept should be adjusted to mitigate the identified impacts.

This **pre-application BAR** describes and assesses potential environmental impacts associated with each of the three precincts (Algoa 1, 6, and 7) individually first, and subsequently in combination in the form of alternate options as they have been configured for this EIA process (i.e. Option A, B and C, Table 2) together with the No-Go option (Alternative D).

2 BACKGROUND

Aquaculture is defined as the propagation, improvement, rearing, regular stocking, feeding or protection from predators and harvesting of aquatic organisms (plant and animal) in controlled or selected aquatic environments (fresh, sea or brackish waters, on land or at sea) for any commercial, subsistence, recreational or other public or private purposes (DEA&T 2007, South African Aquaculture Development Bill 2018).

Unlike with 'capture fisheries', which entail the harvesting of aquatic organisms from the natural environment in which no attempt has been made to manage, or otherwise influence the organisms by containment, feeding or application of any husbandry technique, aquaculture involves some form of intervention in the rearing process to enhance production i.e. regular stocking, feeding and protection from predators.

Due to a growing interest in aquaculture, the Provincial Department of Economic Development, Environmental Affairs and Tourism in the Eastern Cape Province (DEDEAT) published an Introduction to Aquaculture in the Eastern Cape (Hinrichsen 2008) in which it is stated that the global harvest of natural aquatic resources for food, protein, oils and other materials has reached capacity and has already caused a collapse in the stocks of various species, habitat loss and pollution. Nevertheless, the demand for these aquatic resources is increasing and controlled aquaculture production has the potential to meet this demand in a responsible manner.

Marine aquaculture, or mariculture is the process of cultivating and harvesting sea based aquatic organisms. Marine aquaculture includes the commercial farming of all marine organisms such as finfish (or true fish), shellfish (abalone, mussels, prawns) and seaweed.

2.1 History of marine aquaculture in South Africa

Over the past 30 years aquaculture has developed into a global industry with over 100 countries engaging in the production of more than 250 different species of finfish, shellfish, crustaceans and aquatic plants (DEAT 2007).

The Food and Agriculture Organisation (FAO) of the United Nations Fisheries and Aquaculture Department regularly publishes Global Aquaculture Production Statistics online. According to the newly released data, world marine aquaculture production of food fish was 59 million tonnes in 2016, of which Africa contributed only 0.28% of the total production (167 000 t). The estimated value of food fish farmed in the marine environment is USD 101 million (FAO 2018BA), which compares favourably to 79.3 million tons of wild marine fish caught globally in 2016.

Commercial marine aquaculture in South Africa started in the 1980's with the establishment of oyster, mussel and prawn farming. Abalone farming was developed in the 1990s and is now the most valuable resource of the sector. South Africa is regarded as the top producing country of farmed abalone. DAFF annually compiles, analyses and interprets aquaculture production data, which is published in the Annual Aquaculture Yearbook. The most recent Yearbook was published in 2016 and contains the production data for 2015 (DAFF 2016).

During 2015, species cultivated in the marine sector included abalone (*Haliotis midae*), pacific oyster (*Crassostrea gigas*), mussels (*Mytilus galloprovincialis, Chromomytilus meridionalis*), dusky kob (*Argyrosomus japonicus*), and seaweed (*Ulva spp, Gracilaria spp*).

In 2015, the total South African marine aquaculture production was 3592 tonnes, where mussels (1758.44 tons) contributed most to production, followed by abalone (1479.22 tons) and then oysters (276.85 tons). Finfish contributed the least to production in the marine sector. In 2015, the Eastern Cape was home to approximately 38% of South Africa's aquaculture producers (13 out of a total of 34) and has been identified as having significant marine aquaculture potential. The coastline is well known for the harvest of natural marine resources and possesses the potential for the development of a strong marine and freshwater aquaculture sector.

2.2 Finfish farming

Finfish are animals with a skull and in most cases a backbone, that have gills throughout their life and whose limbs, if any, are in the shape of fins. The development of modern sea cage finfish farming which began in the 1970s, occurred largely due to the growth of the salmon farming industry in countries with glaciated coastlines (e.g. Scotland, Norway, British Columbia, Chile) (Clark *et al.* 2013). The number of finfish species used in marine cage culture internationally has since grown dramatically and now includes salmon, tuna, flatfish, kingfish, bream, Sciaenids (e.g. sea bass) and a host of other species grown in a variety of cage culture systems (Staniford 2002).

Although some sea cage farming operations rely on wild caught stock e.g. southern and northern bluefin tuna farms (located largely in Australia and the Mediterranean, respectively), most farms use finfish fingerlings that are obtained from land based hatcheries, where brood stock, egg and larvae husbandry can be carried out under controlled conditions. Fingerlings are stocked into sea cages at species- and environmentally-specific optimal sizes and densities, are fed, usually with commercially available protein and lipid rich dry food, treated for diseases and parasites, graded, and harvested at a size that results in the maximum economic return.

2.3 Shellfish farming

The global production of bivalves has grown from around 1 million tonnes in 1950 to 16.1 million tonnes in 2015 (FOA 2018), with just over half of the volume derived from aquaculture production (McKindsey *et al*. 2011). Bivalve aquaculture accounts for roughly 27% of global aquaculture production and provided approximately 13% of the total fish produced for human consumption worldwide in 2006 (FOA 2009). The rapid growth of the industry has raised concerns about the ecological and physico-chemical impacts of aquaculture on local environment (Black 2001) and numerous studies have been conducted to help better understand the ecological role played by culturing activities (Davenport *et al*. 2003; Holmer *et al*. 2008, National Research Council 2010). Ecological studies of bivalve aquaculture have indentified three primary ways that bivalve culture can impact the ecosystem: 1) material processes – the consumption of food and production of waste, 2) physical structure – the introduction of artificial substrate in the form of structures and anchoring, and the introduction of the aquaculture species itself, and 3) pulse disturbances – as

result of harvesting efforts (Dumbauld *et al*. 2009). Suspended ropes or baskets on longlines or rafts, the method commonly used for bivalve mariculture in South African, reduces the impacts of pulse disturbance because harvesting and maintenance is conducted from boats which ensures that there is no additional physical contact with the benthos. This off-bottom method is, however, more susceptible to biofouling (Shumway & Whitlatch 2011). The impacts of this can be mitigated by appropriate planning and management, which if conducted with enough regularity, can prevent biofouling species from significantly altering the benthic community (Forrest *et al*. 2009). Many studies have focused on the role of bivalve biodeposition to changes in the benthos. These largely report that impacts are localised and negligible by comparison to other aquaculture activities, such as finfish cages (Forrest *et al*. 2009). Known as extractive species, the feeding habits of bivalves actually remove waste materials from the water column and generally have a positive influence of the water quality of the surrounding system (National Research Council. 2010, FOA 2018).

2.4 Project applicant

The Department of Agriculture, Forestry & Fisheries (DAFF) is responsible for overseeing and supporting South Africa's agricultural and aquaculture sector (freshwater and seawater aquaculture alike), as well as ensuring access to sufficient, safe and nutritious food by the country's population. Among other mandates and responsibilities, the Branch Fisheries Management is responsible for developing a sustainable and competitive aquaculture sector that will contribute meaningfully to job creation, economic development, sustainable livelihood, food security, rural development and transformation in South Africa.

Aquaculture is one of the sectors which form part of Operation Phakisa under the Ocean's Economy in South Africa. Operation Phakisa is an initiative of the South African government which aims to implement priority economic and social programmes better, faster and more effectively. Operation Phakisa was launched by the President of the Republic in October 2014. The DAFF is the lead department for the Oceans Economy Aquaculture focus area and its deliverables. The Lab concluded that South Africa's aquaculture sector has a high growth potential due to an increasing demand of fish products. Moreover the capture fisheries yield has been plateauing over the past decade while aquaculture continues to grow over 7% per annum.

As the lead agent for aquaculture management and development in South Africa, DAFF intends to establish and manage a sea-based Aquaculture Development Zone (ADZ) in Algoa Bay located in the Eastern Cape. It must be noted, however, that DAFF intends to develop both sea-based and land-based aquaculture sectors. Land-based aquaculture is therefore not considered an alternative to sea-based aquaculture.

2.5 Identification of potential ADZ sites in Algoa Bay

Algoa Bay is located on the south eastern coast of South Africa. Port Elizabeth is the largest city in the region, and is the economic hub for Algoa Bay. Algoa Bay is one of the few protected bays along the South African coast explaining the preference by a great number of different users (e.g. line fishing, squid fishing, small boating activities, recreational fishing, scuba diving etc.) who make use of the Bay. Furthermore, Algoa Bay is recognised as an important marine biodiversity area due to the islands that are home to important colonies of sea birds and large number of reefs and variety of benthic habitat types (Dorrington *et al.* 2018). The recently approved Addo Marine Protected Area (MPA) covers 116 548 ha, incorporating the shores of the Addo Elephant National Park, the St Croix island group and Bird Island in the eastern part of the bay. As a result, Algoa Bay has a relatively high level of user conflict.

Originally three marine aquaculture (mariculture) precincts were identified for finfish culture in Algoa Bay in the 2011 Strategic Environmental Assessment (SEA) (Clark *et al.* 2011) (Figure 2). In the SEA, site selections were considered using the following exclusionary criteria:

- **Distance from a suitable port.** A suitable port is considered one which is able to accommodate a 15m work boat and falls within 20 km of the proposed site. A greater distance, or the lack of a port to accommodate such a vessel eliminated a location;
- **Water depth.** A balance between the minimum required water depth for flushing waste (international standards are at least 5 m below the bottom of the cage) and the increasing cost of mooring in deeper water. To make it economically viable, it was considered that inshore cages should have a water depth between 20 and 60 m and offshore cages between 30 and 150 m. All shallower or deeper were excluded;
- **Water temperature.** Optimal growth of likely SA species (kob, yellowtail, grunter) trading off against parasite / disease prevalence. Locations where temperature fluctuations are known, or water is too cold or hot for line fish were eliminated;
- **Upwelling cells**. Upwelling can create temperature shocks which negatively affects growth and health of a cultured stock. As such, the known locations for such upwelling cells were eliminated;
- **Exposure to waves.** Extreme sea conditions can damage cages and decrease the service frequency of the facility. Areas with high wave action exposure were thus eliminated;
- **Turbidity and pollutants associated with river mouths.** Outflow from river mouths could potentially deform cages and damage moorings, and rivers that carry high pollutant levels could be hazardous for fish. As such, the location of such river mouths were buffered and excluded as suitable locations;
- **Harmful algal blooms.** Algal blooms which occur frequently and for long periods can impact on the survival, growth rate and health of cultured stock. The known locations of such blooms were therefore excluded as potentially suitable areas;
- **Reef areas and sensitive marine habitats.** Reefs and sensitive habitats, especially rocky areas, can be severely impacted by cultured operations. As such, these habitats were excluded from site selection options. Sandy substrates have less diversity and are less sensitive to impacts from waste and mooring;
- **Marine Protected Areas (MPA's).** MPA's fulfil conservation, research and socio-economic roles and should remain as pristine as possible. Proclaimed MPAs were therefore mapped

and an ADZ was only considered in proximity to an MPA if the MPA Managers Forum agreed to exclude the area from the (proposed) MPA;

- **Archaeologically important shipwrecks.** Mooring and anchoring required for fish farms may damage archaeologically important precincts. Unfortunately, due to their heritage / cultural value, the location of most shipwrecks was not disclosed to the public and could therefore not be mapped. Known wrecks where however taken into account and excluded from the project locations. Reefs pose a navigation risk, which means that a higher number of historically important ship wrecks could occur in these areas. Excluding reef habitat from the potential precincts may mitigate impact on archaeologically important shipwrecks.
- **Existing commercial activities.** To minimise user conflict, no precincts were placed in known fishing, mining and shipping precincts.

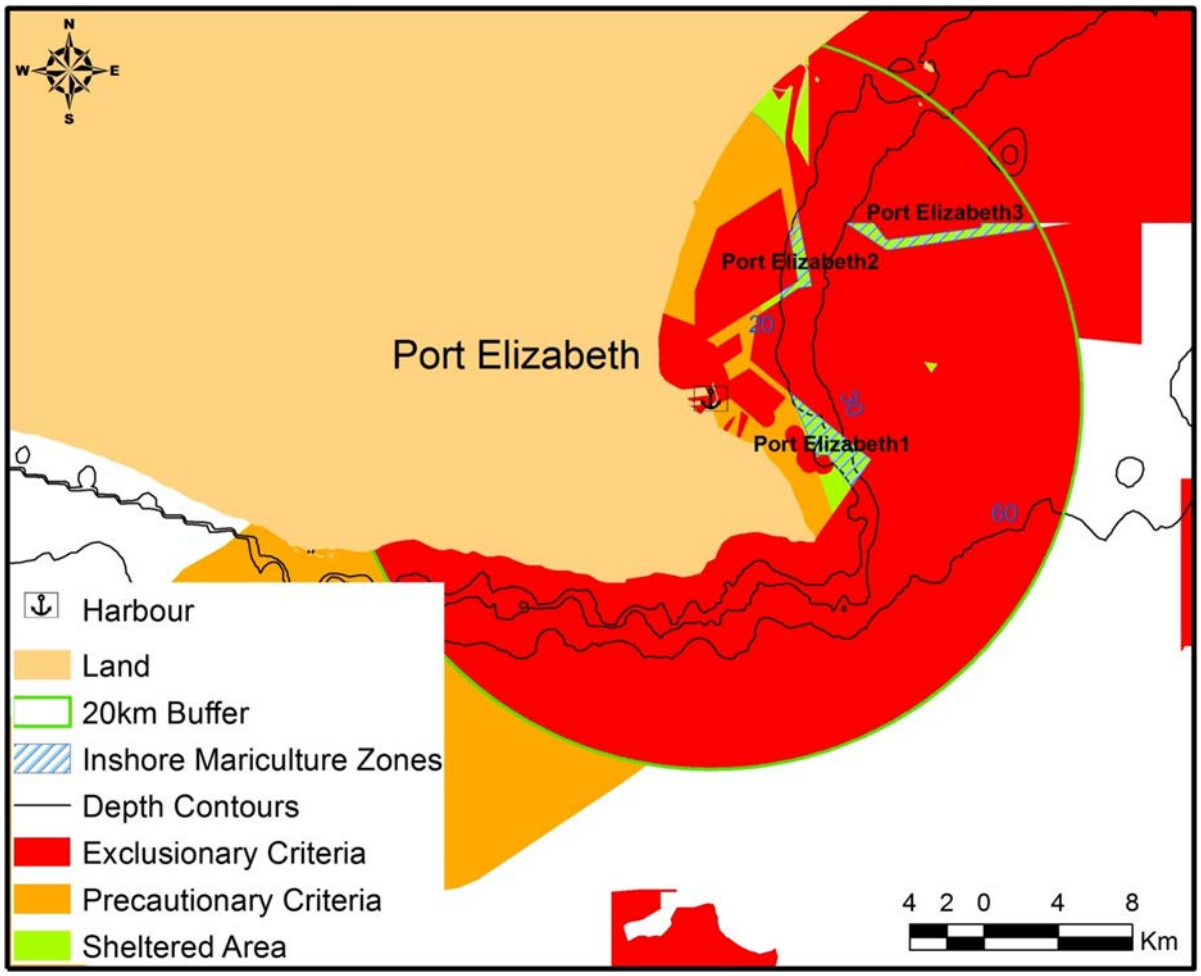

Figure 2 **Areas that met the site selection criteria for potential finfish aquaculture development zone using inshore cage technology within a 20 km radius of Port Elizabeth and Coega harbours (Source: Clark *et al.* 2011).**

The original SEA was conducted for the entire South African coastline and a finer scale SEA was required to ensure a sound site selection process to identify sites to be taken forward into the EIA process (2010-2014). Indeed, precincts Algoa 2 and 3 (named Port Elizabeth 2 and 3 in Figure 2) were screened out from the EIA process as they were found to lie within an area with very high shipping traffic. Although highly preferred from an environmental perspective, the conflict with shipping traffic was considered a fatal flaw (CapeEAPrac 2012) (Figure 3).

Two additional potential finfish precincts, namely Algoa 4 and 6, were subsequently identified, briefly assessed and screened out (See Figure 3). Algoa 4 was found to be environmentally less suitable (wave exposure and depth), which would have required more sophisticated and expensive equipment to achieve the same objectives as the other precincts. Algoa 6 was screened out for finfish culture due to insufficient depth for waste dispersion below the cages.

Finally, Algoa 1 was identified as the preferred alternative, although with a reduced footprint when compared to the area identified during 2011 SEA (Clark *et al.* 2011) (Figure 2 and Figure 3). Algoa 5 was identified as a potential finfish site later on and was taken forward into the impact assessment process as the alternative site to Algoa 1 (Figure 3). Environmental Authorisation (EA) was granted for Algoa 1 on 9 July 2014 (northern portion of Algoa 1 for the first phase and to be expanded into the southern portion/Option 2 should socio-economic and marine monitoring outcomes support expansion).

A total of twenty eight (28) substantive appeals were lodged against the decision to grant EA for Algoa 1. In response, the Minister of Environmental Affairs issued a decision on the Appeal suspending the EA to allow for further studies to be undertaken. In mid-2016, DAFF commissioned three comparative assessments, including a detailed feasibility study, a socio-economic assessment and a marine ecological assessment for Algoa 1 and 5.

The economic feasibility study conducted by Britz and Sauer (2016b) found that conditions at Algoa 1 were marginal for economic aquaculture and limited mitigation was possible. Algoa 1 was found to be not economically competitive and therefore economic feasibility was found to be low (average score of 2.2/5) (Britz and Sauer 2016b). However, DAFF intends to take Algoa 1 forward into the current application process for Environmental Authorisation.

Furthermore, Britz and Sauer (2016b) found that conditions at Algoa 5 are sub-optimal for economic aquaculture and mitigation measures would be impractical or uneconomic to implement, which rendered the proposed site not economically competitive. The closest port, Port of Ngqura, is located approximately 15 km west of Algoa 5, which imposes a severe operational constraint on servicing cages at Algoa 5. For salmon farming, 10 km from port is regarded as a maximum feasible travel distance from port for daily feeding. Combined with severe wind and swell exposure, very large vessels would be required to safely service the cages and to meet requirements for daily feeding and maintenance.

Establishment of a small harbour development at Sundays River could potentially assist in meeting these requirements, but larger vessels required for cage servicing would not be able to operate out of the Sunday's estuary. The requirement for larger vessels would add dramatically to the capital costs for Algoa 5 rendering the return on investment sub-economic (Britz and Sauer 2016b). Furthermore, Algoa 5 is located near the middle of the Addo Marine Protected Area (MPA) which was recently approved by cabinet. For the reasons described above, Algoa 5 was screened out and has not been taken forward as a potential precinct in the current Basic Assessment process.

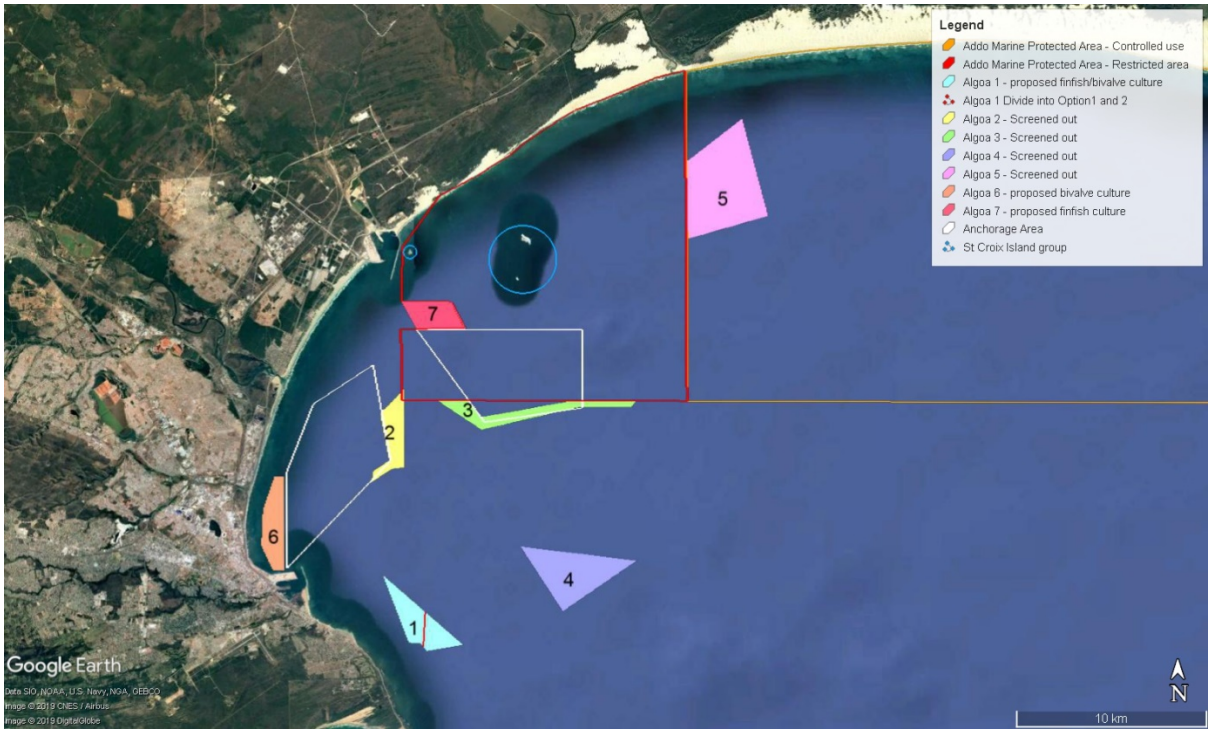

Figure 3 **Precincts considered during the previous and current application for environmental authorisation for a sea-based Aquaculture Development Zone in Algoa Bay, Eastern Cape. Precincts 2, 3, 4 and 5 were found to be unfeasible and were screened out. Precincts 1, 6 and 7 constitute feasible precincts and have been considered during the present Basic Assessment process. Please note the Department of Environmental Affairs Branch Oceans and Coasts has indicated that Algoa 7 could potentially be excised from the Addo Marine Protected Area should Environmental Authorisation be granted for this precinct.**

Following the completion of the comparative assessments for Algoa 1 and 5, DAFF elected to withdraw the original application for environmental authorisation and has elected to submit a new application for the development of the ADZ for which a Basic Assessment process is required in terms of the 2014 EIA Regulations (as amended) promulgated in terms of the National Environmental Management Act (Act 107 of 1998). DAFF intends for the ADZ to accommodate finfish as well as bivalve culture (oysters/mussels) within a combination of precincts.

The precincts considered in this new application include one precinct from the previous process (Algoa 1), and two new precincts, designated as Algoa 6 and 7 (Figure 1). Algoa 6, situated near the Port Elizabeth Harbour, was identified but screened out in the scoping study of the original EIA (2010-2014) which focussed only on finfish culture, and is now been put forward as a potential site for bivalve production in this new (2019) application process. Algoa 7 is a new precinct located

directly in front of the Ngqura harbour that has been identified as a potential site for finfish. This site has undergone an internal feasibility assessment in which it was found to be suitable in terms water depth, shipping traffic, and accessibility (i.e. financial considerations). This site overlaps slightly with the recently approved Addo Marine Protected Area (MPA) but the Department of Environmental Affairs Branch Oceans and Coasts has indicated that the affected portion of this site could potentially be excised should Environmental Authorisation be granted for this precinct.

Thus, in this application process two sites, Algoa 1 and 7, are being put forward as potential sites for finfish culture, while one of these, Algoa 1, along with a third site, Algoa 6, is being put forward for bivalve culture (Figure 1).

Each of the precincts that are being taken forward into the impact assessment process is described in more detail below. It is important to note that DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore the approach to choosing alternatives has changed from considering individual precincts as alternatives to each other (i.e. the previous process chose Algoa 5 as an alternative to Algoa 1) to considering combination of precincts as alternative options. This is discussed in more detail in Section 3.5, which elaborates on the approach taken in choosing alternatives (site, technology, species etc.) for this Basic Assessment process.

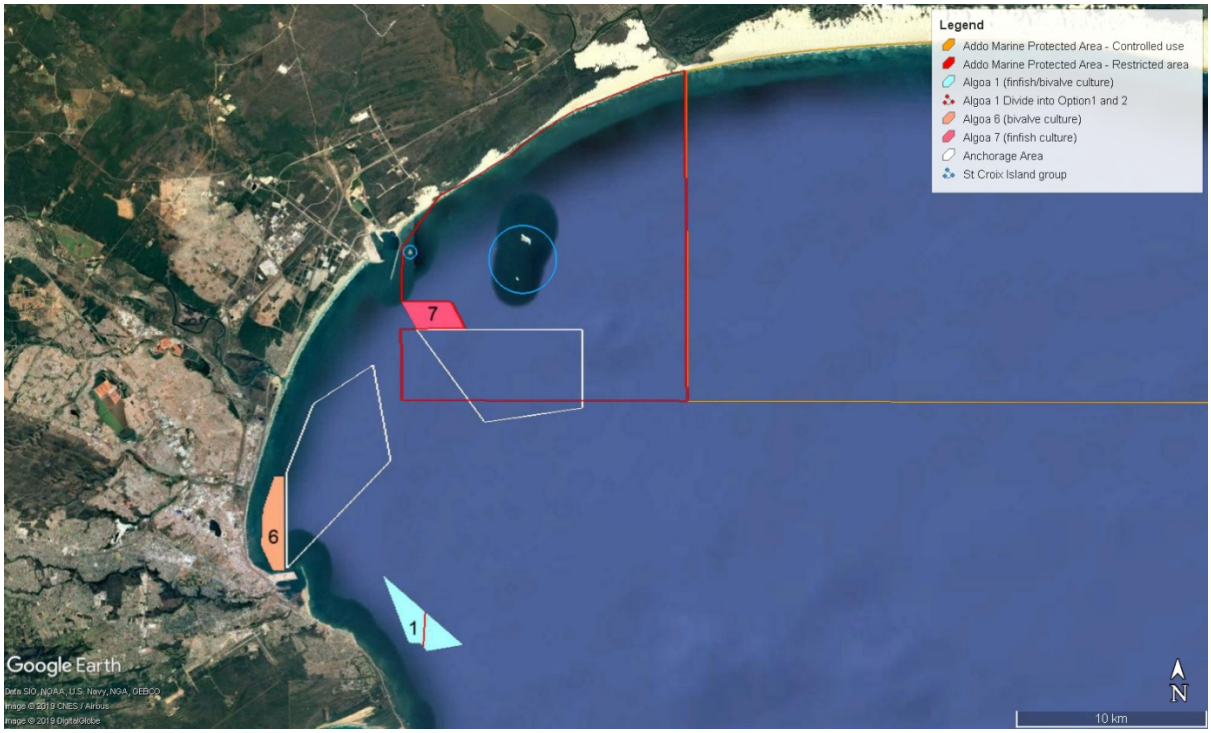

Figure 4 **Precincts considered during the 2019 application for environmental authorisation for a sea-based Aquaculture Development Zone in Algoa Bay, Eastern Cape. Precincts 1, 6 and 7 constitute feasible precincts and have been considered during the present Basic Assessment process. The Department of Environmental Affairs Branch Oceans and Coasts has indicated Algoa 7 could potentially be excised from the Addo Marine Protected Area should Environmental Authorisation be granted for this precinct.**

2.5.1 Algoa 1 (Summerstrand Site)

Algoa 1 has been identified a potential site for bivalve and/or finfish culture. The site measures approximately 522 ha and lies approximately 2 km offshore from the popular beaches of Summerstrand and Humewood. Algoa 1 was identified in the initial SEA study as the best option due to its proximity to Port Elizabeth Harbour (<5 km) and relatively low wave energy conditions. Marine, visual and social-economic specialists identified potentially significant negative impacts on other users and the environment should the entire extent of Algoa 1 be developed. Size reduction, adaptive management and other recommended mitigation measures were identified as mechanisms to minimise the significance of these impacts in the previous EIA process.

Based on the baseline studies provided by specialists during the Scoping Phase of the previous EIA process, Algoa 1 was divided into two segments - Option 1 (north) and Option 2 (south) (see Figure 4). The visual impact assessment study recommended a three kilometre exclusionary buffer around the beach front and a one kilometre exclusionary buffer around the Bell Buoy (a Cardinal marker buoy situated approximately 3 km north east from Summerstrand, marking the Roman Rocks reef as a navigation hazard). This essentially excluded the major portion of Option 1 for which environmental authorisation was granted. In contrast, the socio-economic study found that Option 2 overlapped with a squid nursery area and positioning the farm in this area would have had a significant impact on the squid fishing industry. The EIR concluded that the mitigation measures proposed by the visual and socio-economic specialists were in conflict with each other, in that the visual specialist recommended exclusion of a large portion of Option 1 (North) and the socio-economic specialist recommended the same for Option 2 (South).

To address this apparent conflict, a phased approach (1000 tons in the first year) coupled with careful monitoring was recommended for Algoa 1 Option 1 as a way of mitigating visual concerns. It was proposed that Option 2 would only be considered for expansion if environmental monitoring outcomes were positive.

Similar to the previous EIA process the present impact assessment considers Algoa 1 as a whole. A phased approach in conjunction with rigorous environmental monitoring (socio-economic as well as bio-physical) is critical in determining the intensity of farming that can be supported by the environment (carrying capacity and economic impacts on existing activities). The coordinates delineating the centre and boundaries of Algoa 1 are shown below.

Centre coordinates: 33° 58.860'S; 25° 42.595'E

Coordinates of corner points, clockwise from the northwest corner are listed below:

33° 57.424'S; 25° 41.369'E
33° 59.354'S; 25° 44.055'E
33° 59.519'S; 25° 42.844'E
33° 59.308'S; 25° 42.614'E
33° 59.296'S; 25° 42.224'E

2.5.2 Algoa 6 (Port Elizabeth Harbour Site)

Algoa 6 has been identified a potential site for bivalve culture. The site measures approximately 470 ha and is located in water ranging in depth from 5-12 m. This site is considered suitable for bivalve culture only, as it is too shallow for adequate dispersal of waste from finfish cages. This site is situated adjacent to the Port Elizabeth harbour wall and extends parallel to the shoreline for approximately 4.8 km. The immediate coastal area is characterised by urban industrial development and a mostly modified shoreline fringed by railway tracks and the Settlers Highway (M4). During the previous EIA, stakeholders indicated support for Algoa 6 due to much reduced conflict with other user groups when compared to Algoa 1 (recreational, fisheries, tourism activities and conservation). Economic feasibility of this site is considered good for bivalve aquaculture. The coordinates delineating the centre and boundaries of Algoa 6 are shown below.

Centre coordinates: 33° 56.020'S; 25° 37.651'E

Coordinates of corner points, clockwise from the northwest corner are listed below:

33° 54.624'S; 25° 37.668'E
33° 54.619'S; 25° 37.979'E
33° 57.258'S; 25° 37.998'E
33° 57.259'S; 25° 37.602'E
33° 56.571'S; 25° 37.210'E
33° 55.551'S; 25° 37.272'E

2.5.3 Algoa 7 (Ngqura Harbour site)

Algoa 7 has been identified a potential site for bivalve culture. This site measures 355 ha in size and is positioned approximately 3 km offshore from the Ngqura harbour. Algoa 7 is not expected to impact significantly on shipping traffic. This site overlaps slightly with the recently approved Addo Marine Protected Area (MPA) but the Department of Environmental Affairs Branch Oceans and Coasts has indicated that the affected portion of this site could potentially be excised should Environmental Authorisation be granted for this precinct. However, a pre-cautionary and risk adverse approach would be applied as the operation of an aquaculture farm is in direct conflict with conservation goals of an MPA. The coordinates delineating the centre and boundaries of Algoa 7 are shown below.

Centre coordinates: 33° 50.105'S; 25° 43.098'E

Coordinates of corner points, clockwise from the northwest corner are listed below:

33° 49.722'S; 25° 41.996'E
33° 49.717'S;25° 43.652'E
33° 50.472'S; 25° 44.148'E
33° 50.468'S; 25° 42.497'E

3 PROJECT DESCRIPTION

Aquaculture is defined as the propagation, improvement, rearing, regular stocking, feeding or protection from predators and harvesting of aquatic organisms (plant and animal) in controlled or selected aquatic environments (fresh, sea or brackish waters, on land or at sea) for any commercial, subsistence, recreational or other public or private purposes (DEA&T 2007, South African Aquaculture Development Bill 2018). Marine aquaculture, or mariculture, is the process of cultivating and harvesting sea based aquatic organisms. Marine aquaculture includes the commercial farming of all marine organisms such as finfish, shellfish (i.e. abalone, mussels, prawns) and seaweed. Operations generally involve some form of intervention in the rearing process to enhance production (i.e. regular stocking, feeding, and protection from predators). The proposed Aquaculture Development Zone is sea-based, which means that marine organisms are reared in the sea.

Land-based facilities for the processing of fish and bivalves are not included in this project and therefore the project does not have any water, sewage, waste, and electricity requirements. These aspects have therefore not been discussed in this Basic Assessment Report. Separate Environmental Authorisations would have to be obtained for activities triggering listed activities as specified in the EIA Regulations.

3.1 Site description

Algoa Bay is located on the south eastern coast of South Africa. Port Elizabeth is the largest city in the area and is South Africa's second oldest city. Port Elizabeth represents the commercial capital of the Eastern Cape. Port Elizabeth is a major seaport, with the most significant ore loading facilities in the southern hemisphere. Industrial activities have lately shifted towards Coega where a Special Economic Zone (SEZ) was established in 1999. The Coega Development Corporation (CDC), a state-owned enterprise (SoE), is mandated to develop and operate the 9 003 hectares. Situated on the shores of Algoa Bay the area also has a thriving tourist economy based on activities such as scuba diving, game fishing charters, surfing and kiteboarding with many popular scenic beaches. A detailed description of the receiving environment is included in Chapter 8.

3.2 Proposed infrastructure, layout plan and carrying capacity

3.2.1 Finfish culture

A commercially viable, finfish cage farm, producing in the region of 3 000 tons per year, would require about 35 cages of this size, holding approximately 85 tons of fish each (these figures are based on the I&J proposal to farm yellowtail and kabeljou and will vary depending on the species farmed) (CCA Environmental 2008). The sea floor footprint of a farm this size would be about 20-50 ha depending on the mooring system, but to allow for boat access between cages and fallowing of sites, an area of around 70 ha per operator would be required (See examples in Figure 5 and Figure 6).

This suggests that should the ADZ be fully developed, Algoa 1 could theoretically accommodate nine commercial scale finfish farms with a total production of ~30 000 tons per annum. This exceeds the average annual total South African line fish catch by 2-5 times (Griffiths 2000), and full development of these sites would therefore be reliant on producers accessing new markets for farmed finfish. It is uncertain that this scale of development will be sustainable both from an environmental impact perspective and from industry functionality/economic perspective.

The previous EIA (Hutchings *et al* 2013) therefore adopted a precautionary approach and recommended a much lower initial scale development with no more than three fish cage farms authorized to scale production up from pilot phase (maximum 1000 tons/ precinct) to full commercial viability (three farms producing a total of 9 000 tons per precinct) over a four year period, providing that environmental quality objectives were maintained. Increased global demand for seafood and market changes however, may well have reduced the volume required for commercial viability e.g. the recent development of an export market for South African yellowtail suggests that this figure of commercial viability (3000 t per farm) is probably now an overestimate.

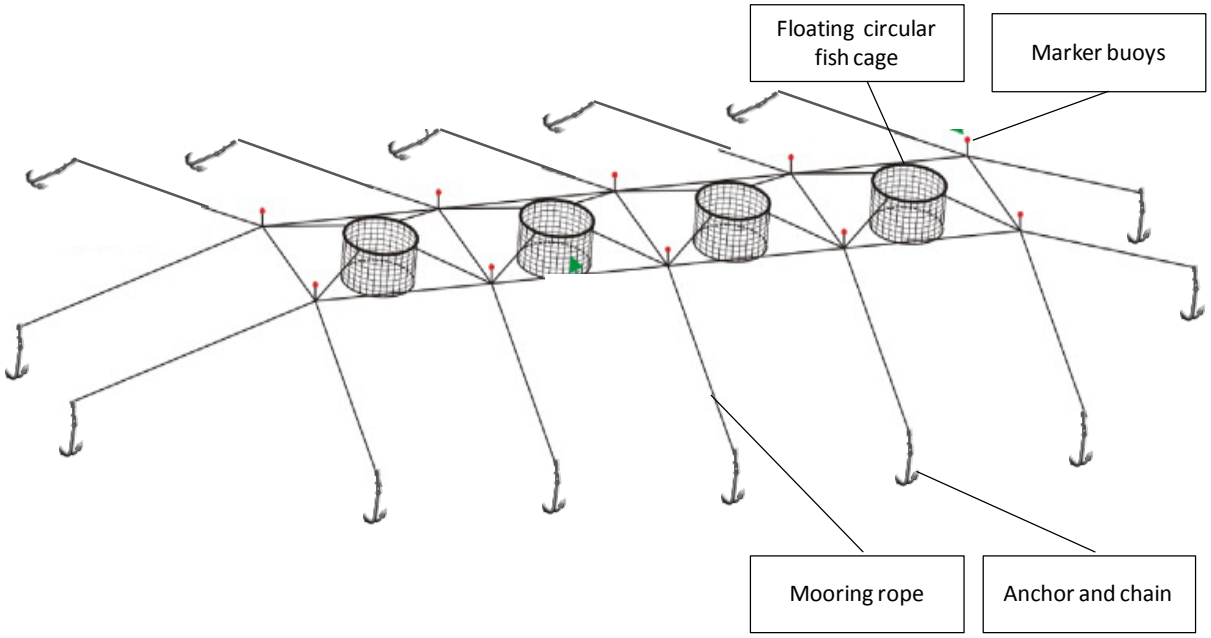

Figure 5 **Example of a finfish sea cage mooring system, showing larger size of sea-floor footprint compared to the sea surface footprint.**

Figure 6 **Finfish cage structures and servicing vessel (Source: Shutterstock).**

In this current EIA process a dispersion modelling study was undertaken to estimate carrying capacity and inform the assessment of potential impacts (Wright *et al* 2019). Two species specific models were developed for the two potential finfish precincts (Algoa 1 and 7) - yellowtail (*Seriola lalandi*), and meagre (*Argyrosomus regius*). Both of these species are widely studied and widely farmed mariculture species around the world, and good baseline and life history data are therefore available in the existing literature for these species. Meagre is a species similar to South African kob (e.g. *Argyrosomus japonicas* and *A. inodorus*), and represents a good proxy for the farming of indigenous kob species in Algoa Bay. In line with the precautionary approach recommended by Cape EAPrac (2013), three scenarios (i.e. various stocking options) were investigated, ranging from a lower initial scale development of 1000 t to maximum estimated commercial viability for the whole ADZ (9 000 t).

Model results indicate that both Algoa 1 and Algoa 7 have acceptable dispersion potential and water quality standards are predicted to be met within the ADZ boundaries (Wright *et al* 2019). However, the carrying capacity of a site is intrinsically linked to its size – a larger ADZ will inherently present more space for mariculture. Therefore, it is perhaps more useful to consider the production capacity of a site, including the number of farms that can be accommodated and the annual production of those farms, while also taking into consideration strategies to minimise environmental impact.

Carrying capacity was estimated on the premise that:

1. the benthic fauna beneath the farm site must not be allowed to disappear due to accumulation of organic material;
2. the water quality in the net pens must be kept high; and,
3. the water quality in the areas surrounding the farm must not deteriorate.

The estimated maximum carrying capacities for each of the two proposed precincts are summarized in Table 1 below.

Table 3 **Summary of dispersion modelling results as per Wright *et al*. (2019) showing carrying capacities for Algoa 1 and 7 for two species, namely *Seriola lalandi* and *Argyrosomus regius*. Note that for each site carrying capacity is shown per species, which means that for example either 3 farms of S. *lalandi* OR 12 farms of *A. regius* can be maintained at Algoa 1.**

Precinct	Species	Number of farms	Total annual production per farm (t)
Algoa 1	*Seriola lalandi*	3	3 252
	Argyrosomus regius	12	4 911
Algoa 7	*Seriola lalandi*	2	3 555
	Argyrosomus regius	7	4 947

These results do not account for disease control. Alvial *et al.* (2012) recommended a minimum 2.5 km buffers zone be implemented to prevent disease transferral between farms. Should this buffer zone be implemented, Algoa 1 and 7 each have the capacity for one farm of either *S. lalandi*, or *A. regius*.

3.2.2 Bivalve culture

Bivalves (oysters and mussels) can be farmed on longlines or mussel rafts. Longlines comprise of a surface rope with floats, which are moored at each end to fix the line in position. The production ropes for mussels or oyster racks are then suspended from the surface rope. Alternatively, rafts for mussel culture can be deployed, which consist of a floating top structure moored to the seabed from which mussel ropes are suspended. Illustrative photographs of mussel rafts and longlines are shown in Figure 7 to Figure 10.

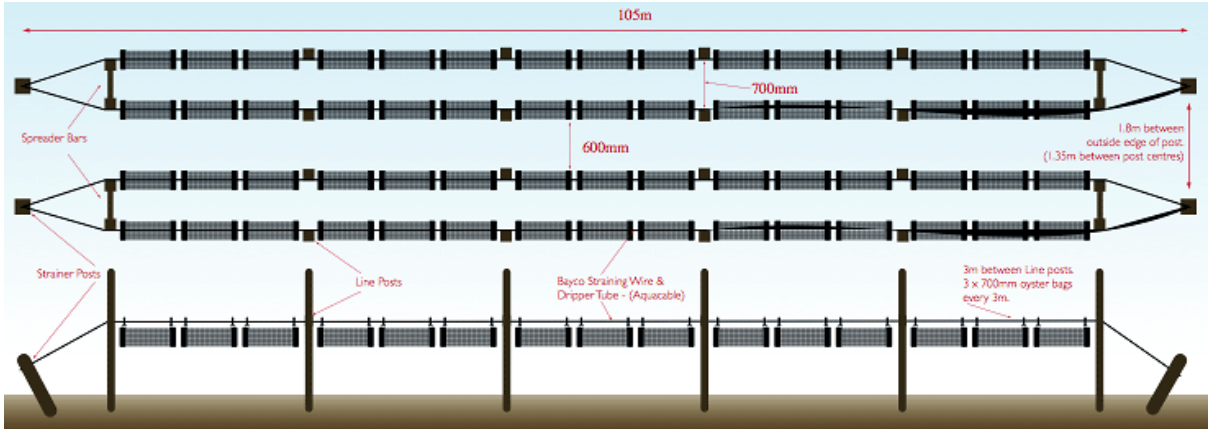

Figure 7 **Adjustable Longline Oyster System (Source: http://www.bstoysters.com/products/farm-layout).**

Figure 8 **Oyster longlines in Tomales Bay, California (Source: https://www.ptreyeslight.com/article/marin-oyster-companys-revised-permit-harbinger-future. Photo credit: David Briggs).**

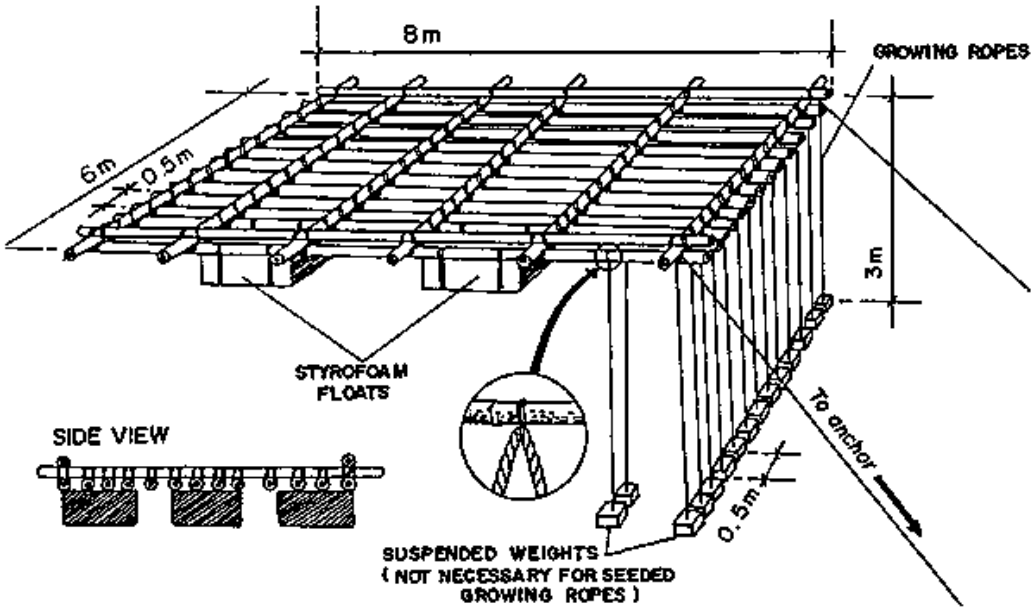

Figure 9 **Conceptual design of a mussel raft structure (Source: Baluyut 1989).**

Figure 10 **Mussel raft structures in Saldanha Bay (photo taken from Port Control).**

3.3 Species considered in the impact assessment

3.3.1 Finfish farming

The development of modern sea cage finfish farming in the 1970s occurred largely due to the growth of the salmon farming industry in countries with glaciated coastlines such as Scotland, Norway, British Columbia and Chile (Hutchings *et al*. 2013a). The number of finfish species used in marine cage culture has increased substantially over the last three decades with salmon, tuna, flatfish, kingfish, bream, Sciaenids (white sea bass, red drum) and a host of other species grown in a variety of cage culture systems (Staniford 2002). Although some sea cage farming operations rely on wild caught stock (e.g. southern and northern bluefin tuna farms located in Australia and the Mediterranean, respectively), most farms use finfish fingerlings that are obtained from land based hatcheries, where brood stock, egg, and larvae husbandry can be carried out under controlled conditions. Fingerlings are stocked into sea cages at optimal sizes and densities, fed with commercially available protein and lipid rich dry food, treated for diseases and parasites, graded, and harvested at a size that results in the maximum economic return. Several species of the genus *Seriola* are used in aquaculture internationally, mostly Japanese amberjack (*S. quinqueradiata*) that is farmed in Japan and Korea (Hutchings *et al*. 2013b). *Seriola lalandi* has been farmed in sea cages in Australia since 2001 with a production of ~ 3300 tons in 2007/8, and has been trialled in Chile and New Zealand (Poortenaar *et al*. 2003, Frenandes and Tanner 2008, Moran *et al*. 2009). Dusky kob (*Argyrosomus japonicus*) has been farmed in Australia where it is locally known as Mulloway, while the congeneric, *A. regius* is extensively farmed in the Mediterranean, with an estimated production of 15 000 tons recorded in 2010 (FAO 2012).

Around 250 species of fish are landed by South African line fisheries, although only about a dozen account for more than 90% of the catch (Mann 2000). Given that a domestic mark*et al*ready exists for popular linefish species, these are preferable for cage culture in a pioneering industry. Dusky kob are large, predatory teleost fishes of the family Sciaenidae that are widely distributed in estuaries and nearshore subtropical and temperate coastal waters less than 100 m water depth in the Pacific and Indian Oceans. In South Africa, the species occurs from the Cape of Good Hope to northern KwaZulu-Natal where they are targeted by commercial and recreational fishers. Sciaenids worldwide have been demonstrated to be prone to overfishing and dusky kob are overfished in South Africa and Australia. This species has many attributes that make them suitable for aquaculture: they are euryhaline (able to tolerate a wide range of salinities), eurythermal (able to tolerate a wide range of temperatures) and hypoxia tolerant (able to tolerate oxygen deficiencies). Their life histories also make them favourable as they are a gregarious, relatively fast growing, highly fecund, and are easily reproduced in captivity.

Yellowtail (*Seriola lalandi*) has a non-equatorial distribution and is found around Australia, New Zealand, India, and from British Columbia to Chile. In South Africa, this species occurs from the west coast to southern KwaZulu-Natal and frequents both shoreline habitats as well as deep pelagic waters. Yellowtail appear to be well suited to marine aquaculture, as it grows fast, has a good yield, are particularly robust, and thrives in sea cage production systems. Commercial culture of *S. lalandi* commenced in Australia in 1998 and the farming industry has since undergone rapid expansion. Grow-out to market size (3 – 5+ kg) is conducted in sea cages with a total culture production of currently estimated at 1 000 tonnes.

Research and development into the suitability of three species for sea cage culture has already occurred within Algoa Bay; namely yellowtail (*Seriola lalandi*), dusky kob (*Argyrosomus japonicus*) and silver kob (*Argyrosomus inodorus*) (Nel and Winter 2008 & 2009). The Department of Science and Technology (DST) Eastern Cape Sea Cage Finfish Farming Pilot Project was initiated in 2007 by the DST, the Stellenbosch University Aquaculture Division, and Irvin and Johnson Limited (I&J) to determine the technical, environmental and financial feasibility of farming indigenous marine finfish species in South Africa. The project commenced in November 2007 with the installation of four HDPE surface gravity type fish cages moored in an anchor based grid in the lee of PE Harbour. Dusky kob, silver kob and yellowtail were grown over a 30 month period. The project achieved promising yellowtail growth results with some fish reaching 1.5 kilograms in 14 months. The results obtained for both kob species were disappointing, with dusky kob only reaching an average size of 549 grams in 19 months and silver kob reaching an average size of 550 grams in 22 months (Nel and Winter 2008 & 2009). The unavailability of yellowtail fingerlings prevented the successful implementation of the continuation phase of the DST Eastern Cape Sea Cage Finfish Farming Pilot Project which was abandoned in 2011. The production system equipment used by the project were sold to Viking Aquaculture in October 2016 and has subsequently been installed in Saldanha Bay for a sea trout pilot project. The initial phase of the project (2007 – 2010) showed that HDPE surface gravity type cages can be deployed and utilised for sea cage aquaculture at selected nearshore sites along the South African coastline. From a species perspective, the initial phase of the project showed that yellowtail has significant potential for commercial aquaculture in the country. The fish produced by the pilot project was sold to South Africa's premier retailer, indicating a high level of market potential for yellowtail.

The DST Eastern Cape Sea Cage Finfish Farming Project led to the implementation of a dusky kob sea cage project in Richards Bay in August 2015 and the development of a similar project in Mozambique. The DST and Stellenbosch University KZN Aquaculture Development Project was a collaborative undertaking between DST, DAFF and the University to determine the technical, environmental and financial feasibility of farming dusky kob in sea cages in Richards Bay, KwaZulu-Natal. Production commenced in August 2015 with the stocking of 25 000 dusky kob fingerlings and had a standing stock of about 25 tonnes in 2017. Of the two species, yellowtail appears to be the more suitable for aquaculture as it grows significantly faster than dusky kob, has a lower optimum culture temperature and will potentially obtain higher prices in export markets (Stellenbosch University 2017).

Several other indigenous fish species are also under consideration; yellowfin tuna (*Thunnus albacares*), East Coast Sole (*Austroglossus pectoralis*), geelbek (*Atractoscion aequidens*), spotted grunter (*Pomadasys commersonnii*) and several sparids including white steenbras (*Lithognathus lithognathus*), white stumpnose (*Rhabdosargus globiceps*) and red roman (*Chrysoblephus laticeps*) (DEA 2013, Government Gazette No. 36145).

Algoa Bay falls within the distributions of all of the above mentioned indigenous species, indicating that the environmental conditions are, at times, suitable (Hutchings *et al*. 2013a). The presence of local wild populations does not, however, confirm suitability of a species for sea cage culture as cages restrict the natural movement of the stocked species, restricting behavioural responses to variable oceanographic conditions. For example, Sciaenids stocked in the Algoa Bay sea cage trials experienced low growth rates and became susceptible to parasites, presumably partly in response to sudden drops in water temperature (G Le Roux, Stellenbosch University, personal communication). Telemetry studies on dusky kob within Algoa Bay have revealed population specific movement responses to changes in water temperature with individual fish displaying site fidelity to estuaries that are used as refugia during periods of low sea water temperature (P Cowley, SAIAB, personal communication).

Research and development into the suitability of different species for cage culture in South Africa is ongoing, which may identify additional candidate species. Diversification of species for use in local sea cage culture will depend on research and development around stock husbandry (including viable hatchery techniques), suitability of species to caged conditions, suitability of cages for local sea conditions, and the development of receptive markets. High value species for which sea cage culture techniques have been established and an international market demand already exists (e.g. yellowtail, yellowfin tuna), could prove to be the most economically viable.

The sustainable aquaculture policy does not rule out the use of alien species (Government gazette No 30263, pg. 13). The Alien and Invasive Species Regulations, 2014 (AIS Regulations) published in terms of the National Environmental Management: Biodiversity Act (Act No 10 of 2004) (NEMBA) are concerned with the responsible introduction of new alien species and the management of existing alien and invasive species in South Africa. For new introductions, the AIS Regulations prescribe when and how risk assessments must be conducted.

Atlantic salmon *Salmo salar* is exempt in term of the AIS Regulations as this species had already been introduced into South Africa at the time when the Regulations were promulgated. Experimental salmon farming has taken place at Gansbaai and sea trout are is currently undergoing trials by Molapong Aquaculture (Pty) Ltd in Saldanha Bay. The warm temperate waters of Algoa Bay however, are not suitable for many cooler water species (e.g. salmon, trout, flounder and plaice) that were initially the mainstay of finfish sea cage culture internationally, nor consistently warm enough for more recently researched tropical species (such as cobia). Risks of disease and parasite introduction, or the establishment of an invasive alien fish species, are generally considered lower if indigenous species are cultured, although disease transmission between local wild stocks and farmed fish is more likely when local species are farmed. This EIA therefore only considers potential impacts of farming indigenous fin fish species. Should future fish farm operators wish to farm alien fish species, a separate risk and impact assessment will need to be conducted.

3.3.2 Shellfish farming

The exotic Pacific oyster (*Crassostrea gigas*) and the native Cape Rock Oyster (*Striostrea margaritacea*) are currently cultivated in South Africa. The Pacific oyster *C. gigas* (also accepted as *Magallana gigas*) is an estuarine oyster native to Japan and South East Asia, although it has been shown to survive on rocky shores in sheltered waters of up to 40 m depth and may attach to the shells of other animals. The optimum salinity for these oysters is between 20 and 25 parts per thousand (ppt or ‰), although the species can occur (but not breed) at salinities below 10 ppt and will survive salinities in excess of 35 ppt. Gametogenesis (the production of sperm and eggs) occurs at around 10°C and salinities of between 15 and 32‰. Spawning generally follows at temperatures above 20°C. The Pacific Oyster was introduced to the Knysna Estuary for farming in the 1950s and since then has been farmed in the Kowie and Swartkops estuaries as well as at three offshore sites; Algoa Bay, Saldanha Bay and Alexander Bay (Robinson *et al*. 2005).

Initially, *C. gigas* was not considered an invasive threat as the oysters seemed unable to reproduce and settle successfully under the local environmental conditions; however, farmed populations have been reported to have spread from the site of introduction to nearby estuaries (Robinson *et al*. 2005). Through the use of DNA sequencing, Robinson *et al*. (2005) confirmed the presence of three naturalised populations of in the Breede, Knysna and Goukou estuaries. The highest densities of approximately 184 000 individuals were found in the Breede Estuary (Robinson *et al*. 2005).

C. gigas is classified as a category 2 invasive marine invertebrate species in terms of the 2016 Alien and Invasive Species (AIS) Regulations promulgated under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA). For this category of invasive species, a permit is generally required to undertake any of the activities listed in terms of NEMBA. However, the AIS regulations exempt the operators from requiring a permit for *C. gigas* in Algoa Bay as shown in Figure 11 (landwards of a straight boundary line with endpoints at the GPS coordinates 33°51’24.82’’S 25°38’11.01’’E and 33°59’20.68’’S 25°40’26.31’’E). All activities, except for the introduction of live specimens into the country, involving *C. gigas* in the area shown in Figure 11 are exempt in this area, provided the operator has a valid Permit from the DAFF. Note that *C. gigas* farming would require a permit at Algoa 1.

Figure 11 **Existing Oyster farms in Algoa Bay and area that is exempted for the farming of *Crassostrea gigas* in terms of the 2016 Alien and Invasive Species (AIS) Regulations promulgated under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA). The area extends landward of the red line.**

The species under consideration for mariculture in Algoa 1 and Algoa 6 include the Pacific oyster (*C. gigas*), the Mediterranean mussel (*Mytilus galloprovincialis*) and indigenous mussels such as brown mussel *Perna perna* and black mussel *Choromytilus meridionalis*. The Mediterranean mussel is already established in Algoa Bay (see Dawson *et al*. 2019), and therefore the specific risks of alien invasive introduction of the species to the Bay is negligible. However, wild populations of the Pacific oyster *C. gigas* outside of the existing culture area have not yet been detected in Algoa Bay, although it is a known invasive in South Africa, introduced to the Knysna Estuary in the 1950's.

3.4 Overview of the project development cycle

Many international assistance institutions distinguish between five stages in the cycle of existence of a project, namely, identification, preparation, appraisal and agreement, implementation, and monitoring and evaluation (Insull and Nash 1990). Individual operators will first enter the pilot phase to establish feasibility, environmental impacts and scalability of the finfish and bivalve projects. Only then will the project enter full scale production. The project development cycle is illustrated in Figure 12.

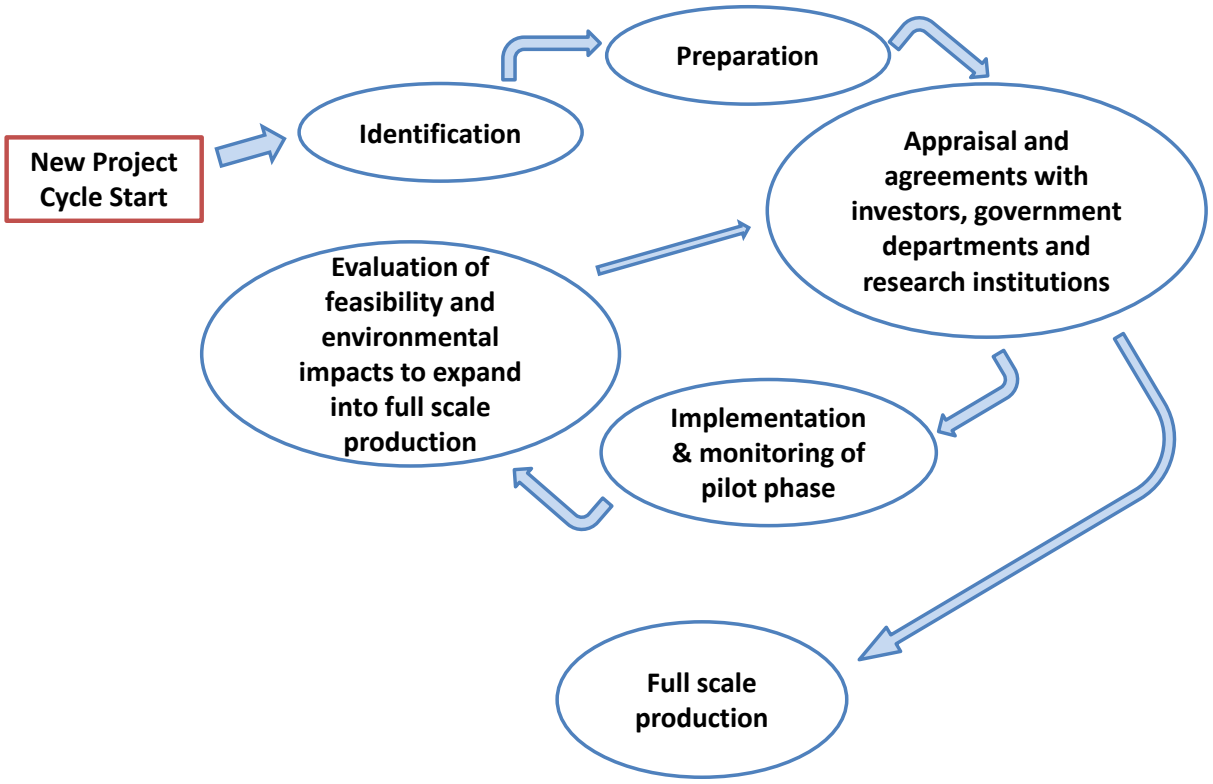

Figure 12 **Schematic of the project cycle for the proposed Aquaculture Development Zone in Algoa Bay, Eastern Cape.**

3.5 Description of alternatives

The EIA process requires the consideration of Alternatives when assessing activities. According to the Guideline on Alternatives (DEA&DP 2013) alternatives are identified as: "different means of meeting the general purpose and requirements of the activity, which may include alternatives to: (a) the property on which, or location where it is proposed to undertake the activity; (b) the type of activity to be undertaken; (c) the design or layout of the activity; (d) the technology to be used in the activity or process alternatives; (e) the operational aspects of the activity; and (f) the option of not implementing the activity". Table 4 shows which of the above-listed alternative types were considered in this Basic Assessment process.

Table 4 Applicability of alternative types to the proposed Aquaculture Development Zone in Algoa Bay (alternatives as defined in the Guideline on Alternatives published by the Department of Environmental Affairs &Development Planning in 2013).

Type of Alternative	Application to Algoa Bay Marine Aquaculture Development
Location	Three precincts are considered for inclusion in the Algoa Bay ADZ. During the previous and current EIA processes, a total of seven precincts have been considered for aquaculture in the ADZ. DAFF proposes to farm both bivalves and finfish in Algoa Bay and therefore the approach to choosing alternatives has changed from considering individual precincts as alternatives to each other (i.e. the previous process chose Algoa 5 as an alternative to Algoa 1) to considering combination of precincts as alternative options.
Type of activity	The proposed activities include bivalve and finfish farming alternatives. DAFF intends to include both activities in the application for environmental authorisation and therefore these two activities were not considered as alternatives of each other. However, Algoa 1 is suitable for both finfish and bivalve and therefore three options have been considered for this site, namely: (1) finfish and bivalve (2) bivalve only; and (3) no farming.
Design or Layout	Designs and layouts are only expected to be finalised once the Applicant identifies and signs agreements with a concessionaire. Designs of fish cages are mostly generic and design alternative should not necessarily affect or change the outcome of the EIA investigation. Different materials have cost implications and are not included in this process. No alternatives for design or layout were considered.
Technology	The technology required to construct and operate a marine aquaculture facility is mostly standardised i.e. it complies with industry norms whereby a cage with access and work areas are required. Furthermore, specific materials used are industry and cost driven and will be implemented by individual operators. No alternatives were therefore considered.
Operational Aspects	Operation of a marine aquaculture facility must comply with basic management actions and mitigations, but operation of such a facility is dependent on whichever concessionaire is chosen to operate on the site. No operational aspects are thus considered as alternatives, however operational monitoring must be implemented at all cost.
"No-Go Option"	This option must always be considered as a baseline against which the other alternatives are measured and refers to not continuing with the activity. The No Go option in this case is not undertaking the marine aquaculture development.

Taking the above into consideration, it can thus be concluded that location and type of activity alternatives could be introduced into the BA process for the proposed Algoa Bay ADZ development. It is important to note that DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore the approach to choosing alternatives has changed from considering individual precincts as alternatives to each other (i.e. the previous process chose Algoa 5 as an alternative to Algoa 1) to considering combination of precincts as alternative options. Each of the precincts taken forward into the impact assessment process is described in more detail in Sections 2.5.1-2.5.3. The proposed combinations of alternative options are shown in Table 5.

Table 5 Alternative options of precinct combinations involving Algoa 1, 6 and 7 considered in the Basic Assessment process for the proposed Algoa Bay Aquaculture Development Zone.

Option	Algoa 1	Algoa 6	Algoa 7
A	Finfish & Bivalve	Bivalve	Finfish
B	Bivalve	Bivalve	Finfish
C	X	Bivalve	Finfish
D	X	X	X

The environmental impacts of various farming intensity levels in Algoa Bay are assessed by way of three options. **Option A** includes both finfish and bivalve culture at Algoa 1. This option would allow for finfish farming at two precincts. Furthermore, this option would offer a protected environment as a nursery site for bivalves (Algoa 6) as well as a clean, comparatively unpolluted environment as a bivalve grow-out site (Algoa 1). **Option B** includes only one site for finfish farming (Algoa 7) but provides the same opportunities to bivalve farmers as Option A. **Option C** excludes Algoa 1 altogether and limits bivalve culture to Algoa 6.

The **Status Quo Alternative** proposes that the Algoa Bay ADZ does not go ahead. The Eastern Cape coast is one of the few areas along the South African coastline considered suitable for marine based aquaculture. Therefore the 'No-go/Status Quo' alternative will eliminate the potential associated with the area as a whole, which will result in the loss of potential benefits associated with the aquaculture industry, as well as the opportunity to meet growing seafood product demand. Not establishing ADZ will leave only current fishing production methods to supply the growing demand for seafood products. The sustainability of these methods is questionable in the long term, and the negative impact on wild stocks has been flagged by DAFF as a critical concern. Irrespective of the potential positive impacts, a number of negative impacts are associated with developing an ADZ and as such, the No-Go option must be considered as the status quo against which the alternative options must be measured.

The **pre-application BAR** describes and assesses environmental impacts related to each precinct and alternative combinations in Chapter 9 and provides a summary of impacts and an impact statement for the three combinations of precincts in Section 10.

4 LEGAL & PROCESS REQUIREMENTS

The current assessment is being undertaken in terms of the **National Environmental Management Act (Act 107 of 1998)** (NEMA). This Act makes provision for the identification and assessment of activities that are potentially detrimental to the environment and which require authorisation from the competent authority (in this case, the national Department of Environmental Affairs, DEA) based on the findings of an EIA. More detail on the environmental authorisation process is provided in Section 4.2 below.

A number of other laws, regulations and guidelines are also relevant to this project and are briefly outlined below (note that only relevant legislation has been included in this chapter). Most importantly, the Constitution provides the foundation for many of the applicable laws and regulations (Section 4.1). These environmental requirements are not intended to be definitive or exhaustive but serve to highlight key environmental legislation and responsibilities only.

4.1 The Constitution of the Republic of South Africa

Chapter 2 of the Constitution of the Republic of South Africa (Act 108 of 1996) - The Bill of Rights Section 24 states that everyone has the right to an environment that is not harmful to their health or wellbeing; and to have the environment protected for the benefit of present and future generations. Reasonable measures must be implemented to protect the environment. This includes preventing pollution and promoting conservation and environmentally sustainable development, while promoting justifiable social and economic development.

Conservation of resources and promotion of sustainable and renewable resources fulfil the requirements of the Constitution.

4.2 The National Environmental Management Act (Act 107 of 1998)

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an Environmental Authorisation issued by the competent authority, in this case, the National Department of Environmental Affairs (DEA). The 2014 EIA Regulations promulgated in terms of NEMA (as amended by Government Notice R326 in 2017), govern the process, methodologies, and requirements for the undertaking of EIAs in support of EA applications. The EIA Regulations are accompanied by Listing Notices (LN) 1-3 (R327, R325 and R324) that list activities requiring an EA.

The EIA Regulations provide for two alternative authorisation processes depending on the type of activity that is proposed. A Basic Assessment (BA) process is required for projects associated with limited environmental impacts as defined in LN 1 and 3. In contrast, a Scoping and Environmental Impact Reporting process (S&EIR, also referred to as an EIA) is required to obtain EA for project with large scale, greater environmental impacts (defined in LN 2).

Anchor has determined that the proposed project triggers a number of activities listed in LN1 and LN3 of the 2014 EIA Regulations (as amended) and that an application for EA should follow the Basic Assessment process.

Before commencing with the project, the proponent (DAFF) is required to appoint an independent Environmental Assessment Practitioner (EAP) to undertake a Basic Assessment process and to obtain EA in terms of NEMA from the DEA. Regulations 19 and 20 of the EIA Regulations contain the detailed approach to the BA process. The BA process aims to identify and assess all potential environmental impacts (negative and positive). The Basic Assessment Report (BAR) should recommend how potential negative impacts should be effectively mitigated and how benefits can be enhanced. A marine impact specialist study will be undertaken to inform the BAR.

The listed activities associated with the proposed development, as stipulation under 2010 Regulations R327 and R324 are presented in Table 6 and Table 7.

Before any of the listed activities can be undertaken, Environmental Authorisation (EA) must be obtained from the relevant authority, in this case the National Department of Environmental Affairs (DEA). Should authorisation be given for these activities, any concessionaires operating under the EA must comply with the conditions and requirements contained in it. In the event that any other activities not authorised are required, an additional assessment must be undertaken and the relevant approvals obtained.

The Environmental Management Programme (EMPr) is also being drafted in terms of NEMA Section 28 General Duty of Care. The EMPr stipulates strict monitoring protocols to ensure that any identified impacts are being managed will be implemented.

Table 6 **Listed activities in Listing Notice 1 (R327) promulgated in terms of the National Environmental Management Act (Act 107 of 1998) associated with the proposed Aquaculture Development Zone in Algoa Bay, Eastern Cape.**

Listed activity as described in Listing Notice 1 (R 327)	Description of the project activity
7. The development and related operation of facilities, infrastructure or structures for aquaculture of sea-based cage culture of finfish, crustaceans, reptiles, amphibians, molluscs, echinoderms and aquatic plants, where the facility, infrastructure or structures will have a production output exceeding 50 000 kg per annum (wet weight).	Production output is proposed as a phased approach, commencing with a pilot scale for 1000 tons/annum and potentially expanding over a period of 3-5 years to carrying capacity (species and location-specific). Expansion would be subject to positive monitoring results from the pilot scale and consent from the AMC.
15. The development of structures in the coastal public property where the development footprint is bigger than 50 square metres, excluding— (Exclusions are not applicable)	Structures associated with the fish cages and boat mooring facilities. The total ADZ area will exceed 50 square metres in coastal public property.
17. Development- (i) in the sea; […] in respect of- […] (e) infrastructure or structures with a development footprint of 50 square metres or more.	Individual operators will moor the finfish cages and oyster long-lines to the seafloor. The combined footprint is likely to exceed 50 square metres.

Listed activity as described in Listing Notice 1 (R 327)	Description of the project activity
19A. The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from – […] (iv) the sea; (Exclusions are not applicable)	Individual operators will moor the finfish cages and oyster long-lines to the seafloor. The combined volume to be deposited on the sea floor exceeds 5 cubic metres.
42. The expansion and related operation of facilities, infrastructure or structures for aquaculture of sea-based cage culture of finfish, crustaceans, reptiles, amphibians, molluscs, echinoderms and aquatic plants where the annual production output of such facility, infrastructure or structures will be increased by 50 000 kg (wet weight) or more.	There are existing oyster and mussel farming facilities, which will be expanded as part of the ADZ.
54. The expansion of facilities- (i) in the sea; […] in respect of- […] (e) infrastructure with a development footprint of 50 square metres or more.	There are existing oyster and mussel farming facilities, which will be expanded as part of the ADZ.
67. Phased activities for all activities— (i) listed in this Notice, which commenced on or after the effective date of this Notice or similarly listed in any of the previous NEMA notices, which commenced on or after the effective date of such previous NEMA Notices; excluding the following activities listed in this Notice – (Exclusions applicable to Activities 17 and 54) […] where any phase of the activity was below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.	The proposed development will occur in stages, where individual operators will contribute to the expansion of the ADZ as a whole.

Table 7 Listed activities in Listing Notice 3 (R324) promulgated in terms of the National Environmental Management Act (Act 107 of 1998) associated with the proposed Aquaculture Development Zone in Algoa Bay, Eastern Cape.

Listed activity as described in Listing Notice 3 (R 324)	Description of the project activity
13. The development and related operation of facilities of any size for any form of aquaculture. a. Eastern Cape ii. In a Protected Area identified in the NEMPAA	Algoa 7 precinct is situated within the recently approved Addo Marine Protected Area.

4.3 National Environmental Management: Protected Areas Act (Act 57 of 2003)

NEMPAA was enacted to regulate the system of protected areas in South Africa and to provide for their management. Any commercial activity carried out in a protected area (which include marine protected areas and sensitive estuaries) requires the written authorisation of the management authority, which will usually be SANParks or a provincial conservation authority. Algoa 7 is situated within the recently approved Addo Marine Protected Area. Although SANParks objected to the Algoa 5 ADZ in the 28 appeals, the Department of Environmental Affairs has nonetheless made provision for an aquaculture area of 1000 ha within the proposed MPA (DEA, 2016).

4.4 National Environmental Management: Biodiversity Act (Act 10 of 2004)

This Act controls the management and conservation of South African biodiversity within the framework of NEMA. Amongst others, it deals with the protection of species and ecosystems that warrant national protection, as well as the sustainable use of indigenous biological resources. Sections 52 & 53 of this Act specifically make provision for the protection of critically endangered, endangered, vulnerable and protected ecosystems that have undergone, or have a risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention through threatening processes.

The NEMBA also controls the undertaking of restricted activities involving alien and invasive species. Restricted activities include but are not limited to the holding, controlling, breeding, and importing exporting of alien and invasive species for mariculture. The ADZ may include the farming of alien and/or invasive species, which is regulated by the Alien and Invasive Species Regulations promulgated in terms of NEMBA. The farming of some species may require a permit in terms of NEMBA Section 65. Note that exemptions for specific species can be applied for in areas where the species already exists (e.g. some oysters and mussel species).

4.5 National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008)

The Act aims to establish a system of integrated coastal and estuarine management in the Republic, including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable; to define rights and duties in relation to coastal areas; to determine the responsibilities of organs of state in relation to coastal areas; to prohibit incineration at sea; to control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment; to give effect to South Africa's international obligations in relation to coastal matters; and to provide for matters connected therewith.

The ICMA activities applicable to the Algoa Bay Marine Aquaculture development may include activities associated with waste, land use and lease agreements. The national Department of Environmental Affairs Branch: Oceans and Coasts (DEA: O&C) has been included in this EIA process as a relevant state department. Any permits or agreements must be obtained from the department by individual operators.

4.6 National Heritage Resources Act (Act 25 of 1999)

The protection and management of South Africa's heritage resources are controlled by the National Heritage Resources Act (Act No. 25 of 1999) (NHRA). The NHRA reflects the tripartite (national/provincial/local) nature of public administration under the South African Constitution and makes provision for the devolution of cultural heritage management to the appropriate, competent level of government. Because national government is responsible for the management of the seabed below the high water mark, however, the management of maritime and underwater cultural heritage resources under the NHRA does not devolve to provincial or local heritage resources authorities but remains the responsibility of the national agency, SAHRA.

The NHRA gives legal definition to the range and extent of what are considered to be South Africa's heritage resources. According to Section 2(xvi) of the Act a heritage resource is "any place or object of cultural significance". This means that the object or place has aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

In terms of the definitions provided in Section 2 of the NHRA, maritime and underwater cultural heritage can include the following sites and/or material relevant to this assessment:

- material remains of human activity which are in a state of disuse and are in or on land [which includes land under water] and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures (Section 2(ii));
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, a defined respectively in sections 3, 4 and 6 of the Maritime Zones Act,

1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation (Section 2(ii)); and

- Any movable property of cultural significance which may be protected in terms of any provisions of the NHRA, including any archaeological artefact or paleontological specimen (Section 2(xxix)).

Of the heritage resource types protected by the NHRA, the marine aquaculture operations have the potential to impact the following:

- submerged pre-colonial archaeological sites and materials; and
- maritime and underwater cultural heritage sites and material, which are principally historical shipwrecks.

As per the definitions provided above, these cultural heritage resources are protected by the NHRA and a permit from SAHRA is required to destroy, damage, excavate, alter, deface or otherwise disturb any such site or material.

It is also important to be aware that in terms of Section 35(2) of the NHRA, all archaeological objects and paleontological material is the property of the State and must, where recovered from a site, be lodged with an appropriate museum or other public institution.

Section 38 of the NHRA requires that any person who intends to undertake certain categories of development must notify the relevant heritage agencies and furnish details of the location, nature and extent of the proposed development. Section 38 also makes provision for the assessment of heritage impacts as part of an EIA process.

As the proposed development is undergoing an Environmental Authorisation (EA) application process in terms of NEMA, it is incumbent on the developer to establish whether a Heritage Impact Assessment (HIA) needs to be completed as per section 38(3) and 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA). If required such an HIA would include an underwater maritime study and any other applicable heritage components. The HIA would be conducted as part of the EA Application in terms of NEMA and the 2017 NEMA EIA Regulations.

The proposed project will affect the surface environment of the ocean more so than the sea bottom. The disturbance on the seabed will be associated with mooring/anchoring mechanism for the cages. Anchor appointed ACO Associates cc to conduct a desktop Maritime and Underwater Cultural Heritage Study as the Maritime and Underwater Cultural Heritage (MUCH) Unit at SAHRA indicated that such a study would likely to be requested. A summary of the HIA has been included in this BAR and the specialist study has been included as a standalone document in Appendix D.

4.7 Marine Living Resources Act (Act 18 of 1998)

The Marine Living Resources Act (Act 18 of 1998) recognises the need to utilise marine living resources in order to achieve economic growth, human resource development, capacity building within fisheries and mariculture branches, and employment creation. Exploitation of marine resources should occur sustainably within the development objectives of the national government. The Department of Agriculture, Forestry and Fisheries is the competent authority for the MLRA.

Most importantly, the Act prohibits the undertaking of marine aquaculture or the operation of a fish processing establishment unless a right has first been obtained from the Minister of Agriculture, Forestry and Fisheries. Once a right is obtained application must be made for a permit. While a marine aquaculture right is valid for 15 years the permit is only issued for one year. The rights or permits may be suspended if conditions are not being adhered to or if the right or permit is not being used effectively (DAFF 2013).

Regulations in terms of the Act also require permits for specific activities related to aquaculture, including but not limited to (DAFF 2013):

- possession, selling, import and export of fish and aquatic plants
- prohibition is placed on controlling or being in possession of specimens of specified species below a certain size (exemptions can be obtained)
- use of abalone and oysters in commercial operations
- outright prohibition on any use of certain fish species
- collection of broodstock from wild stocks
- permit for erection of structures in the sea

4.8 Sea-Shore Amendment Act (Act 190 of 1993)

The Sea-Shore Amendment Act 1993 (No. 190 of 1993) prohibits the erection of buildings and structures and the laying of pipes below the high water mark on the sea shore or in the sea without a lease in terms of the Act. In 2014, the Seashore Act was repealed with regards to the functions and powers of the Minister, but not with regards to the functions and powers of Provincial Departments. Coastal Lease Agreements are issued by the provinces (different institutions and processes). Recognising that this provincial level system has to be repealed by a consolidated national system in terms of ICMA (See Section 4.5), the provinces were assigned the responsibility to repeal the applicable sections of the Seashore Act once a replacement system is in place and effective. None of the provinces have repealed the Seashore Act and hence, coastal lease agreements are still issued via existing administrative processes.

Coastal use permit in terms of Section 65 of the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) (as amended in 2014) (ICMA) is only required if a list of activities requiring such a permit has been published in the Government Gazette. No such list has been promulgated yet and we anticipate that a coastal use permit is not required.

4.9 Other relevant legislation and guidelines

Apart from the above-mentioned related key Legislation, a host of national legislation is also regarded as relevant to the development of sea-based ADZ, including:

- The Maritime Zones Act (Act No 15 of 1994)
- Sea-Shore Amendment Act (Act 190 of 1993)
- Agricultural Pests Act (Act 36 of 1983)
- Development Facilitation Act (Act 67 of 1995)
- Fertilizers, Farm Feeds, Agriculture Remedies and Stock Remedies Act (Act 36 of 1947)
- The Animal Diseases Act (Act 35 of 1984)
- The Genetically Modified Organisms Act (Act 15 of 1997)
- The Animal Improvement Act (Act 62 of 1998)
- The Sea Birds and Seals Protection Act (Act 46 of 1973)
- The Health Act (Act 63 of 1977)
- The Medicines and Related Substances Control Act (Act 101 of 1965)
- The Foodstuffs, Cosmetics and Disinfectants Act (Act 54 of 1972)
- The Water Services Act (Act 108 of 1997)
- The National Regulator for Compulsory Specifications Act (Act 5 of 2008); and
- Standards Act (Act 8 of 2008)

These numerous pieces of legislation are not integrated and are managed by a range of different regulatory bodies. A review of all the applicable legislation was beyond the scope of the Basic Assessment Report. DAFF, as the lead agent for the development and management of the aquaculture sector in South Africa, published the first edition of the "Legal Guide for the Aquaculture Sector in South Africa" in 2013 (DAFF 2013). All operational specific permits and licenses must be obtained by the individual operators before commencement of any activities.

The following environmental Regulations and Guidelines were considered as background to this application:

Brownlie S (2005). Guideline for involving biodiversity specialists in EIA processes. Department Environmental Affairs & Development Planning.

DWA (2001). Generic public participation guideline. Department of Water Affairs and Forestry.

DEA&T (2002). Integrated Environmental Management Information Series 3: Stakeholder Engagement. Department of Environmental Affairs and Tourism, Pretoria.

DEA&DP (2003). Waste Minimisation Guideline for Environmental Impact Assessment reviews. NEMA EIA Regulations Guideline & Information Series, Department Environmental Affairs & Development Planning.

DEA&T (2004). Criteria for determining alternatives in EIAs, Integrated Environmental Management, Information Series 11, Department of Environmental Affairs & Tourism, Pretoria.

DEA&T (2004). Environmental management Plans, Integrated Environmental management, Information Series 12, Department Environmental Affairs & Tourism

DEA&T (2005). Assessment of Impacts and Alternatives, Integrated Environmental Management Guideline Series, Department of Environmental Affairs & Tourism, Pretoria.

DEA&T (2005). Guideline 4: Public Participation, in terms of the EIA Regulations 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism, Pretoria.

DEA&DP (2005). Guideline for the review of specialist input in the EIA process. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). Guideline for involving biodiversity specialists in the EIA process. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). Guideline for environmental management plans. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). Provincial urban edge guideline. Department Environmental Affairs & Development Planning.

DEA&T (2006). EIA Regulations in terms of the National Environmental Management Act (Act No 107 of 1998) (Government Notice No R 385, R 386 and R 387 in Government Gazette No 28753 of 21 April 2006).

DEA&DP (2006). Guideline on the Interpretation of the Listed Activities. NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). Guide on Alternatives, NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). Guideline on Appeals, NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). Guideline on Exemption Applications. NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). Guideline on Public Participation. NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). Generic Environmental Best Management Practice Guideline for Aquaculture Development and Operation in the Western Cape. Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Transitional Arrangements, NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Generic Terms of Reference for EAPs and Project Schedules, NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Public Participation. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Alternatives, NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Need & Desirability, NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Exemption Applications. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2013). Guideline on Appeals. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

Keatimilwe K & Ashton PJ 2005. Guideline for the review of specialist input in EIA processes. Department Environmental Affairs & Development Planning.

Lochner P 2005. Guideline for Environmental Management Plans. Department Environmental Affairs & Development Planning.

Munster F 2005. Guideline for determining the scope of specialist involvement in EIA processes. Department Environmental Affairs & Development Planning.

Oberholzer B 2005. Guideline for involving visual & aesthetic specialists. Department Environmental Affairs & Development Planning.

Winter S & Beaumann N 2005. Guideline for involving heritage specialists in EIA processes. Department Environmental Affairs & Development Planning.

Celliers, L., Breetzke, T., Moore, L. and Malan, D. 2009. A User-friendly Guide to South Africa's Integrated Coastal Management Act. The Department of Environmental Affairs and SSI Engineers and Environmental Consultants. Cape Town, South Africa.

Policy and Guidelines for Fin Fish Farming, Marine Aquaculture experiments and Pilot Projects in SA. DEAT 2006, 2007.

Guidelines for Mariculture Ranching in South Africa. DEAT 2006, 2007.

Marine Aquaculture Sector Development Plan 2006, 2007.

Policy for the development of a Sustainable Marine Aquaculture Sector in South Africa. DEAT, 2007.

Strategic Environmental Assessment (SEA). DEAT, 2009.

Strategic Environmental Assessment – Identification of potential marine aquaculture development zones for finfish cage culture. DAFF, 2011.

National Environmental Management Act (Act 107 of 1998): Environmental Impact Assessment Guideline for Aquaculture. DEA, 2013.

Republic of South Africa. 2018. Aquaculture Development Bill. BB22 – 2018.

5 NEED AND DESIRABILITY OF THE ACTIVITY

In keeping with the requirements of an integrated Environmental Impact process, the Guideline on Need and Desirability (Western Cape 2010) has been utilised to provide a concise estimation of the activity to the broader societal needs. The concept of need and desirability can be explained in terms of its two components where need refers to time and desirability refers to place. The questions pertaining to both NEED and DESIRABILITY, as specified in the Guideline, are answered below.

5.1 Need (Timing)

Aquaculture is the fastest growing form of food production in the world and a significant source of protein for people in many countries. Globally, nearly half the fish consumed by humans is produced by fish farms. This worldwide trend toward aquaculture production is expected to continue. At the same time, the demand for safe, healthy seafood is also expected to grow (California Green Solutions, 2011). Over the past decade, the surging demand for fish and fishery products has mainly been met by aquaculture production, as capture fisheries have been rather stagnant or even declining in some countries (United Nations, 2010). Notwithstanding the growth in the consumption of fish and food in general and the positive long-term trends in nutritional standards, under-nutrition (including inadequate levels of consumption of protein-rich food of animal origin) remains a huge and persistent problem.

The long-term forecast for the demand for food remains positive, driven by population growth and urbanization. In particular, demand for fish products is expected to continue to rise in the coming decades. However, future increases in per capita fish consumption will depend on the availability of fishery products. Major increases in fish food production are forecasted to come from aquaculture, while production from capture fisheries stagnates. Taking into account the population forecasts, an additional 27 million tonnes of production will be needed in 2030 to maintain the present level of per capita consumption (United Nations, 2010). Future demand will, however, be determined by a complex interaction of several factors and elements. The global food sectors, including the fishery sector, will have to face several challenges stemming from demographic, dietary, climatic and economic changes, including reduced reliance on fossil energy and increasing constraints on other natural resources. As the world's population continues to grow, lack of fresh water and space means that terrestrial agriculture is unlikely to be able to meet food demand. Freshwater aquaculture, which is largely confined to the tropics, is expanding, but its reliance on fresh water may limit long-term growth. Fishing catches have been declining globally for two decades, and although conservation measures and a shift in consumption patterns could allow some recovery, marine aquaculture holds more potential for sustained growth. Aquaculture (which includes mariculture) is best positioned to contribute to food security, wealth and job creation. It also contributes to the reduction of protein deficiency in the diets of many rural communities (Science Daily, December 2009).

A report from the Department of Science and Technology suggests that in many parts of Africa, aquaculture offers strategic entry points for short and long-term investment opportunities to contribute to food security, improve health, women's economic empowerment and local enterprise development for the poor. In South Africa, aquaculture is providing an opportunity for the socio-economic development and beneficiation by rural communities through the sustainable non-consumptive utilisation of water in State and privately-owned irrigation water-works and storage reservoirs and schemes, without the transfer of land ownership being a prerequisite (Department of Science and Technology, 2011a).

It is clear from emerging trends worldwide, which are also applicable to South Africa, that aquaculture (including marine finfish culture) could positively contribute to addressing the following:

- Increasing demand for fish products in the coming decades;
- Major increases in fish food production are forecasted to come from aquaculture;
- Continued growth in the world population;
- Lack of fresh water and space;
- Marine aquaculture holds more potential for sustained growth due to declining fishing catches; and
- Aquaculture (which includes mariculture) is best positioned to contribute to food security, wealth and job creation.

Several questions must be answered in assessing the need of the proposed activity in the Algoa Bay area:

1. Is the proposed development in line with the projects and programmes identified as priorities within the Integrated Development Plan for the Nelson Mandela Bay Municipality?

The Nelson Mandela Bay Metropolitan Municipality IDP (2017-2022) presents 6 pillars, which form the foundations on which the Municipality's developmental priorities are hinged:

1. Well-run city
2. Opportunity city
3. Safe city
4. Inclusive city
5. Caring city
6. Forward thinking city

The Opportunity City is envisioned to delivery on well-planned initiatives to enable and cultivate job creation and economic opportunity, develop competitive advantage, and ensure access to skills. The objectives are to:

- Grow and diversify the local economy through the attraction of new investment, skills development and facilitation of an enabling environment for small business growth and job creation; and
- Facilitate and promote infrastructure led growth, development and tourism.
- Executing existing and designing and implementing new projects that competitively differentiate Nelson Mandela Bay as a destination city for business, tourism and investment – including through strategic partnerships.

- Developing an effective integrated public transport system that promotes access to opportunity through mobility.

The relevant Key Performance Indicators (KPIs) are listed below:

- KPI 63: Number of new agroprocessing firms/companies established within the NMBM
- KPI 65: Decrease percentage youth unemployment
- KPI 67: Increase the number of industrial areas targeted for upgrade and revitalisation
- KPI 68: Facilitate exports contracts within the NMBM
- KPI 69: Percentage contribution to the GDP of key Economic Clusters targeted for development as per the NMBM Economic Growth and Development Plan
- KPI 70: Increase the number of SMMEs supported through the SMME Support Centre and Enterprise Development Policy turning a profit within business plan stipulated timeframe

Mariculture industry in Algoa Bay has the ability to stimulate economic development and create jobs at the local level. The mariculture industry is labour intensive and the pilot marine finfish project in Algoa Bay has generated interest from the local aquaculture industry. The project aims at creating employment and human capital development opportunities. The resultant BEE opportunities will also create additional wealth and job opportunities.

The mariculture finfish operation could provide additional skills and up-skilling opportunities to persons that would either like to obtain employment in the future or persons that are already working in the fishing industry that could be up-skilled. An opportunity exists to invest in the finfish mariculture once the pilot operation has provided an indication of the viability and feasibility of a finfish farm in Algoa Bay.

Given the importance of food security and the need for and envisaged growth in the aquaculture industry and the BEE opportunities, finance from the Agriculture Strategic Business Unit (SBU) of the Industrial Development Corporation (IDC) and incentives from the Department of Trade and Industry (DTI) may be available to assist with the establishment of finfish mariculture ventures in Algoa Bay.

Small businesses could position themselves to support the operations of a finfish mariculture operation, provide services and products required to establish and operate the fish farm, and also benefit from the downstream opportunities that are presented by the development of a sustainable finfish farm in Algoa Bay.

The proposed ADZ would therefore contribute to the meeting of the above-listed KPIs. The proposed development is therefore in line with the projects and programmes identified in the IDP on condition that the mariculture industry develops organically without unfair and/or negative impacts on other priority projects/programmes.

2. Should the development occur here at this point in time?

Apart from Algoa 6, Algoa 1, 5, and 7 are already fairly congested with other land uses including recreational activities, commercial fishery and conservation initiatives (recently approved Addo MPA). The South African coastline has limited sheltered environments which accommodate sea-based aquaculture, eco-tourism and water sport activities such as long-distance swimming and scuba diving. Consequently, the proposed ADZ may be in conflict with other uses, however these should not be seen as mutually exclusive as changes in management/operations for all activities can allow for symbiotic relationships.

Does the community/area need the activity and the associated land use concerned?

The Scoping and Environmental Impact Reporting (S&EIR) process conducted between 2010 and 2014 demonstrated that certain sectors within the local community oppose the proposal mostly due to potential conflict with existing industries and conservation initiatives. It is therefore to be expected that these entities will argue against the need for this activity. On a strategic level, however, food security and job creation affects all community members and a successful, well managed mariculture industry speaks directly to supporting communities in the study area and beyond.

The Eastern Cape coast suffers high poverty in the coastal communities reliant on marine resources. It is a well-known fact that wild fishing stocks are under pressure and aquaculture is one way of improving marine resource management. The proposed activity will provide benefits in terms of skills-based employment opportunities, contribution to GDP, small business development and local community development. To this effect the activity is much needed.

Equally though the Socio-Economic Impact assessment and subsequent comparative study conducted in 2016 (Britz *et al.* 2016; Britz & Warwick 2016) has identified a number of Medium to High negative impacts, mostly related to user conflicts in the Bay, whereby major contributors to employment, and conservation may be negatively affected. Uninterrupted monitoring of the mariculture operations during the pilot phase, as well as any expansions, is crucial to determine the level and significance of impacts on other users.

In the event that monitoring protocols cannot be achieved the project should be interrupted and no further expansions allowed.

Are the necessary services with adequate capacity currently available?

Port Elizabeth and the Ngqura Industrial Development Zone have sufficient capacity for fish processing and product manufacturing facilities. The proximity of two major ports, Port Elizabeth and Ngqura Harbours is critical in servicing and managing the Aquaculture Development Zone.

Is this development provided for in the infrastructure planning of the municipality?

This development is initiated by the National Department of Agriculture, Forestry and Fisheries (DAFF) and will be funded by concessionaires and is therefore not provided for in the infrastructure planning of the municipalities (metropolitan, local and district).

Is this project part of a national programme to address an issue of national concern or importance?

The National Aquaculture Strategic Framework (2012) indicates that aquaculture development is a priority of government. The Government recognises the opportunities presented by aquaculture and is committed to creating appropriate platforms for access to and optimal utilisation of available resources and existing infrastructure to facilitate new economic activity to create opportunities for wealth creation and gainful employment whilst ensuring the government's key overriding constitutional obligation for a fairer and equitable society is upheld. The vision for the South African aquaculture sector is to develop and grow a sustainable and competitive aquaculture sector that meaningfully contributes to transformation, wealth creation and employment through a diversity of production systems that produces safe, nutritious and affordable food while ensuring the environmental services required for securing its future. The mission is to maximise socio-economic opportunities and benefits from aquaculture through meaningful transformation and being a regional leader. The policy covers 16 strategic issues to create an ambient environment for aquaculture to flourish:

- Developmental focus
- Legislation and regulatory framework
- Financial Services & incentives
- Access to land and water
- Availability of and access to inputs
- Culture based fisheries
- Training, education and capacity building and research
- Technology transfer
- Extension and sector outreach services
- Aquatic animal health management
- Information systems
- Product quality, safety and diversification
- Gender, youth and disability
- Marketing and trade
- Monitoring, control and evaluation

It is essential that these issues are considered holistically and that all stakeholders that could provide input in the establishment of finfish mariculture operations be considered. The value chain for the development of the finfish mariculture is therefore a fundamental premise to understand the linkages and interactions between the requirements and role-players.

Operation Phakisa was initiated in August 2013 ("phakisa" meaning "hurry up" in Sesotho. The name highlights the urgency of delivery). This operation is meant to address national key priority areas such as poverty, crime and unemployment. A study of the economic potential of South Africa's oceans indicated that the immense potential of this untapped resource has not fully taken advantage of. The oceans have the potential to contribute up to 177 billion rand to the gross domestic product (GDP) and create just over one million jobs by 2033. Aquaculture is one of four critical areas to explore and further unlock the potential of South Africa's vast coastline.

The Aquaculture work stream has underlined the high growth potential of South Africa's aquaculture sector due to increasing demand for fish. While aquaculture contributes to almost half of the global fish supply, it contributes less than 1% of South Africa's fish supply. The sector offers significant potential for rural development, especially for marginalised coastal communities.

5.2 Desirability (place)

The individual benefits of a project overstate the true benefits if the project diminishes benefits elsewhere in the area. The economic desirability is therefore essential to determine whether the proposed development compliments economic planning as reflected in spatial development planning. It is not sufficient that the development results in some positive spin-offs if it is not compatible with planning guidance designed to maximise the overall economic potential of an area. Regulatory Policy and Guidelines in particular are central to economic development planning and are prepared in order to guide overall development of an industry or a sub-industry in a direction that local and provincial authorities see as desirable. In order to provide some context, the Nelson Mandela Bay IDP and various related strategic frameworks, policies, guidelines and sector development plans are considered as a premise for further assessment.

Several questions must be answered in assessing the desirability of the proposed activity:

Is the development the best practicable environmental option for this site?

Based on the available information commercial bivalve and finfish farming is a desirable use of the sea space within Algoa Bay. South Africa's coastline is very exposed and there are few suitable precincts for sea-based aquaculture. Certain areas in Algoa Bay were identified as suitable in the Strategic Environmental Assessment (SEA) conducted in 2011.

It is accepted, however, that active and strict operational monitoring at the selected site/s will assist in determining to what extent commercial bivalve and finfish farming is the best practicable environmental option compared to other uses in the Bay.

Would the approval of this application compromise the integrity of the existing approved and credible municipal IDP and SDF?

Both the IDP and SDF support the potential for sustainable job creation, sustainable environmental resources, and sustainable economic development and would therefore not be compromised by the proposed development.

Would the approval of this application compromise the integrity of the existing approved environmental management priorities for the area?

The SEA took into account factors including environmental management priorities such as existing and future proposed Marine Protected Areas (MPA's) when identifying suitable aquaculture development zones. Algoa 7 is positioned inside the recently approved Addo Marine Protected Area and lie closer to the St Croix Island group than the other proposed ADZ precincts (Algoa 1 and 6).

Do location factors favour this land use at this place?

South Africa's coastline is very exposed and there are few suitable precincts for sea-based aquaculture. The 2011 SEA confirmed that the preferred locations are favourable compared to vast areas along the South African coast line that are not suitable for this activity. The assessments by the various specialists showed that there are impacts related to such a venture, but many of these are "generic" impacts which are applicable to any sea-based aquaculture facility. The management of these impacts has thus for many places been tested, and as such management mitigations can be applied with a measurable level of confidence. For the site specific impacts, the mitigations proposed by the specialists should be implemented, and importantly, the phased approach with strict monitoring protocols is being supported. Proximity to two big harbours (Port Elizabeth and Ngqura) contributes to this site being preferred.

How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas?

Algoa 7 is situated within the recently approved Marine Protected Area. The Department of Environmental Affairs has nonetheless made provision for an aquaculture area of 1000 ha within the proposed MPA (DEA, 2016).

How will the development impact on people's health and wellbeing?

The proposed development is unlikely to impact negatively on people's health and wellbeing. According to the Socio-Economic Impact Assessment there are positive impacts related to employment, economic investment and community development.

Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?

Without mitigation and at maximum scale the proposed ADZ will result in unacceptable opportunity costs to competing industries and the receiving environment. Successful implementation of recommended mitigation measures, monitoring and implementation in a phased manner could avoid reaching levels of unacceptable opportunity costs.

User conflicts within the proposed ADZ precincts are primarily applicable to Algoa 1, but these can potentially be mitigated and managed with the assistance of uninterrupted monitoring protocols for the pilot farms before any expansion is considered. Social support is currently lacking for Algoa 1 due to real but unquantified socio-economic impacts that are likely to occur if a finfish farm is established on the northern part of Algoa 1 (Option 1) (Hosking 2016). The southern portion of Algoa 1 represents a quantifiable risk to the squid industry and should be avoided.

Care must be taken to avoid unwanted conflict with existing marine and tourist enterprises/marine protected areas to avoid unacceptable opportunity cost. The proposed monitoring protocol will form an important tool for evaluating the level of conflict and provide a platform for the various users to interact as a committee.

In the event that monitoring protocols cannot be achieved without detrimental impacts on other significant users the project must be interrupted at pilot phase and no further expansion allowed.

Will the proposed land use result in unacceptable cumulative impacts?

The site specific cumulative impacts are deemed to have a Low - High negative impact for the various specialist disciplines, which can be reversed if specified thresholds are exceeded. On a strategic level these impacts can offset the higher impact of loss of wild fish stocks.

In the event that marine aquaculture for finfish is deemed inappropriate and incompatible with other users, based on the results of the proposed monitoring protocol, the appropriate action should be taken to cease the negative impacts.

6 POLICY AND PLANNING

The decision to investigate South Africa's marine aquaculture capacity is based on national policy and informed by on-going strategic planning undertaken by the national Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Environmental Affairs (DEA). In 2013, DAFF promulgated the National Aquaculture Strategic Framework Policy, which identifies the establishment of ADZ as a key strategy to develop aquaculture.

Various policies and guidelines have been developed dealing with marine aquaculture, their known impacts (including direct, indirect and cumulative), the processes of how they should be investigated, as well as recommendations of how such should be managed to avoid unwanted negative results/impacts.

The fact that marine aquaculture is being considered at Government level is proof of a strategic approach to this industry. The main policies and guidelines include:

- Policy and Guidelines for Fin Fish Farming, Marine Aquaculture experiments and Pilot Projects in SA (DEAT 2006, 2007)
- Guidelines for Mariculture Ranching in South Africa (DEAT 2006, 2007)
- Marine Aquaculture Sector Development Plan 2006, 2007
- Policy for the development of a Sustainable Marine Aquaculture Sector in South Africa. (DEAT 2007)
- Strategic Environmental Assessment (SEA) (DEAT 2009)
- Strategic Environmental Assessment – Identification of potential marine aquaculture development zones for finfish cage culture (DAFF 2011)
- Environmental Integrity Framework for Marine Aquaculture (DAFF 2012)
- National Environmental Management Act (Act 107 of 1998): Environmental Impact Assessment Guideline for Aquaculture (DEA 2013)
- National Aquaculture Strategic Framework Policy (DAFF 2013)
- Aquaculture Development Bill (2018)

Notwithstanding the research already undertaken as a result of the above projects, the marine aquaculture industry and Authorities require first-hand experience to implement and test the recommendations and management objectives. It is therefore vital that implementation and operation of future marine aquaculture projects be monitored closely to determine to what extent the industry can regulate itself. The above policy and guideline documents all refer to the importance of compliance and monitoring as safe keep measures for marine aquaculture. Thus it will only be through rigorous control of the industry, that long-term results and the potential success of the activity will become known.

The overriding strategy, on which this proposal is being touted, is the protection of wild fish stocks, the sustainability of the fishing industry in South Africa and the need to provide food security for an ever growing population.

7 ENVIRONMENTAL RISKS TO THE ADZ

Marine aquaculture relies on good water quality to comply with national and international food safety standards for the aquaculture products produced. Overall, the final fish product is less sensitive to environmental pollution than bivalves. Bivalves are filter feeders and easily assimilate and bioaccumulate pollutants or harmful algae, that are toxic to humans, directly from the environment. Bivalves also assimilate microbes (viruses, bacteria and parasites) if present in the water column.

This chapter briefly describes the main pollution sources, which could potentially reduce viability of the proposed Aquaculture Development Zone. DAFF has internally assessed the need and desirability of declaring the ADZ in Algoa Bay Area. Public comments received to date have highlighted numerous risks to aquaculture in Algoa Bay. Many of these were highlighted in the previous EIR process and DAFF is well aware of the challenges facing future aquaculture developments in Algoa Bay (the same challenges are faced by land-based facilities). DAFF has nonetheless decided to proceed with the application for environmental authorisation. The sections below highlight the potential risks to the development, but do not form part of the impact assessment, which assesses the impacts of the development on the environment and not *vice versa*.

7.1 Harmful Algal Blooms in Algoa Bay

An algal bloom is defined as the rapid growth or accumulation of algae in aquatic ecosystems. Harmful algal blooms (HAB) are algal blooms composed of phytoplankton known to naturally produce bio-toxins that are harmful to the resident population, as well as humans. The presence of harmful algal blooms leads to fish die-offs, fish sickness, and human sickness when affected organisms are consumed (Biology Dictionary 2018). This is especially pertinent to bivalve culture, as a result of their ability to bioaccumulate these toxins in their tissue.

Algal blooms are caused by excessive amounts of nitrates, phosphates, and other nutrients entering an aquatic ecosystem (Biology Dictionary 2018). In the marine environment, strong offshore winds can trigger an upwelling event where cold, nutrient rich bottom water is transported to the surface. Upwelling events are characteristic of western boundary currents and occur mostly on South Africa's west coast. However, Algoa Bay can experience intense, intermittent upwelling events, the frequencies of which may change with the progression of climate change.

A recent publication by Lemley *et al*. (2019) attribute the increased observation of eutrophic symptoms in Algoa Bay, including harmful algal blooms (e.g. *Heterosigma akashiwo* and *Lingulodinium polyedra*) and hypoxia (<2 mgl^{-1}) at least in part to anthropogenic nutrient loading from land based sources (e.g. waste water treatment works, storm water outfalls).

As these algae grow, out-competed plants die off and become food for the bacteria that decompose them. With this increased food availability, the bacteria also experience explosive growth, rapidly using up all the oxygen in the water until many fish and aquatic insects can no longer survive. The end result of an algal bloom is a dead zone (Biology Dictionary 2018).

In the marine environment, assimilation of effluent is much more effective than in freshwater bodies and therefore discharges from sewage treatment plants and storm water run-off do not typically result in a widespread HAB, such as those observed as a result of environmental conditions. The following content has been extracted from the Final socio-economic report compiled by Britz *et al.* (2016).

Periodic Harmful Algal Blooms (HABs also referred to as 'red tide') caused by dinoflagellate are a potential threat to the viability of cage aquaculture in Algoa Bay. The now defunct Marine Growers Abalone farm next to the present Ngqura Harbour suffered heavy stock losses during two dinoflagellate (species not unidentified) blooms in January 2000 and again in January 2001 (Muller, 2001). The recent extended (December 2013-March 2014) HAB event of the dinoflagellate *Lingulodinium polyedrum* along the East coast and in Algoa Bay is of particular concern for the viability of cage aquaculture.

L. polyedrum blooms are associated with periods of warm water (>20°C) and calm wind conditions, which are likely to become more prevalent in Algoa Bay as marine warm water events are on the increase globally and in South Africa. Warm water events are of particular concern within the bay as they appear to persist for longer than outside the bay due to the bay circulation pattern (Bornman and Goshen, 2016).

During the severe HAB event of the dinoflagellate *Lingulodinium polyedrum* in early 2014, the South African Environmental Observation Network performed invaluable monitoring of oxygen, chlorophyll, cell density and temperature. The HAB bloom conditions resulted in extremely altered water quality which is considered a high risk to aquaculture production. The cell density of the dinoflagellates reached 29,000 cells per ml producing 200% oxygen supersaturation (12mg/l) in the surface waters as a result of photosynthetic activity. The night-time oxygen levels were not measured, but a severe drop in oxygen level would be expected due to cellular respiration. A HAB bloom in Mexico during which 200% oxygen saturation (12mg/l) was recorded in the daytime had a night-time minimum of 4mg/l (Gocke *et al.*, 1990). The decaying Algoa Bay bloom resulted in low oxygen conditions (<2mg/l) towards 20m and deeper.

Lingulodinium polyedrum is a *thecate dinoflagellate* that produces yessotoxins. The effect of these toxins on fish is unknown but they have been shown to bioaccumulate in shellfish and have a toxic effect on mice. *Thecate dinoflagellates* are known to leak toxins when decomposing and the possibility of a toxic plume being produced under or around the sea cages should not be overlooked. Whilst there may not be a proven toxic effect on fish, salmon subjected to a 3 week sitting bloom of *Neoceratium spp* showed histological cell damage to the liver indicative of hypoxia and exposure to toxic phytoplankton. This population of fish struggled to return to normal feeding post the event and as such rapidly lost condition (A. Irish, Senior Biologist, The Scottish Salmon Company, pers. comm., September 2016).

The effects of an HAB bloom on kob in cage culture have not been observed, but could have potentially severe sub-lethal and lethal effects. It is unlikely that the daytime oxygen super-saturation will result in negative effects on the fish, however, the low oxygen levels (of the order 4 mg/l) at night would be stressful i.e. affecting feeding, growth and making the fish more vulnerable to disease. Wild fish would actively seek water with higher oxygen levels and farmed fish show the same instinct and can display "burrowing" behaviour causing extensive physical damage to the face

which can lead to osmoregulatory failure or secondary infection. While the low oxygen (<2mg/l) at 20m depth would be below the fish cages (10-15m depth), if the water column turned over moving the deoxygenated bottom water up to the cages, mass fish mortalities could occur. There are a number of *in situ* bloom mitigation measures that have been considered by the mariculture sector, which include aeration and oxygenation, airlift pumping, moving fish pens away from blooms, perimeter skirts, ozone treatment and other methods (Anderson *et al.* 2001). However, most of these mitigation measures involve expensive technology and successful mitigation is certainly not guaranteed. Pre-emptive harvesting of finfish stock prior to occurrence of a major HAB event is considered by some to be a mitigation means, although an effective early warning system must be in place. Furthermore, marketing large volumes of fish on short notice is difficult (Anderson *et al.* 2001).

The effect of exceptionally high algal cell density on the gills of the target species is not known, however, in other species HAB cells have been known to cause clogging, irritation and mucous production. Whilst not spined like many other thecate dinoflagellates, the armoured plates of *Lingulodinium polyedrum* will cause a degree of abrasion on gill tissue. This would lead to significant proliferation and hyperplasia of the gill tissue, compromising the respiratory process. Prolonged exposure to this challenge would exacerbate the damage (A. Irish, Senior Biologist, The Scottish Salmon Company, pers. comm., September 2016).

Figure 13 **Red tide bloom in Port Elizabeth during January 2014. Humewood Beach (Above) and satellite image of the bloom (Courtesy Dr G Pitcher, DAFF).**

7.2 Dredging in the Port of Ngqura

Dredging of the seabed is performed worldwide in order to expand and deepen existing harbours/ports or to maintain navigation channels and harbour entrances where sediment accumulates through natural and human-induced sedimentation (Erftemeijer & Lewis 2006). Aside from dredging itself, dredged material may be suspended during transport to the surface, overflow from barges or leaking pipelines, during transport to dump precincts and during disposal of dredged material (Jensen & Mogensen 2000 in Erftemeijer & Lewis 2006). Dredging has been touted as one of the most common anthropogenic disturbance of the marine environment (Bonvicini Pagliai *et al.* 1985).

The Ngqura harbour is currently under development and there is a good prospect of further port development and capital dredging that may have an impact on the proposed aquaculture activities. The TNPA is planning to dredge 190 000 m^3 and 50 000 m^3 in February and 140 000 m^3 in March 2019 (*Pers. comm.* Mandilakhe Mdodana, TNPA).

The original EIA that was done for the port development included a sediment modelling study which looked at impacts of the dredging and dredge spoil disposal (Transnet 2014a). The modelling results show that there is no risk from dredging in the port to Algoa 7 (Figure 14). However, there is some risk associated with dredge spoil disposal to Algoa 7 if the TNPA intends to continue using the same disposal site for maintenance dredging and port expansion. The northern boundary of the current disposal site is situated only 1 km to the east of Algoa 7 (Figure 16).

The modelling results shown in Figure 14 show that suspended sediment concentrations exceed the threshold value of 10 mg/l, for roughly 2-5 days per season. Suspended sediment concentrations will exceed the threshold value of 20 mg/l only within the confines of the dredge spoil disposal area and Figure 15. These values are suggested guideline below which ecological impacts are unlikely to occur in sensitive areas within the Bay (Steffani *et al.* 2003). Therefore it is unlikely that this activity will affect the surface turbidity within the proposed finish ADZ. In addition, there is no equivocal evidence that these activities will have significant effects on benthic communities (Transnet 2014b)

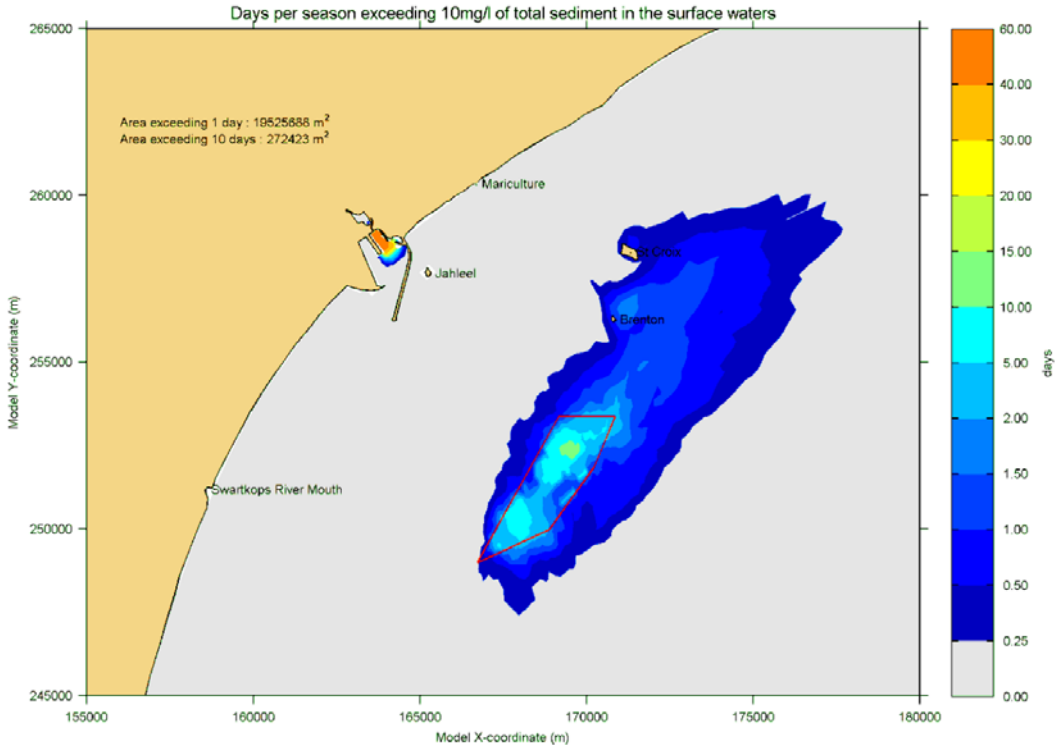

Figure 14 **Number of days per season that a suspended sediment concentration threshold of 10 mg/L is exceeded in the in the harbour and above the disposal site. (Source: Chapter 7 Transnet Marine Infrastructure EIA report 2014).**

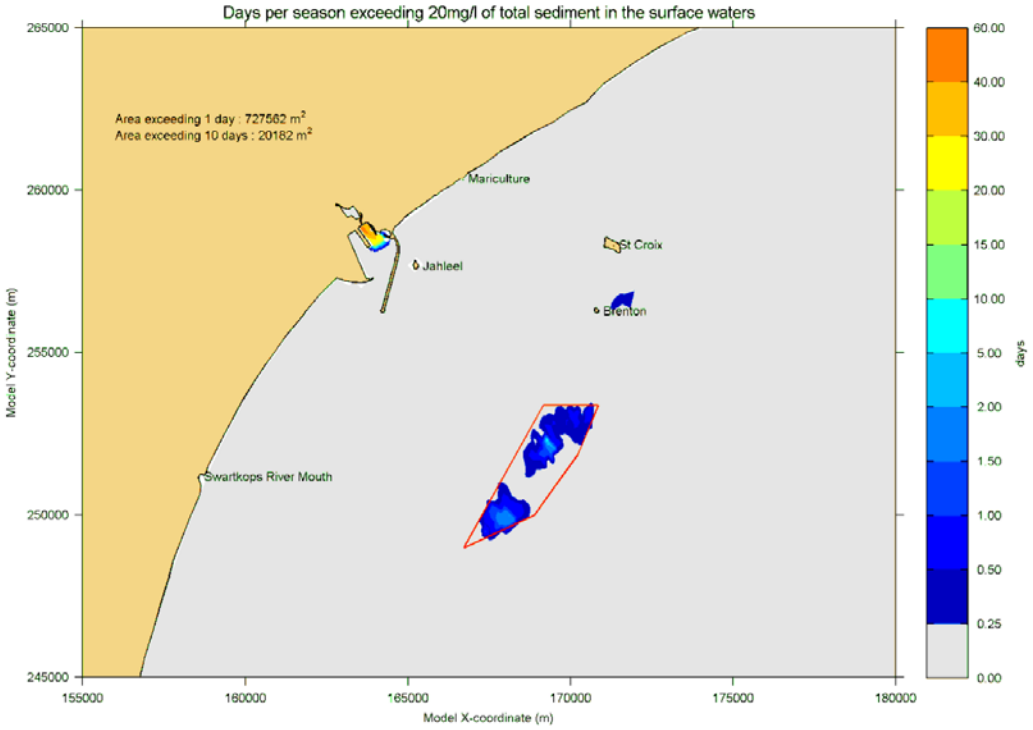

Figure 15 **Modelled effects of dredge spoil dumping showing the number of days per season that suspended solids concentration threshold of 20 mg/l is exceeded in surface waters in the harbour and above the disposal site. (Source: Chapter 7 Transnet Marine Infrastructure EIA report 2014).**

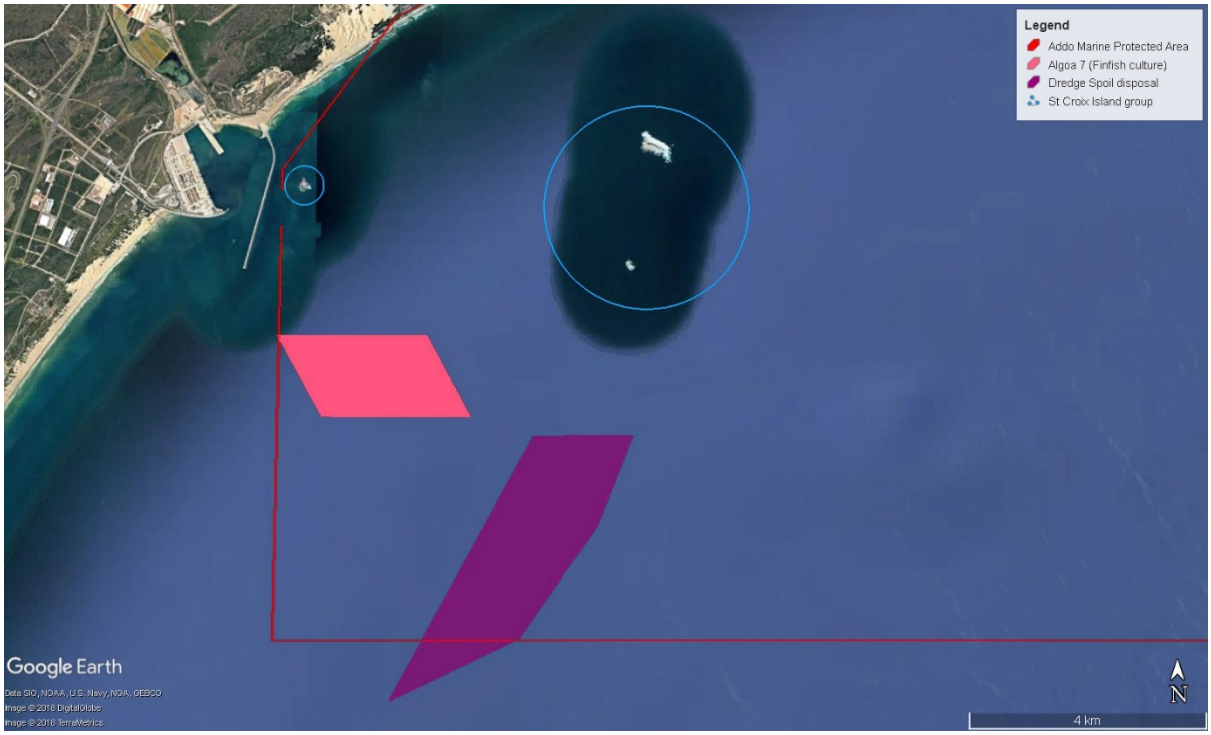

Figure 16 **Location of the dredge disposal site for the Port of Ngqura in relation to the proposed ADZ Algoa 7.**

7.3 Ship to ship offshore bunkering activities

Ship-to-ship bunkering is the transfer of fuel from in port supplier ship to the bunkers of larger vessels - ultimately the equivalent of petrol stations at sea. Currently, within Algoa Bay, two companies are licensed to conduct bunkering operations, however an additional two applications are being considered for licensing (personal contact with Dr. Lorien Pichegru). Unplanned events or accidents during the re-fuelling may result in the loss of hydrocarbons and can have potentially significant impacts on the marine environment. Accidental, or non-routine, discharges of hydrocarbons may include the accidental loss of fuel during refuelling or from vessel collisions.

Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment. Spilled fuel can have toxic and/or smothering effects on organisms in the path of a spill, with coastlines being particularly vulnerable. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton (particularly copepods), pelagic eggs and fish larvae, and habitat loss or contamination (CSIR 1998b; Perry 2005). Spills can also have socio-economic implications if fisheries and coastal tourism (among others) are disrupted.

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product (Pulfrich 2015). The magnitude of coastal impacts related to such spill events are also dependent on the location (inshore/offshore) and amount of hydrocarbons spilled i.e. large volumes spilled in close proximity to the coast, as would be the case for bunker operations conducted in Algoa Bay, would have a greater impact than smaller amounts spilled offshore. The physical properties that affect the behaviour and persistence of oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the composition of the oil (e.g. the amount of asphaltenes, resins and waxes). Spilled oil undergoes physical and chemical changes (collectively termed 'weathering'), which in combination with its physical transport determine the spatial extent of oil contamination and the degree to which the environment will be exposed to the toxic constituents of the released product (Pulfrich, 2015). As soon as oil is spilled, various weathering processes (Figure 1) begin breaking down the oil. Although the individual processes may act simultaneously, their relative importance varies with time (Figure 2). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer term processes of oxidation, sedimentation and biodegradation (Pulfrich 2015).

Any discharge into the Bay may affect both natural fish populations and the cultured fish within the ADZ cages and while free fish will be able to avoid a large spill, the fish within the ADZ will not be able to escape and will suffer greatly. Impacts on juvenile and adult fish can be lethal, as gills may become coated with oil. Sub-lethal and long-term effects can include disruption of physiological mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson *et al.*2000). The result of which would cause severe decrease in overall production rates of any farm within the vicinity of the spill. Offshore bunkering occurs in proximity to Algoa 6 and 7 and these precincts are seen to be at higher risk than Algoa 1 and 5.

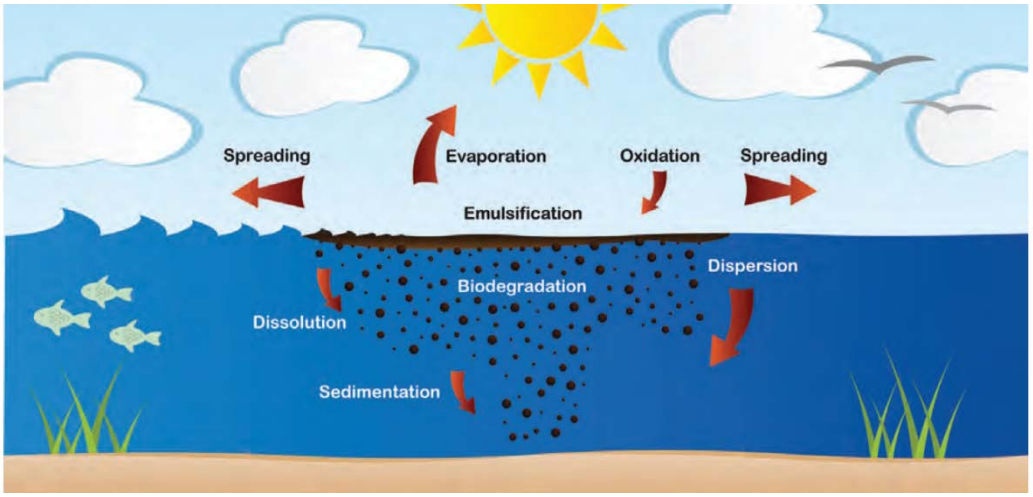

Figure 17 **Weathering processes acting on oil at sea. Some of these processes no longer apply when oil is stranded on the shoreline. Source: ITOPF.**

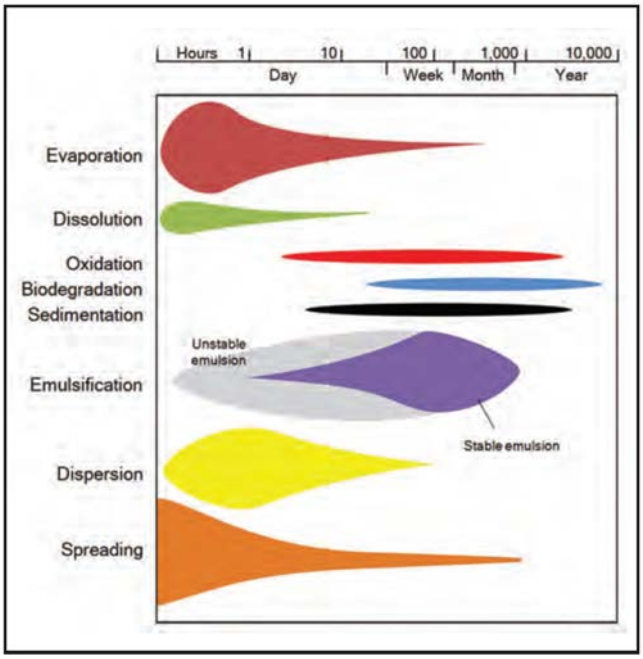

Figure 18 **Relative importance of weathering processes on a crude oil spill with time; the width of each band indicates the importance of each process. Source: ITOPF.**

7.4 Land-based effluent disposal into Algoa Bay

7.4.1 Legislative context for pollution control

Contemporary coastal water management strategies around the world focus on maintaining or achieving receiving water quality such that the water body remains or becomes fit for other designated uses. Designated uses of the marine environment include aquaculture, recreational use, industrial use, as well as the protection of biodiversity and ecosystem functioning. Guideline limits for mariculture are much more stringent than recreational guideline limits and levels of compliance for mariculture are much lower than for recreational use.

This goal oriented management approach arose from the recognition that enforcing end of the pipe effluent limits in the absence of an established context (i.e. not recognising the assimilative capacity and requirements of receiving environments) would reach a point where water bodies would only be marginally fit for their recognised uses. This management approach is referred to as the Receiving Water Quality (RWQ) framework (Anchor 2015) and most countries have adopted this framework. These countries have developed water quality guidelines for a variety of uses, which include target values for a range of contaminants that must be met in the receiving environment. Furthermore, in some countries (currently excluding South Africa) Water Quality Guidelines (WQG) are legislated standards and are legal requirements to be met by every user/outfall. Although the importance of managing water quality through the RWQ framework is undisputed, the degree to which this is implemented differs widely between countries.

With the promulgation of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (ICMA) (as amended), responsibility for regulating land-derived effluent discharges into coastal waters was transferred to the Department of Environmental Affairs (DEA). In terms of Section 69 of ICMA, no person is permitted to discharge effluent originating from a source on land into coastal waters except in terms of a GDA or a Coastal Waters Discharge Permit (CWDP). Exemptions were issued to proponents who, at the time of promulgation, were discharging effluent into coastal waters in terms of permits issued under the NWA, provided that the effluent was treated to meet the General and Special Standard (Government Gazette No. 20526, 8 October 1999). These users were required to apply for a CWDP within three years of promulgation of the ICMA; however, not all operations that discharge wastewater into the sea have done so. New operators wishing to discharge effluent to coastal waters are required to apply for a CWDP before commencing and are also required to comply with the applicable WQG. Applications for CWDP are expected to include data on contaminant levels in the effluent to be discharged, as well as results of dilution and dispersion model studies. These models are required to estimate the worst case scenario and indicate maximum expected levels for the same contaminants at the edge of the Recommended Mixing Zone (RMZ). These levels are expected to comply with published guideline levels as defined by other existing, or potential, beneficial uses of the receiving environment.

The DEA is currently in the process of developing a permitting system for such effluent discharges and for this purpose, the Assessment Framework for the Management of Effluent from Land Based Sources Discharged to the Marine Environment was recently developed (Anchor 2015). This framework recognises that discharges differ in effluent characteristics (volume and quality) and discharge locality (i.e. biophysical conditions, use of the receiving environment), which ultimately determines the risk that a particular discharge poses to the receiving environment. It was recommended that the potential scope of a GDA, the level of assessment during the application process for a CWDP, as well as licensing conditions should be based entirely on the environmental risk posed by a particular effluent. Accordingly, the guidelines provide a framework within which an effluent can be characterised (effluent components and properties) and potential impacts assessed within the context of the receiving environment (i.e. sensitive versus robust receiving environments).

In March 2018 the DEA:O&C published Draft Regulations for comment. The new draft regulations seek to provide an administrative framework to implement Section 69 of the ICMA and stipulate time-frames, renewal application processes, applicable fees and information to be submitted as part of an application for a CWDP. The regulations have not yet been promulgated.

To date, no CWDPs have been issued to companies discharging effluent into Algoa Bay and three applications are currently pending. A list of these and other relevant information has been included in Table 3.4, and their locations relative to Algoa 1, 6, and 7 are shown in Figure 19. Lemley *et al*. (2019) provides figures for annual loads of DIN and DIP entering the coastal waters of Algoa Bay from land based sources as 8.7×105 and 1.4×105 kg, respectively. Considering the worst case scenario, mariculture operations in Algoa Bay are predicted to input less than 10% of the 870 000 kg DIN currently entering Algoa Bay from land based sources (Wright *et al.* 2019). This does constitute a significant cumulative impact of nutrient loading into Algoa Bay that is already regarded as showing eutrophic symptoms due to anthropogenic pollution (Lemley *et al.* 2019).

Table 8 **Pending applications for Coastal Waters Discharge Permit and issued permits for effluent discharges into Saldanha Bay.**

Applicant	Status	Type of discharge	Impact level
Coega Development Corporation	Application submitted and reference number has been issued – information for decision-making is to be submitted to the DEA: O&C	Industrial and Aquaculture	High
Cape Recife Waste Water Treatment Works	Application submitted - information for decision-making is to be submitted to the DEA: O&C	Sewage, industrial, stormwater	High
Fish Water Flat Waste Water Treatment Works	Application submitted - information for decision-making is to be submitted to the DEA: O&C	Sewage, industrial, stormwater	High
Drift Sands Waste Water Treatment Works	Application submitted - information for decision-making is to be submitted to the DEA: O&C	Sewage, industrial, stormwater	High

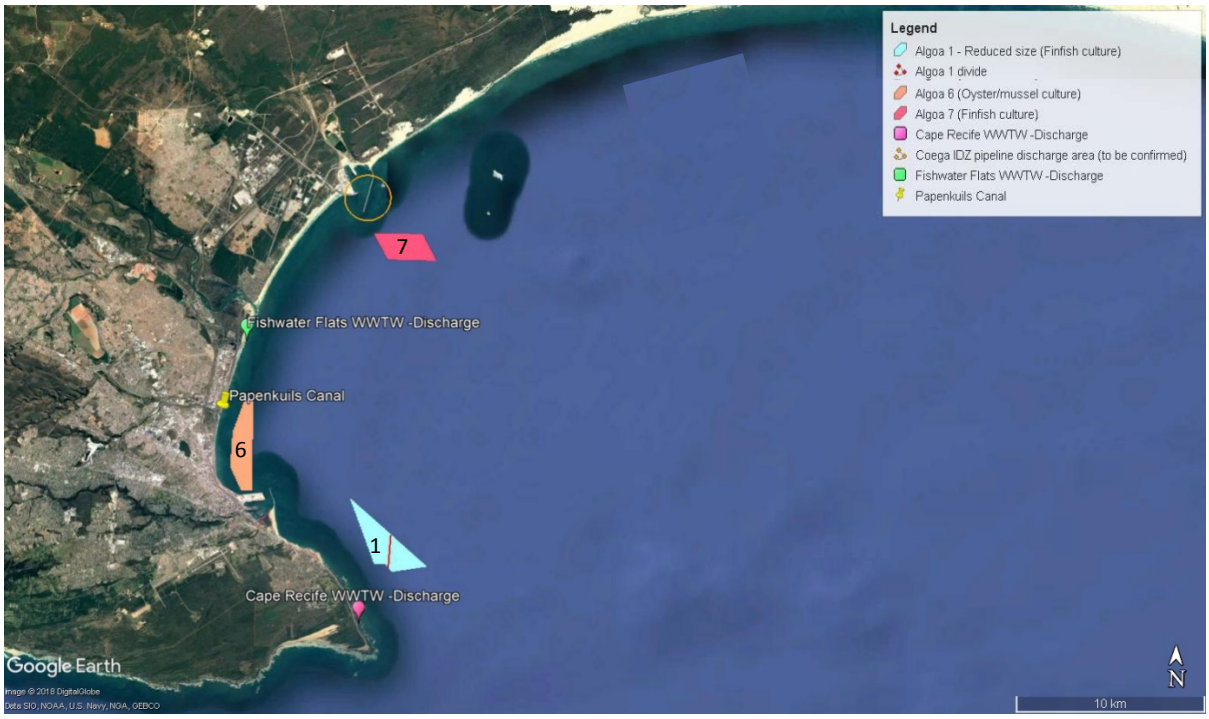

Figure 19 **Locations of effluent discharges in Algoa Bay relative Algoa 1, 6, and 7 precincts of the proposed sea-based Aquaculture Development Zone in Algoa Bay.**

7.4.2 Coega Industrial Development Zone Marine Pipeline Servitude

The Coega Development Corporation (CDC) has proposed the construction of an integrated common user marine pipeline servitude within the Coega Industrial Development Zone (IDZ) to enable numerous investors to make use of seawater for factory processes (Laird and Clark 2016). Discharge of cooling water, seawater for mariculture activities and desalination wastewater needs to be facilitated; while treated domestic wastewater and industrial effluents are likely to be discharged in the future.

Anchor assessed the suitability of the potential effluent discharge precincts as part of the EIA for the marine pipeline servitude based on likely impacts of predicted effluent dilutions on the marine environment, marine users and aquaculture water quality requirements. Subtidal pipelines (below the sea surface) and surface canals were both assessed for outfall design options based on predicted effluent volume and buoyancy (Laird and Clark 2016). Subsequently, the CDC commissioned PRDW Africa to conduct further modelling on more options, which was concluded in 2017. It is unclear when the CDC will submit a final effluent outfall design and modelling study in support of their CWDP application. Depending on where the effluent will be discharged, Algoa 7 may be impacted by the pipeline servitude, considering that Algoa 7 is situated approximately 4 km from the Ngqura harbour and that the effluent can be classified as a high impact effluent type (high volume and likely of poor water quality).

It is recommended that DAFF engages with the CDC to find the best environmental solution that would accommodate various users of Algoa Bay.

7.4.3 Waste water treatment works

Sewage is by far the most important waste product discharged into rivers, estuaries and coastal waters worldwide. However, sewage is not the only organic constituent of wastewater, received by sewage treatment plants, other degradable organic wastes, which can result in nutrient loading, include:

- Agricultural waste
- Food processing wastes (e.g. from fish factories and slaughter houses)
- Brewing and distillery wastes
- Paper pulp mill wastes
- Chemical industry wastes
- Oil spillages

Bivalves filter feed and thereby assimilate heavy metals and bacteria and other pathogens into their tissue from the water column. If international food safety limits are exceeded, the mussel or oyster product is no longer safe for consumption, which introduces a risk factor when a bivalve farm is situated near a pollution source. Wild fish are known to have high heavy metal content due to biomagnification (the tendency of pollutants to concentrate as they move from one trophic level to the next). Farmed fish, however, will be fed fish pellets and will not be taking up pollutants from the receiving environment.

There are three waste water treatment works (WWTW) in Port Elizabeth, namely the Fishwater Flats, Cape Recife and Driftsands WWTWs. The Fishwater Flats WWTW outfall is situated close to Algoa 6, however, modelling results for this outfall are currently not available. The Cape Recife WWTW is currently in the process of being upgraded. The modelling report prepared by Hutchings *et al*. 2016 shows that under worst case scenario water quality guidelines are likely to be met approximately 1 km south of Algoa 1 (Figure 20). The plume should therefore not affect mariculture activities at Algoa 1.

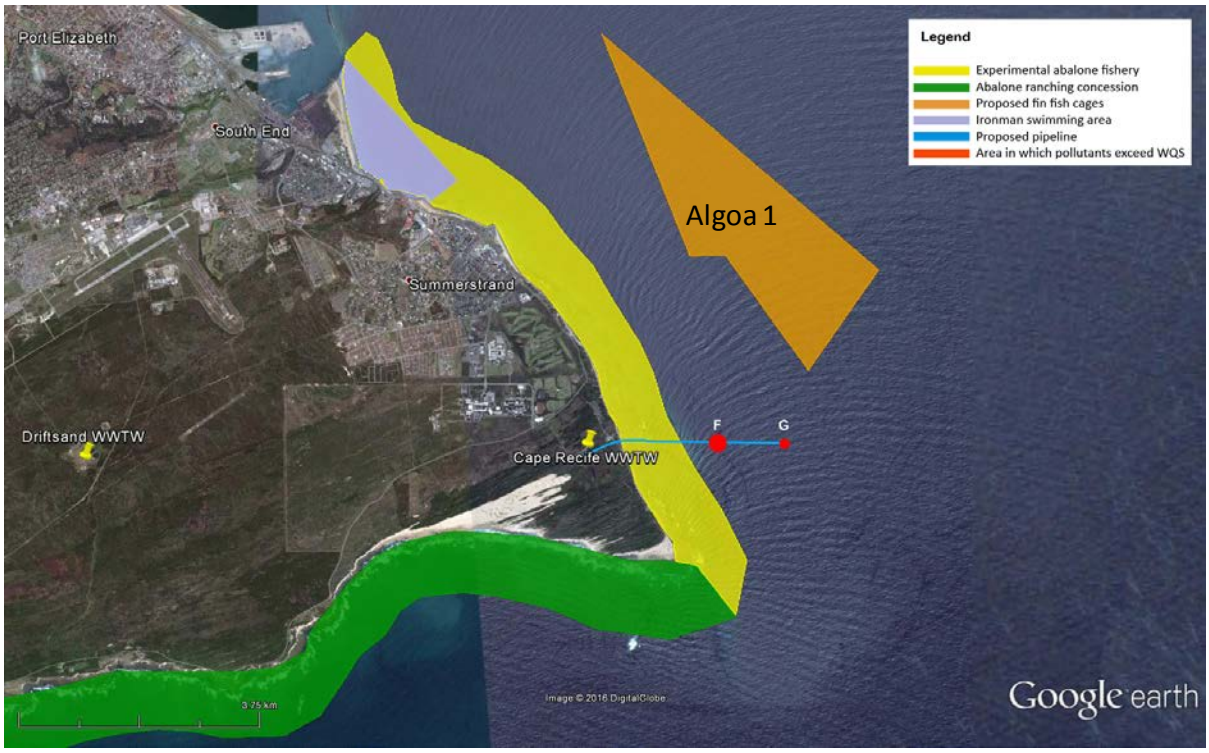

Figure 20 **The expected footprint of contaminants modelled in the worst case scenario is shown by a red circle for both Outfall F and Outfall G of the proposed upgrades to the Cape Recife Waste Water Treatment Plant. At the edge of the red circles, contaminants are likely to have become sufficiently diluted to meet water quality guidelines (Hutchings *et al*. 2016). The outfall pipeline is shown relative to the Algoa 1 precinct of the proposed sea-based Aquaculture Development Zone.**

7.4.4 Reducing wastewater discharges into Algoa Bay

Disposal of wastewater is a major problem in coastal environments. Sewage and industrial effluent discharge is arguably the most important waste product that is discharged into Algoa Bay in terms of potential impact on the proposed ADZ. With the ongoing drought in the Eastern and Western Cape, however, industry and local municipalities are coming together to investigate the feasibility of reclaiming freshwater from treated sewage. Most commonly, treated sewage is used to irrigate sports fields and golf courses although some industries further treat the water for use in industrial processes. In Saldanha Bay, Arcelor Mittal now represents the highest consumer of treated wastewater from the Saldanha Bay Waste Water Treatment Works. Arcelor Mittal constructed a Reverse Osmosis plant, which treats wastewater such that it can be used for cooling steel production equipment (Clark *et al.* 2018).

Major infrastructural changes are required for the re-cycling of treated sewage and are associated with significant initial as well as ongoing fiscal investments. Budgetary constraints experienced by local municipalities are significant, and a public-private partnership is likely to be required to ensure successful implementation. Considering that the aquaculture industry is developing fast in the Eastern Cape, it is recommended that DAFF engages with the local municipality, the Coega Development Corporation and potential business to find ways to reuse the wastewater that would otherwise be discharged into the coastal environment.

8 DESCRIPTION OF THE AFFECTED ENVIRONMENT

8.1 Site context

The proposed activity is sea-based and therefore a property description has not been included in this Basic Assessment Report. Boats used for the maintenance of the ADZ will be launching from the Port Elizabeth and Coega harbours. Land-based storage and processing facilities are not included in this Basic Assessment process and are therefore not included in the description of the site.

A more detailed account of the marine ecology and maritime underwater heritage resources can be found in the specialist studies contained in Appendix D.

8.2 Marine and coastal environment

8.2.1 Oceanography

The waters off the Eastern Cape coast are warm-temperate with average sea surface temperatures of 17-22°C (Goschen and Schumann 1988, Schumann *et al*. 2005). The south-flowing Agulhas Current is the dominant oceanic-scale feature and typically flows along the coast at approximately 1 m/s on average (Grundlingh and Lutjeharms 1979, Ross 1988). Several hundred kilometres to the north east of Port Elizabeth near East London, the current moves away from the shore as the continental shelf begins to widen (Dingle *et al*. 1987). This generally results in the inshore waters being markedly cooler, by a few degrees compared with the Agulhas Current water further offshore (Goschen and Schumann 1988).

The movement offshore of the Agulhas current in the vicinity of East London creates shear edge features such as eddies which may periodically circulate warm water inshore near Port Elizabeth (Stone, 1988). As a result of these Agulhas shear edge features, water temperature can vary over short temporal scales along the Eastern Cape Coast, particularly in the vicinity of St Francis and Port Elizabeth.

Another source of temperature variability and a characteristic of the Eastern Cape coast are upwelling events (Beckley 1983, Schumann 1999, Schumann *et al*. 1988, Churchill 1995, Goschen & Schumann 1995). This phenomenon is caused by wind driven currents particularly during easterly winds (Churchill 1995). Upwelling cells are prominent adjacent to many of the rocky headlands, particularly off Cape Recife and Cape Padrone and may move into Algoa Bay (Schumann *et al*. 1982, Beckley 1983, Churchill 1995, Goschen and Schumann 1995, Goschen *et al*. 2012). Although not as frequent or as severe as those upwelling events on the west coast, wind-driven upwelling has been responsible for fish kills, and water as cold as 6 °C has been recorded in the area (Ross 1988).

Recent research has revealed that several aspects of the Agulhas Current hydrodynamics bring cold, deeper water onto the shelf that may then be bought to the surface by offshore or alongshore winds; and that upwelling events are associated with increased frequency of coastal trapped waves (CTWs), although the links between upwelling and CTWs are unknown (Goschen *et al* 2012).

8.2.2 Algae blooms

Historically, the upwelling events were generally relatively weak and short lived the proliferation of harmful algal blooms was, until recently, not known to occur. Between December 2013 and March 2014; however, a large and persistent harmful algal bloom of *Lingulodinium polyedra* did form within Algoa Bay and spread along the east coast as far as Wilderness (Morrissey 2015). The intensity of the bloom was such that waters turned a dramatic red colour with spectacular phosphorescence at night. *Lingulodinium polyedra* produces yessotoxins that are toxic to mice and may accumulate in bivalves (although human toxicity is not known) (Bornman 2014). It does irritate the gills of fish interfering with respiration and the bloom led to fish kills in several places (Bornman 2014). This species had been documented as cysts in marine sediments collected from the area, suggesting that it was not a recent introduction, and the bloom was likely triggered by a combination of favourable environmental conditions. This algal species was again documented in Algoa Bay during December 2015, although it did not develop to the same extent as the 2014 bloom presumably due to the fact that environmental conditions were not conducive. A recent publication by Lemley *et al* (2019) attribute the increased observation of eutrophic symptoms in Algoa Bay, including harmful algal blooms (e.g. *Heterosigma akashiwo* and *Lingulodinium polyedra*) and hypoxia (<2mgl−1) at least in part to anthropogenic nutrient loading from land based sources (e.g. waste water treatment works, storm water outfalls).

8.2.3 Temperature and salinity

Yearly-average minimum temperatures are found in winter of 14-15°C and maximum average temperatures in summer of 20-22 °C (Beckley 1983 & 1988, Schumann *et al*. 2005). Temperature variation in Algoa Bay is high and typically ranges between 11 °C in winter and 27 °C in summer (Beckley 1983 & 1988). A strong thermocline is evident in summer in water deeper than 15 m characterised by fairly intense gradients of up to 3 °C/m, whereas in winter conditions are homogenous (Schumann *et al*. 2005).

Salinity remains relatively constant within Algoa Bay and close to natural oceanic water for the region of 35.2 ‰ (Schumann *et al*. 1988). However, close to the mouth of the Swartkops River and at the New Brighton Pier outfall, salinity as low as 34.7 ‰ has been measured, although it remains only in the top 5 m of water and does not penetrate deeper (Schumann *et al*. 2005).

8.2.4 Wind and wave climate

Schumann *et al*. (1991) found the wind to vary across Algoa Bay, and that prevailing wind directions in Algoa Bay are parallel to the large-scale orientation of the coastline, namely west-south westerly and east-north easterly. Schuman & Martin (1991) reported that the westerly-component of wind dominated in speed and frequency throughout the year, while the easterly component of wind varies considerably between seasons. Both north easterly and south westerly winds reached a maximum in speed and frequency during October and November and a minimum during May, June and July. The maximum average wind speed was 4 m/s for NE winds and 4.7 m/s for south westerly winds during October.

Wave climate is predominantly from the south west with swells of less than 2 m being most common and occurring approximately 80% of the time (MacLachlan 1983). However, an important percentage of waves in excess of 3 m emanate from the south west generated by storms in the Southern Ocean. Most of Algoa Bay is protected from these swells by the rocky headland at Cape Recife, despite some degree of refraction (Ross 1988, Goschen and Schumann 2011). Nevertheless, maximum wave heights of 6 m have been recorded along the surf zone of Algoa Bay by MacLachlan (1983), possibly from easterly swell, and Council for Scientific and Industrial Research (CSIR, 1987) buoy-data have recorded wave heights of between 0.5-5.0 m (87% of waves between 1-3 m) in summer and between 1.0-6.5 m in winter approaching the Bay at Cape Recife.

8.2.5 Subtidal habitats

Relative to sandy habitats, reefs are scarce in Algoa Bay. On shallow subtidal reefs (<10 m), algae, grazers and filter feeders are the most prolific fauna. Dominant algae consist mainly of red foliose species, especially *Plocamium spp*. The ascidian *Pyura stolonifera* is also abundant (Beckley, 1988). Cape oysters, particularly in areas prone to periodic sanding are prevalent. Abalone *Haliotis midae* are an important species occurring on shallow subtidal reefs, particularly on algae dominated reefs. The large predatory whelk Charonia lampas is also frequently encountered, particularly on deeper reefs.

Deeper reefs below 10 m are characterised by exceptionally high levels of diversity and dominated by many species of filter feeders, particularly colonial ascidians, sponges, sea fans, soft corals, hydroids and bryozoans (Wooldridge & Coetzee 1998). Sponges and ascidians are especially diverse on subtidal reefs in the region and are particularly poorly studied. Sea fans (*Leptogorgia palma, Eunicella albicans, E. papillosa* and *E. tricoronata*) are common in the area as is the purple soft coral *Alcyonium fauri.* Bryozoans become more abundant with depth due to their fragile structure as do feather stars, two species of which, namely *Comanthus wahlbergi* and *Tropiometra carinata* occur in the area.

A study conducted on nearshore subtidal macrobenthic communities, at a depth of 10 m along the western shore of the bay, reported a diversity of 174 and 187 species, during summer sampling seasons in 2008 and 2009 respectively (Masikane 2011). In addition, it has recently been suggested that the invertebrate diversity within the Bay may be extraordinarily high and include several previously undescribed taxa (Dorrington 2018).

8.2.6 Birds

The islands of Algoa Bay are home to many endangered, vulnerable and near-threatened birds including breeding colonies of African penguins (Crawford *et al*. 1990; Barnes 1998), Cape gannet (Crawford, 1997b; Barnes, 1998), African black oystercatchers (Martin 1997), Roseate tern (*Sterna dougallii*, Randall *et al*. 1991; Crawford, 1997a), Cape Cormorant (Cooper *et al*. 1982) and winter visiting Antarctic terns (Williams, 1997). The African penguin colony at St Croix Island is the largest in the world (Pichegru *et al*. 2010).

8.2.7 Fish, sharks and marine mammals

Algoa bay has high diversity of fish species, the distribution of which depends on the habitats they favour. Characteristic fishes found on the deeper reefs include Panga (*Pterogymnus laniarius*), Piggy grunter (*Pomadasys olivaceum)*, Santer (*Cheimerius nufar)*, Carpenter (*Argyrozona argyrozona*), Fransmadam (*Boopsoidea inornata)*, Roman (*Chrysoblephus laticeps)*, Dageraad (*Chrysoblephus cristiceps)*, Yellowbelly rockcod *(Epinephelus marginatus)*, Steentjie (*Spondyliosoma emarginatum)* and white musselcracker (*Sparadon durbanensis*) (Smale & Buxton 1998; Chalmers 2012).

Six species of cetaceans are regularly seen in Algoa Bay; these include southern right whales (*Eubalaena australis*), humpback whales (*Megaptera novaeangliae*), Bryde's whales (*Balaenoptera brydei*), Indian Ocean bottlenose dolphins (*Tursiops aduncus*), Indo-Pacific humpback dolphins (*Sousa chinensis*), and longbeaked common dolphins (*Delphinus capensis*) (Saayman *et al.* 1972, Karczmarski *et al.* 2000, Reisinger & Karczmarski 2009, Melly 2011).

Algoa Bay is the eastern most distribution of the Cape fur seal and breeding takes place on Black Rocks (Mills & Hes, 1997). The presence of this breeding colony may act as an important factor for the aggregation of Great white sharks (*Carcharodon carcharias*), which are known to target seal breeding colonies as feeding grounds (Kock *et al.* 2013, Hewitt *et al.* 2018). While a range of sizes of white sharks can be found around Seal Island, the inshore areas of Algoa Bay are home to the greatest proportion of young-of-year sharks (Dicken & Booth 2013).

8.3 Landscape and seascape context

The landscape context is important for the determination of potential visual impacts that could arise from the proposed development. Port Elizabeth is the largest city in the area and is South Africa's second oldest city. Port Elizabeth represents the commercial capital of the Eastern Cape. Port Elizabeth is a major seaport, with the most significant ore loading facilities in the southern hemisphere. Industrial activities have lately shifted towards Coega, situated 15 km northeast of Port Elizabeth, where a Special Economic Zone (SEZ) was established in 1999. The Coega Development Corporation (CDC), a state-owned enterprise (SoE), is mandated to develop and operate the 9 003 hectares. The Coega Industrial Development Zone provides back-of-port facilities and infrastructure to the adjacent deep water Port of Ngqura. The depth of the channel and its location in the protected Nelson Mandela Bay make it one of the best positioned deep water ports on the South African coast (Coega Development Corporation 2018).

The predominant landscape character of the land and sea is industrial (harbour, industrial activities and freight shipping) and constitutes a strong contrast when compared to the beautiful beaches stretching along the coastline of Algoa Bay. Situated on the shores of Algoa Bay the area also has a thriving tourist economy based on activities such as scuba diving, game fishing charters, surfing and kiteboarding with many popular scenic beaches. The Cape Recife Nature Reserve, which is located on the peninsular of Algoa Bay, has a strong wilderness sense of place.

The proposed Algoa 1 finfish culture site is located 2.2 km offshore from Summerstrand, which is an upmarket residential area and a popular holiday destination. Despite its proximity to the Port Elizabeth harbour, the sense of place is certainly not industrial. The site lies approximately 4 km from the Nelson Mandela University (NMU) Private Nature Reserve and the Cape Recife Nature Reserve, which contribute to a wilderness sense of place.

The proposed inshore bivalve culturing site, Algoa 6, is situated adjacent to the Port of Port Elizabeth harbour wall and extends north parallel to the shoreline for approximately 4.8 km. The immediate coastal area is characterised by urban industrial development and a mostly modified shoreline fringed by railway tracks and the Settlers Highway (M4).

The proposed Algoa 7 finfish culture site is located 3 km offshore from the Port of Ngqura and is also located within the recently approved Addo MPA (although note that the DEA has indicated that Algoa 7 could potentially be excised should Environmental Authorisation be granted). The site lies immediately north of a TNPA Anchorage area and to the east of the shipping lane providing access to the Port of Ngqura. The sense of place is generally determined by anchored and passing ships and the nearby industrial harbour.

8.4 Underwater Cultural Heritage

South Africa has a rich and diverse underwater cultural heritage. Strategically located on the historical trade route between Europe and the East, South Africa's rugged and dangerous coastline has witnessed more than its fair share of shipwrecks and maritime dramas in the last 500 years. At least 2400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s. This doesn't include the as yet unproven potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions along the South African east coast.

In addition to historical shipwrecks, the record of South Africa's long association with the sea is much broader and extends far back into prehistory. This element of our maritime and underwater cultural heritage is represented around the South African coast by thousands of pre-colonial shell middens and large numbers of tidal fish traps, which reflect prehistoric human exploitation of marine resources since the Middle Stone Age, more than 150,000 years ago. Another, until recently, largely unacknowledged and unexplored aspect of our maritime and underwater cultural heritage are pre-colonial terrestrial archaeological sites and palaeolandscapes which are now inundated by the sea.

The proposed project will affect the surface environment of the ocean more so than the sea bottom. The disturbance on the seabed will be associated with mooring/anchoring mechanism for the cages. Anchor appointed ACO Associates cc to conduct a desktop Maritime and Underwater Cultural Heritage Study as the Maritime and Underwater Cultural Heritage (MUCH) Unit at SAHRA indicated that such a study would likely to be requested. A summary of the HIA has been included in this BAR and the specialist study has been included as a standalone document in Appendix D.

8.4.1 Submerged prehistory of Algoa Bay

There have, to date, been no specific studies of the submerged prehistory of Algoa Bay. However, the archaeological evidence for a hominin presence in the Algoa Bay region in the Earlier, Middle and Later Stone Age is plentiful. Earlier and Middle Stone Age lithic material has been found in the in the Sundays River Valley, while at the important site of Amanzi Springs, 40 km north of the Port Elizabeth near Addo, Earlier Stone Age artefacts are found in situ with well-preserved plant and faunal remains within spring sediments (Deacon, 1970).

There is Later Stone Age archaeological material preserved in caves and rock shelters, such as Melkhoutboom Cave, in the Cape Fold Belt Mountain surrounding Port Elizabeth (see Deacon and Deacon, 1963; Deacon, 1976; Binneman, 1997) and large numbers of coastal shell middens have been reported at Humewood, St. George's Strand and the Coega River Mouth (Rudner, 1968).

Most recently, Binneman and Webley (1997) reported thirteen shell middens and stone tool scatters about 500 m east of the Coega River mouth in the archaeological assessment carried out for the development of maritime infrastructure for the Port of Ngqura. Importantly, some of this archaeological material was recorded in secondary context in the gravels from older river terraces along the banks of the Coega River – a context reminiscent of the Table Bay finds referred to earlier.

Also important to note is the presence in Algoa Bay of a late Quaternary of consolidated, calcareous aeolianite, known as the Nahoon Formation, which was deposited during sea level regressions associated with the last two glacial periods. The Nahoon Formation outcrops between Plettenberg Bay and East London and is known to preserve vertebrate trackways, estimated to be approximately 124 000 years old, which include the footprints of a young human child in the sandstone at Nahoon Point north of East London in 1964 (Roberts, 2008). Where Nahoon Formation outcrops survive below the current sea level, there is the potential for them to preserve further trackways and also archaeological material.

The rivers that currently feed into Algoa Bay would, during times of lower sea level in the past, have flowed across the exposed floor of the bay and are likely to have been an activity and resource focus for hominins. As in Algoa Bay and elsewhere in the world, there is thus the potential for the preservation within current seabed sediments of Algoa Bay of pre-colonial archaeological sites and material.

8.4.2 Maritime history and shipwrecks of Algoa Bay

Port Elizabeth owes its foundation, and Algoa Bay its position as South Africa's second port to the arrival in 1820 of 5000 British immigrants, brought to the eastern Cape as part of a government scheme to strengthen the eastern boundary of the colony. The bulk of these settlers were landed on the beach next to the Baakens River and below Fort Frederick (Ingpen, 1979; Inggs 1986). With people came trade and commerce and Algoa Bay soon became a busy port providing a link for the eastern Cape with Cape Town and England, with wool becoming the major export (Ingpen, 1979; Turner, 1988; Knox-Johnston, 1989).

Algoa Bay is a wide, relatively shallow (<70 m), eastward-facing bay whose crenulate shape is the result of the dominant swell from the south-west. The bay is not a natural harbour, but is nevertheless a safe anchorage for much of the year because the dominant winds are from the southwest, with an increase in the frequency of winds with an easterly component during the summer months. The strongest winds occur during October and November and it was these south-easterly gales which historically decimated shipping in the bay (Inggs, 1986; Schumann *et al*, 2005).

The assessment by the specialist appointed for this Basic Assessment Report (Gribble 2019) found that at least 310 shipwrecks have occurred in Algoa Bay since the early 1500s, with the majority dating to the 19th century and linked to the colonial settlement of the region. While Algoa 1 and 7 both have relatively few wrecks known to have occurred in their vicinity, Algoa 6 is located in the area of Algoa Bay with the highest concentration of recorded historical shipwrecks. This was the area, in the most protected portion of the bay, where the historical landing place was situated adjacent to the Baakens River mouth, where, as a result, the anchorage was located directly offshore and where the early shipping-related infrastructure development took place in Algoa Bay.

The assessment also found that records of a further 147 shipping casualties described only as “Algoa Bay” or “Port Elizabeth”, which could be located anywhere in the bay should also be considered in relation to the development of aquaculture in all three proposed areas, are. The bulk of these wrecks are likely to occur in the vicinity of the modern harbour and North End, around Algoa 6, given the centrality of that portion of the bay to historical shipping activity. The potential presence of these wrecks must be taken into account in respect of the development of all three proposed aquaculture areas.

8.5 Socio-economic character

Algoa Bay's 40 km of breath-taking coastline boasts a perfect combination of warm water and protected beaches. Algoa Bay is a large log-spiral bay, anchored by rocky headlands at Cape Recife in the south east, and Woody Cape and the Bird Island group in the northeast. The relatively large Zwartkops and Sundays Rivers and the much smaller Papenkuils and Coega Rivers discharge into the bay (CSIR, 2007). Algoa Bay (also known as Nelson Mandela Bay), is a favoured draw-card for beach and water sport enthusiasts and is fast becoming known as South Africa's water sport capital as it offers activities throughout the year, especially wind-surfing and fishing. In fact, Algoa Bay is regarded as one of the best sailing venues in the world, while scuba diving is of world-class quality with beautiful reefs, shipwrecks, fish and colourful coral species.

A wide range of environmental conditions are monitored in Algoa Bay and the 120 000 ha Addo MPA along the middle-eastern section of the bay was recently approved by cabinet and is likely to be promulgated within the first quarter of 2019. Algoa Bay serves as the entrance to two ports nestled along the coast within the bay, namely Port Elizabeth and a new port at Ngqura (Coega) a mere 20 km away. Agriculture and farming have always played an important role in the port's activities, principally deciduous and citrus fruit and the annual wool crop. More recently, containers have assumed a prominent role in the fortunes of the harbour, with Port Elizabeth serving its local industrial base and offering an alternate port of call to container ships whenever the Durban or Cape Town container terminals are congested. Other principal products handled at the harbour include manganese ore, which is railed from the Northern Cape, and petroleum products that are imported from other South African ports. The motor industry has long been an important industrial activity for the Eastern Cape and the port plays a leading role in this regard, boasting a large open-area car terminal. The fishing industry also makes extensive use of the port. There are no major ship repair facilities, but a slipway is available for fishing vessel repair. Passenger ships usually make use of one of the fruit terminal berths when calling at Port Elizabeth. The South African Navy has established a naval station at Port Elizabeth, but does not maintain any ships there. In future, some of the port's present commercial activity may be lost to the port of Ngqura (Coega), although the car terminal and possibly the container terminal will remain intact.

The entrance channel to Port Elizabeth is maintained at a depth of -14.5 m Chart Datum and has a generous width of 310 m. Limitations on vessels using the port are 11 m draught for passenger and dry cargo vessels, 11.2 m for container ships, 12.1 m for ore carriers and 9.6 m for tankers, all according to berthing. Deeper vessels may be accommodated with the permission of the harbour master. Tug assistance and pilotage is compulsory. Ships may anchor outside the port in Algoa Bay provided the approaches to the entrance channel are kept clear. Port Elizabeth's main features are the container terminal, fruit terminal and manganese terminal. The container terminal has a capacity in excess of 375,000 TEUs and has the advantage of being able to load railway trains directly under the gantry cranes, without containers having to be double handled, thus speeding up delivery to inland destinations. A full range of ships chandelling and stevedoring as well as other support services is available (Transnet, 2011a).

The deep-sea port of Ngqura, which began commercial ship operations (containers) in October 2009, lies some 20 km northeast of Port Elizabeth at the mouth of the Coega River in Algoa Bay. An Industrial Development Zone, known as the Coega IDZ, has been developed over the 12 000 ha site in the area including the river and port, with a 4 500 ha core development immediately identified. The IDZ will serve as a primary location for new industrial development for export driven industries.

The deepwater Ngqura port is capable of serving post-Panamax dry and liquid bulkers and the new generation of cellular container ships. The port consists of a main eastern breakwater, 2.7 km in length extending into Algoa Bay to a maximum water depth of 18 metres, and a secondary western breakwater 1.125 km in length.

8.5.1 Demographic and economic profile

This socio-demographic profile of the study area is based on data from the 2011 National Population Census Survey, available on the Statistics South Africa website (http://www.statssa.gov.za).

The proposed Algoa Bay Aquaculture Development Zone is located closest to the Nelson Mandela Bay Municipality on the south- eastern coast of Africa in the Eastern Cape. Formed in 2001 as an administrative area, the Nelson Mandela Bay Metropolitan Municipality covers Port Elizabeth, the neighbouring towns of Uitenhage and Despatch, and the surrounding agricultural areas. It is one of eight Category A (i.e. metropolitan) municipalities in South Africa, with a population of 1 152 115 in 324 292 households (StatsSA 2011). Of the population, 552 994 (48%) are male and 599 121 (52%) are female.

As per the 2011 Census (StatsSA 2011), 60.1% of respondents described themselves as black African, 23.6% coloured, 14.4% white and 1.1% Indian/Asian. IsiXhosa is spoken by 53.2% of the residents as their mother tongue, followed by Afrikaans (28.9%) and English (13.3%). The 2011 census showed that 39.3% of the population had some primary education, while 15% had completed secondary and 2.7% had some form of higher education. The population is comprised of 25.5% young people (0–14 years) 37.1% youth (15–35 years) 31.4% adults (36–64 years) and 6% elderly (65+ years).

The overall unemployment rate in the Nelson Mandela Bay Municipality was 36.6% in 2011, compared to 46.4% in 2001 and 36.3% in 1996. Youth unemployment rate was at 47.3% in 2011.

The average household income per annum was R105 602 in 2011 (up from R53 904 per annum in 2001). The Municipality contributes up to 44% of the provincial Eastern Cape GDP (http://www.nelsonmandelabay.gov.za/Business). The majority of households within the Nelson Mandela Bay Municipality have access to services (i.e. water, electricity, sanitation, and refuse removal), and the Municipality consistently has the highest percentage of households with access to flush/ chemical toilets (89.4%) and lowest percentage with no access to a toilet (1.9%), compared to other local municipalities in the Eastern Cape.

The GDP growth rate for the Nelson Mandela Bay Municipality was 2.1% in 2010 and the GDP per capita R 52 147 (as per the Eastern Cape Socio Economic Consultative Council). The largest economic sectors in the Nelson Mandela Metro are manufacturing, finance, community services and transport. Community services, trade and manufacturing sectors are the sectors that create the most employment in the metro. The Coega Industrial Development Zone (IDZ) is a multibillion-dollar industrial development complex adjacent to the deep water Port of Ngqura in the Nelson Mandela Bay Municipality, customized for heavy, medium and light industries. StatsSA (2018) highlights the unique developmental opportunities presented by the municipality having two ports (Port Elizabeth Harbour and Ngqura) to "establish a strong and vibrant maritime sector".

8.5.2 Affected user groups

Marine user groups can be broadly defined as recreational or commercial. Recreational marine activities that are most likely to be affected by fish cage farming in the four potential ADZ include recreational boat (skiboat) fishing, recreational scuba diving and yacht sailing. Other recreational marine activities such as open water swimming, surf skiing, kayaking, wind and kite surfing that may be affected are also considered. Data on the spatial extent of the potentially affected recreational marine activities identified above were sourced from literature (guide books etc) and from comment and data made available by interested and affected parties (I&APs) during the public participation phases of the previous EIA process. The degree of spatial overlap of the identified activities with the potential ADZ is then assessed and qualified.

A number of commercial marine activities take place within the broader Algoa Bay region; these include shipping, marine ecotourism, and a range of commercial fisheries. Mining and gas exploration may also take place within Algoa Bay in the future. This section was compiled by Anchor Environmental in July 2013 and has been integrated into this Basic Assessment Report and has been updated where required. The socio-economic impact assessment in this Basic Assessment Report assesses potential impacts on these industries (Section 9.4).

8.5.2.1 Recreational user groups

Non-motorised water sports and bathing

Water sports such as surfing, kite boarding, surf-ski paddling, stand up paddle boarding, open water swimming and sea kayaking have seen significant growth in Nelson Mandela Bay over recent years. Competitions like the Ironman ultra-triathlon events and the Ocean Racing Series both use Hobie Beach as a venue (Nelson Mandela Bay Metro Municipality). In addition to the social recreational value of these activities, these water sports and major events are economically important to the region.

The closest point to land of Algoa 1 is over 2 km and the popular swimming and water sport beaches off Summerstrand are approximately 3.5 km distant. Algoa 7 lies approximately 4 km offshore from the popular St Georges Strand and Wellington Estate which are popular bathing beaches and recreational facilities. Mariculture developments at Algoa 1, 6 and 7 is unlikely to affect non - motorized recreational marine users in terms of sea space, despite the popularity of these activities in the Algoa Bay area. These activities mostly take place within 1 km of the coast as shown in the proposed beach aquatic safety zone (Figure 21). Algoa 6 is situated very close to the shore within TNPA jurisdiction and there are no recreational beaches or facilities nearby.

There has been concern expressed by I&APs that fish farm development at Algoa 1 and 7 could affect/pose a risk to these user groups. Water sports people are at risk of being bitten by a shark anywhere along South Africa's coastline (the probability of a shark bite incident increases with both the density of sharks and the density of water users, and the probability of an incident occurring in a popular water sports area such as Port Elizabeth is relatively higher than in remote areas with few water users). It is probable that marine predators, such as sharks, will be attracted to finfish cages that may appear to be a source of food. Indeed monitoring of fish cage trials previously undertaken in Algoa Bay did record increases in fish diversity and abundance under cages stocked with fish and an incident where two ragged tooth sharks successfully entered a fish cage (Nel and Winter 2008). Despite this, these authors stated that the fish cages "do not seem to present a great attraction for cetaceans, pinnipeds or sharks".

Nonetheless, sandbar sharks in Hawaii exhibit site fidelity in the vicinity of fish cages, whilst tiger sharks although transient, may repeatedly visit fish cages (Papastamatiou *et al.* 2010). White sharks have been documented entering fish cages to prey on captured stock (Galaz & De Maddalena 2004). An Australian study has shown changes (increases in residency time) in white shark behaviour where a food reward was realized from shark cage diving operations at the North Neptune Islands, but this effect was localized (Bruce & Bradford 2011). In contrast, a study in False Bay South Africa found little evidence of conditioning of white sharks around Seal Island in response to low level (three operators) cage diving operations (operating permit conditions and chumming practices did however, differ between the two countries) (LaRoche *et al.* 2007).

It is clear that fish cages may provide a food reward to large sharks (that are potentially dangerous to humans) and in so doing alter their distributional and behavioural patterns. Certainly anti-predator nets are specifically designed to exclude large predators from entering the fish cages (and getting a food reward) and these are routinely used by fish farm operators as such predators are clearly attracted to the cages in the first place. Effective anti-predator nets lower the likelihood of sharks receiving a food reward from within a fish cage, but wild (and escaped fish) are known to concentrate around the outside of fish cage infrastructure that operate as Fish Attractant Devices (FADs). These fish, or uneaten food sinking out of the cages, may serve to be a suitable and regular food reward to alter behaviour of wild marine predators.

Marine predators are thought to locate food sources by following cues (olfactory, audio, and electrical) up the concentration gradient. Theoretically therefore, a perceived food source (e.g. fin fish farm) 2 km offshore should attract predators away from the coastal areas utilized by water sports people. This may occur providing the food cues are detectable at such a distance (this is unknown and dependent on prevailing oceanographic conditions and species specific physiology). This does not imply that risk of a shark bite incident will lower in the inshore recreational areas; indeed, should the fish cages increase residency times of large sharks in the broader region (e.g. western Algoa Bay), the occurrence of sharks may well increase at the bathing beaches. It is clear that there is a high degree of uncertainty as to possible changes in the risk of shark bite incident to non-motorized marine water users should fish farms be developed in Algoa Bay (Alison Kock, City of Cape Town Shark spotters programme, personal communication).

This is due a lack of data and understanding of the site and species specific and indeed individual shark behavioural responses to such a development. Recent research suggests that the inshore areas of Algoa bay are an important nursery area for white sharks (Dicken and Booth 2013). The only conceivable way to address this is with extensive monitoring of shark movement patterns both at the ADZ precincts, and at the popular bathing beaches inshore, before and after the stocking of cages. Baseline data would have to extend for at least 12 months to cover seasonal variation in shark movement patterns (preferably longer to include inter-annual variation). Acoustic tracking of white sharks and other large shark species (e.g. bull sharks) is currently under way both within Algoa Bay and elsewhere off the SA coast (including research currently underway by researchers at Bayworld funded by the Nelson Mandela Metropole).

Continuation and expanding of these research programmes to include acoustic receivers at the proposed ADZ precincts and the popular bathing beaches is a potential monitoring method that could be utilized. The decision making authorities should however, also consider the ethical issue of monitoring large shark movements in response to a fish farm development when there is a high degree of uncertainty regarding the threat to human bather safety associated with the development.

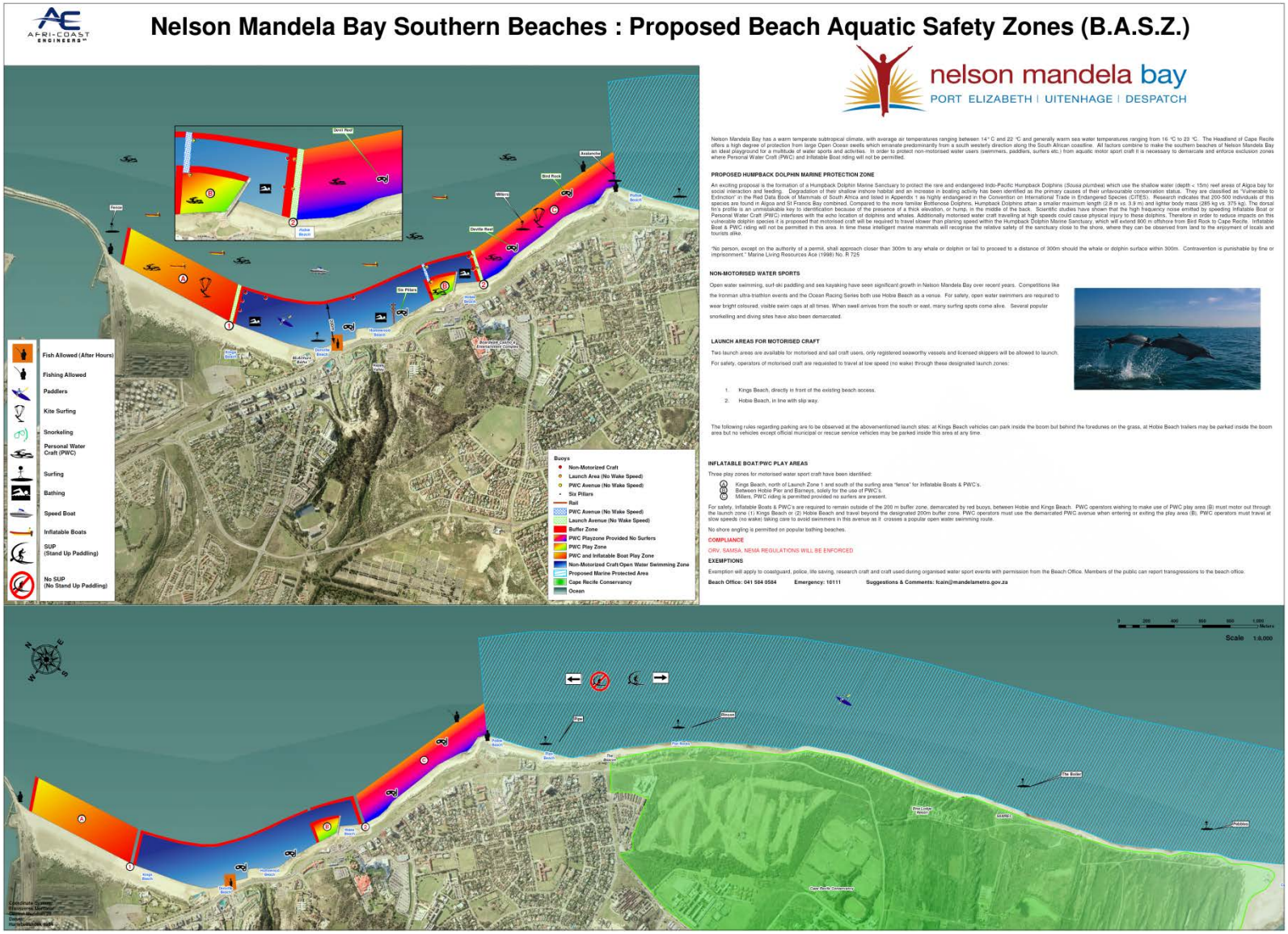

Figure 21 **Proposed Beach aquatic safety zones and marine recreational areas for the Summerstrand beaches (adjacent to Algoa 1).**

Yachting

Algoa Bay Yacht Club (ABYC) was established approximately 54 years ago. The club now includes a large clubhouse and marina with ~130 yachts moored within the Port of Port Elizabeth. ABYC has been host to many national and international sailing events including the long running Algoa Bay week regatta (http://abyc.co.za). Competitive sailing and social Wednesday evening sailing takes place every week throughout the sailing season. During the scoping phase of the previous EIA process, a meeting with the ABYC was held on the 12 May 2012. During this meeting it was pointed out that Algoa 1 is situated in the main sailing area. The ABYC was requested to provide a map of the main sailing areas (Figure 22). Clearly yacht sailing within Algoa Bay takes place across a large area between Cape Recife and the Sundays River mouth and overlaps completely with Algoa 1 and 7. Fish cage farming could pose a navigational hazard to yachts and race courses may have to be adjusted to avoid fish farm infrastructure. To minimize this hazard, all fish cage infrastructure would have to be clearly marked on charts and by navigational markers as required by the South African Maritime Safety Authority. It is acknowledged that yachting may be affected by ADZ development within Algoa Bay, however, the relatively large area utilized by yachts within Algoa Bay and relatively small proposed ADZ areas, means that these activities should not be mutually exclusive.

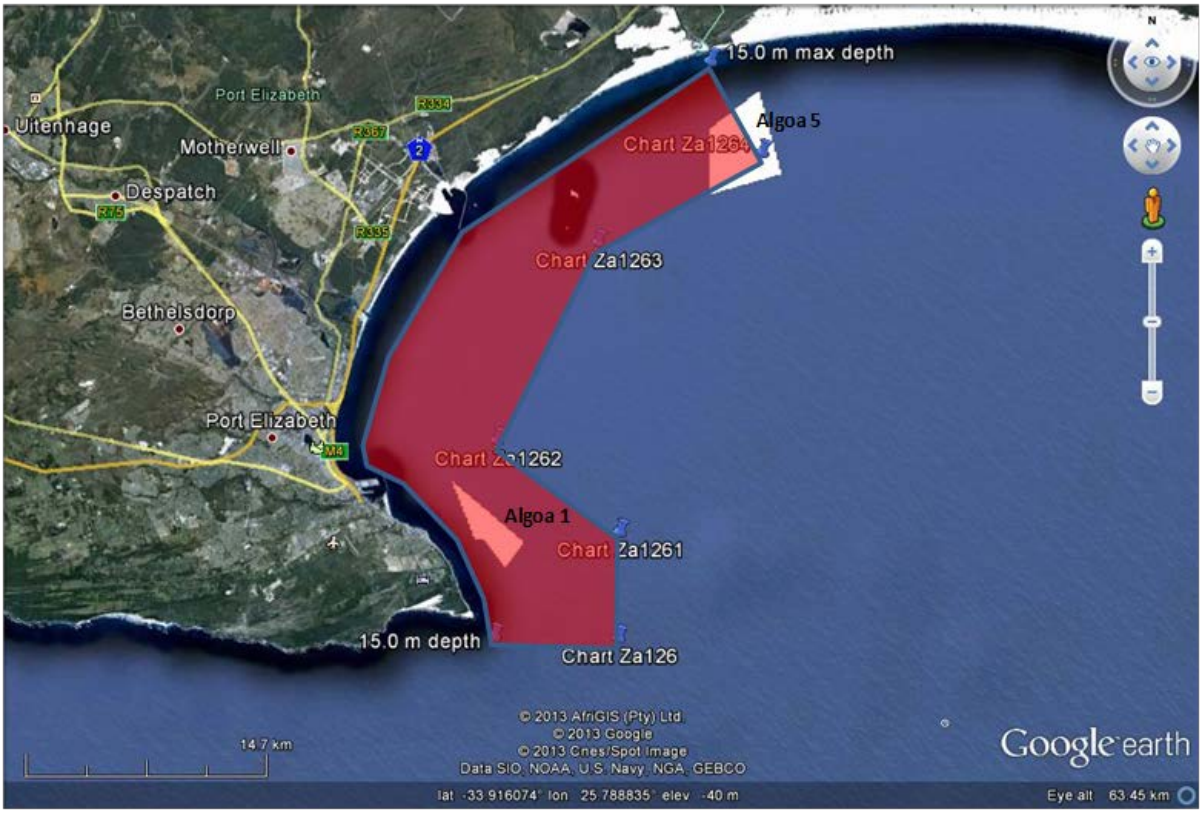

Figure 22 **Regular yacht sailing area within Algoa Bay (source: Arthur Rump, ABYC). (Hutchings *et al.* 2013a). Note that Algoa 5 is no longer considered for the current Basic Assessment process.**

Scuba diving

Recreational scuba diving is a popular activity within Algoa bay and at least four dive shops located within Port Elizabeth supply training and equipment. Recreational scuba divers registered as I&APs during the project scoping and supplied locations of 18 popular diving spots (mostly reefs) in the Algoa Bay area (Figure 23). None of these 18 precincts overlap with a proposed ADZ (one of the site selection criteria in the Strategic Environmental Assessment excluded known reef areas), and as such loss of access to any of these dive precincts by recreational scuba divers will not occur. Five of these precincts are however, 500-1000 m from the border of Algoa 1. Stakeholders expressed concerns that waste originating from finfish farms could reduce visibility and smother nearby reefs, rendering these precincts no longer attractive for SCUBA tourists.

Modelling of waste (nutrient and chemical) dispersal from a proposed fish farm at Mossel Bay (an area with similar current speeds to Algoa Bay) was conducted by Mead *et al.* (2009). Settable waste was expected to sink to the sea floor within 200 m of the cages (Mead *et al.* 2009). This study did indicate that elevated levels of dissolved nutrients would likely occur up to 2 km from the fish cages, with nitrate (ammonia is typically excreted by fish, this is broken down into nitrites and nitrates) levels expected to be above background concentrations 8 - 12km from the site under certain oceanographic conditions (Mead *et al.* 2009).

The hydrodynamic modelling undertaken for this study (Wright *et al.* 2019) showed that elevated levels of dissolved nutrients were not likely to occur more than 1 km from the individual farms. The presence of elevated nutrients/suspended solids is usually attributed to a reduction in the clarity of water, i.e. light penetration or visibility. Suspended solids usually remain in suspension in the water column since their density is similar to that of seawater and turbulence in the water column. Under calmer conditions, solids may settle out from the water column and be deposited onto the substratum. Increased nutrients within the water column, which can stimulate phytoplankton growth, can also result in lowered light penetration due to the presence of loom. In addition, there may be a risk of hypoxic bottom water as production settles to the ethos. When the suspended solids concentrations are elevated above background levels, it may have an impact on the ecosystem as a whole and/or on individual species. For example, the energy available to seaweed may be reduced due to light attenuation due to elevated suspended solid levels. Conversely, reduced nutrient availability in the water column may occur through adsorption and subsequent sedimentation of settleable solids. At high concentrations, suspended solids may cause abrasion or clogging of sensitive organs such as gills, which in turn, results in stress and increased disease susceptibility.

Given that the study did not take cumulative effects into account, it is recommended that a precautionary principle be followed, especially when considering the potential scale of fish farm development proposed for Algoa Bay. In addition, should any therapeutic or antifouling chemicals used in fish cage culture operations reach the reefs at concentrations that are still effective (the Mead *et al.* 2009 study assumed a similar dispersal rate and distance as for dissolved nutrients), this would probably cause further deleterious impacts on diving reef communities. The Wright *et al.* (2019) study did not consider the dispersion or impacts of antifouling chemicals.

Recreational skiboat linefishing

A recreational ski boat fishing club, (Port Elizabeth Deep Sea Angling Club) operates out of PE harbour and the Noordhoek skiboat club has a slipway some 6 km west of Cape Recife. The Swartkops and Sundays estuaries are also used by a few recreational fishing vessels to access the sea, but these are not legally registered launch precincts. Recreational boat fishing takes place throughout Algoa bay. Chalmers (2012) estimated annual recreational ski boat fishing effort in the Algoa Bay at 2 118 boat days. Most vessels carried an average of ~4 crew and a resultant 61 074 angler hours of recreational linefishing effort takes place annually with an estimated retained catch of ~21 000 fish from 26 different species (Chalmers 2012). Geelbek, santer, and silver kob dominated the catches in the western sector of the bay (Chalmers 2012).

Should the ADZ be declared "no go" areas this would result in a loss of available fishing ground to the recreational boat fishery. All of the proposed ADZ straddle areas reported by Chalmers (2012) as having both high and relatively low recreational ski boat fishing effort (Figure 24). However most of the skiboat fishing effort does appear to take place inshore of Algoa 1 and 7; and indeed bathymetry surveys have indicated no reef habitat (Algoa 1, 6 and 7) around which targeted line fish (and fishers) aggregate (see description of affected marine environment). Recreational boat line-fishers would therefore appear to be little affected by loss of fishing ground should the ADZ be declared off limits. Navigational impacts are however anticipated as fishing vessel skippers may have to alter their desired course to and from the fishing grounds to avoid fish farm infrastructure, particularly in the case of Algoa 1 which is situated between popular fishing areas and the port of PE entrance (Figure 24). These impacts are assessed in the socio-economic impact assessment of this report.

The significance of potential impacts relating to disease and parasite transmission and genetic contamination of wild fish stocks and fisheries are dealt with in the marine ecology impact assessment.

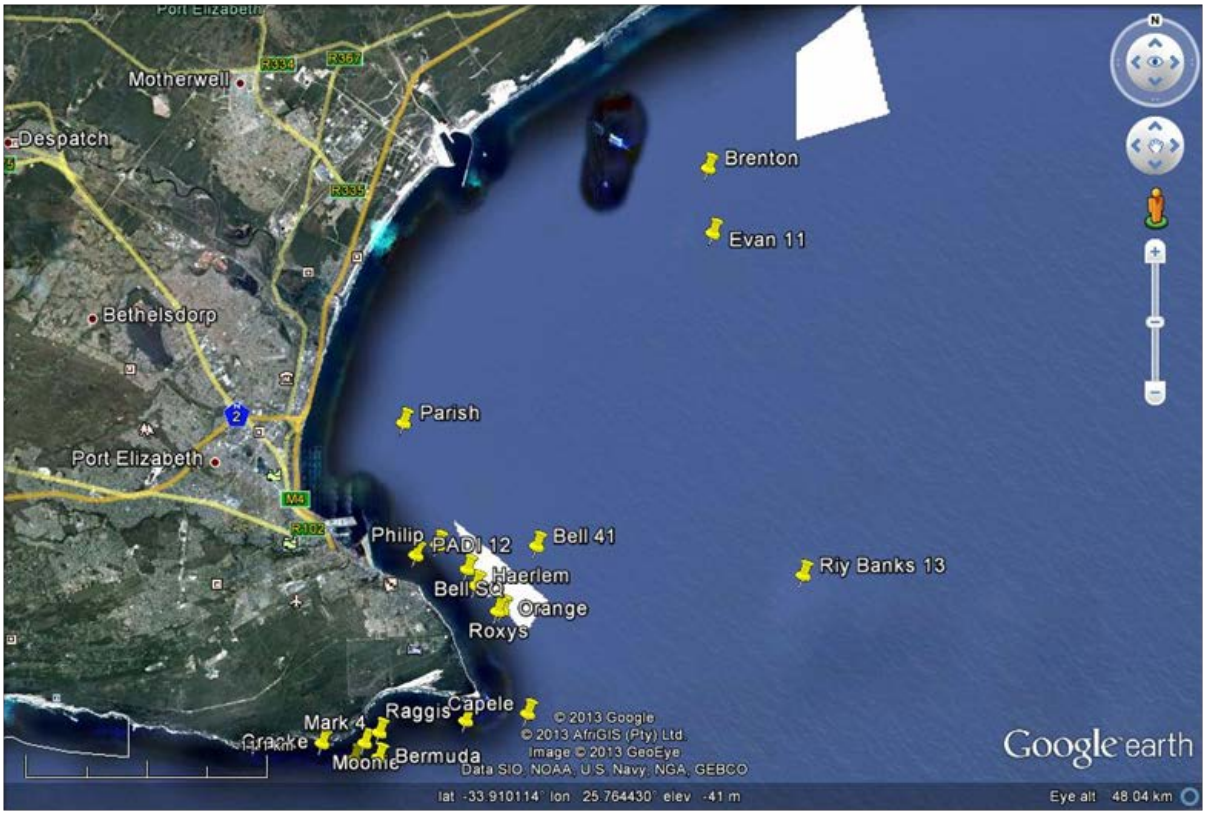

Figure 23 **Popular recreational SCUBA dive precincts within Algoa Bay relative to the location of the two proposed ADZ precincts. (Dive site positions provided by Prodive Port Elizabeth) (Hutchings *et al.* 2013a). Note that Algoa 5 is no longer considered for the current Basic Assessment process.**

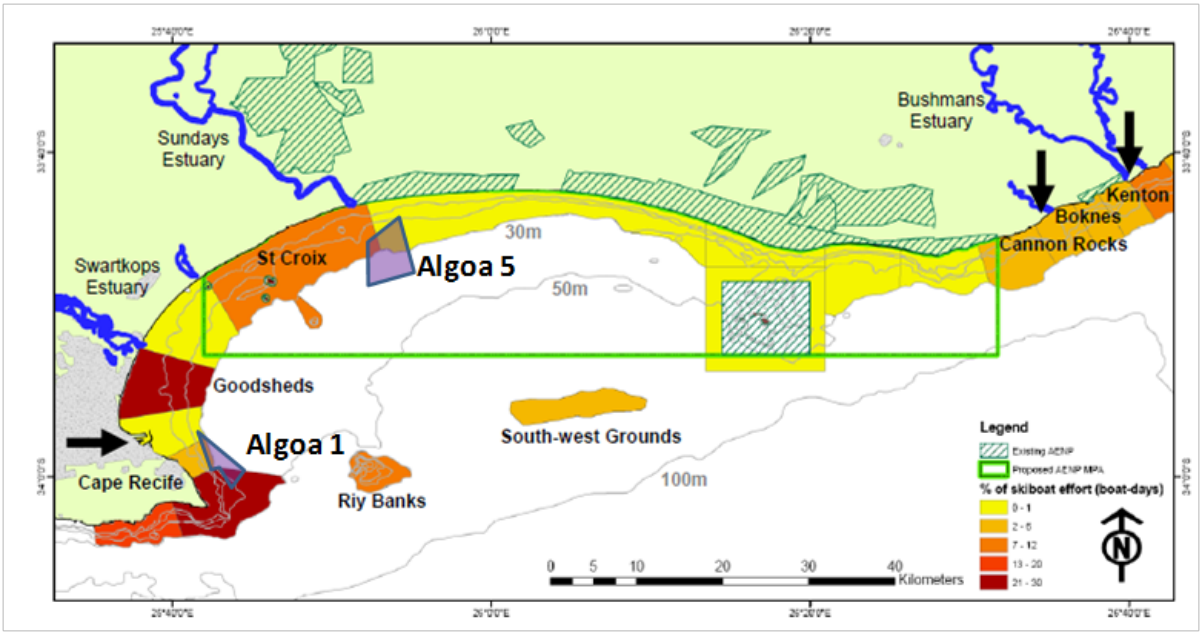

Figure 24 **Estimated distribution of recreational boat line fishing effort throughout Algoa Bay (Source: Chalmers 2012) and position of the proposed ADZ precincts (Hutchings *et al.* 2013a). Note that Algoa 5 is no longer considered for the current Basic Assessment process.**

8.5.2.2 Commercial fishing

Four commercial fisheries operate within Algoa bay and may potentially be affected by the proposed ADZ namely: small pelagic, traditional linefish, squid and shark longline. A description of each of these fisheries sourced from Turpie *et al.* (2012) and area of operation relative to the proposed ADZ is provided below.

Small pelagic

The small pelagic purse-seine fishery targets shoals of small pelagic fish that occur near the surface at night. Once the shoal is located, a net is set around it in a large circle, which hangs from the surface like a circular curtain, and then the bottom of the net is drawn together using a footrope. Fish are pumped from the net into the hold of the boat, where they are kept chilled before being transferred directly into the onshore factory for processing. The boats tend to fish overnight, landing their catches in the early mornings.

The small pelagic fishery in South Africa originated in St Helena Bay on the west coast, originally targeting sardine (pilchard) *Sardinops sagax* and horse mackerel *Trachurus trachurus capensis* (Sauer *et al.* 2003a). These resources declined after 1962 due to overfishing, and mesh sizes were reduced to target the smaller anchovy *Engraulis encrasicolus*, which became dominant in catches for two decades. Sardines have subsequently recovered to a large extent. The fishery also exploits the red-eye round herring *Etrumeus whiteheadi*; the chub mackerel *Scomber japonicas* is a valuable by-catch species. The fishery is managed through quota allocations in the form of TACs for adult sardine, for anchovy and for sardine by-catch. Pilchard is the only targeted species in Algoa Bay, with some incidental by-catch of horse mackerel and chub mackerel, as well as maasbanker.

Concern for declining populations of penguins (and to some degree gannets) on nesting Islands in Algoa Bay led to two experimental area closures for the pelagic fishing industry in recent years. Namely a 20 km radius around St Croix Island and a 5 km radius closure around the Rij Banks was implemented in January 2009 for a three year period (Pichegru *et al.* 2010, 2011). This restriction has now been lifted, but a similar size (10.799 NM radius) pelagic fishing exclusion area is now in place around Bird Island (2012 permit conditions DAFF).

While the small pelagics purse-seine fishery is still concentrated on the west coast, it has spread to the south coast, centred around Mossel Bay and Port Elizabeth. About 4-5 boats are based in Port Elizabeth, and 1-2 in Port St Francis, but the Mossel Bay boats sometimes move eastwards to fish in the Algoa Bay area, so that one can get up to 10 boats operating in the area. Likewise, the Port Elizabeth-based boats sometimes fish further west. In those situations, fish might be offloaded at the nearest port and trucked back to the processing plants.

In the Algoa Bay area, boats typically depart in the early evening to search for fish, but will try to only purse seine the fish as close to the following morning to maximise fish quality (minimise time in the hold). Port Elizabeth boats can travel as far as Plettenberg Bay, though seldom go that far. Location is decided on the basis of communication between vessels and skippers local knowledge. The viable range is reported to extend from Bird Island in the east to Jeffrey's Bay in the west, with the cost of diesel as well as concerns about deterioration of the fish on board being the limiting factors. In a westerly wind, fishing tends to be in the east.

Westerly winds exceeding 15 knots, and strong south easterly winds curtail fishing activity entirely, since the rolling action of the ship affects fish quality. Skippers also look for larger sized fish since these fetch better prices, so might target the last location where good catches were made, but will not target the same area if smaller fish were caught there the day before. . Fishing takes place all year as far as possible (limited by TAC), but activity is influenced by market demand.

The spatial distribution in effort and catch in the small pelagics fishery is shown in Figure 25. However, average effort and catch gives a somewhat distorted view of reality, as there is considerable interannual variability in the spatial location of fishing effort. Since the fish are highly mobile, fishing grounds may change quite radically from year to year. In terms of average annual effort and catch, the two proposed ADZ lie within reporting grid blocks that account for a very small proportion of the national catch and effort, but approximately 12% of the Eastern Cape annual average. Although this may appear to be a significant overlap with important Eastern Cape fishing grounds, the proposed ADZ areas only cover a small portion of the reporting grids, and given the mobility of the target species, the fishery should still have access to the shoals as they move away from the ADZ.

Proclamation of either or both the proposed ADZ within Algoa Bay would appear to have a minor affect the Algoa Bay small pelagic fishery in terms of loss of fishing grounds. Should any future finfish cage operation use frozen fish food at any stage of production however, there is a small but potentially highly significant risk of disease introduction that could decimate small pelagic stocks. A pilchard herpes virus, thought to be introduced via frozen pilchards imported for direct use in tuna fish cages, (this has never been confirmed, an introduction via ballast water is also a possible explanation, but given the apparent origin of the outbreak in the tuna farming centre of southern Australia, the former appears more likely), spread though Australian and New Zealand pilchard stocks in 1995 and 1998-99. This caused pilchard mortalities of up to 70% resulting in huge economic losses to the fishing industry and associated ecosystem level impacts (Crockford *et al.* 2005, Whittington *et al.* 2005). It should be noted that South African commercial fisheries already import and use frozen bait. The impact of disease transfer on wild stock is considered in the marine specialist study and is not repeated in the socio-economic section as it is assumed that the socio-economic impact would be directly linked to the loss of stocks.

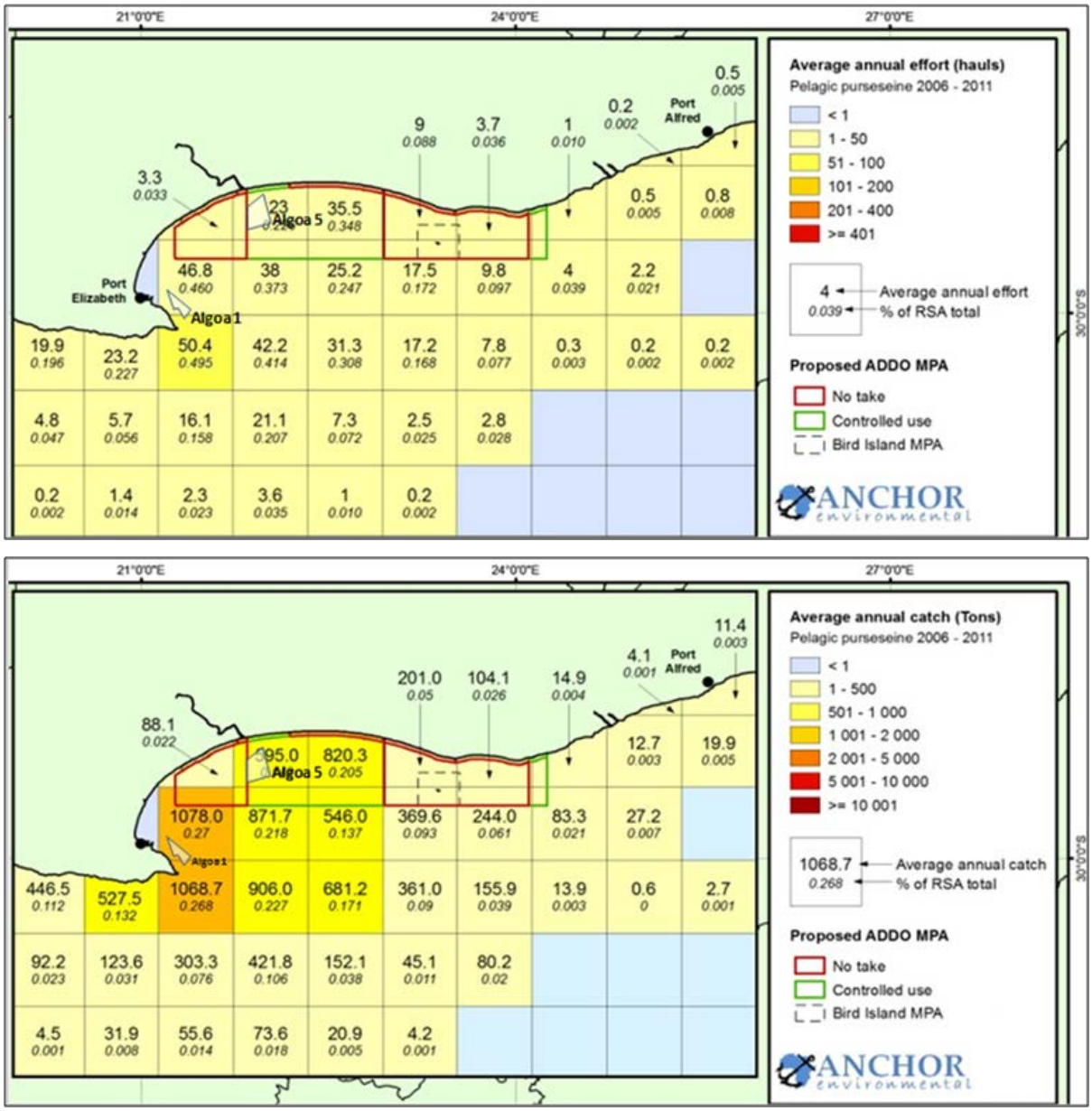

Figure 25 **Average annual effort (top) and catch (bottom) in the small pelagic sector in the Algoa Bay area 2006-2009 and the positions of the proposed ADZ precincts (Data source : DAFF) (Hutchings *et al.* 2013a). Note that Algoa 5 is no longer considered for the current Basic Assessment process.**

Squid jig fishery

Squid *Loligo vulgaris reynaudii* was historically targeted by a (mostly foreign) demersal trawl fishery and landed as by-catch in the South African inshore trawl fishery. A dedicated jig fishery for squid was initiated in 1984 (DEAT: MCM 2005), and the landed catch is now worth more than R180 million per year. The jig fishery first concentrated in the area between Plettenberg Bay and Port Elizabeth, though it now ranges further east as far as the Wild Coast. Squid fishing in the early part of the fishery was from boats that range from small ski-boats to deck boats of about 20 m length, though the latter have come to dominate the fleet (Sauer *et al.* 2003a).

The boats are equipped with powerful lights for night fishing and blast freezers. The fishery operates in depths of 20 – 120 m, though mostly in the shallower waters (see below), where adult squid are targeted in spawning aggregations.

The squid jig fishery usually produces in the order of 6-7 000 tons per annum, though catches of up to 12 000 tons have been recorded in the past. Squid by-catch in the demersal trawl fishery fluctuates between 200-600 tons annually. Squid only live for two years, and there is substantial interannual variability in stock abundance (reportedly amongst the highest for all South African fisheries) that is linked to a variety of influencing factors. There is a high level of uncertainty regarding the status of the squid stock, with initial estimates (Roel & Butterworth 2000) suggesting that effort levels at the time (~3.6 million man hours per annum) were unsustainable and were placing the resource at a high risk (~90%) of collapse. Assumptions implicit in this assessment included the contention that jig-fishing has a negative impact on recruitment, invoked to account for the decline in trawl CPUE observed at the time that the jig fishery commenced. Subsequent refinements of the model by Glazer & Butterworth (2006) allowed them to conclude that spawning success is not strongly affected by jig fishing activity and that current levels of effort (around 3 million man hours per annum) and even higher levels of effort may in fact be sustainable, although further increases above current effort levels do still carry a high estimated risk of stock-collapse.

The squid jig fishery is currently regulated by means of total applied effort (TAE), which limits the number of vessels and crew allowed. The fishery currently comprises 88 rights holders. Since 1988, the fishery has been closed once a year for four weeks in an attempt to counter the effects of "creeping effort" associated with increases in vessel efficiency and catch technology. The closed season corresponds with the peak spawning season for this species, and generally occurs around the month of November (Glazer & Butterworth 2006). All of squid caught in the jig fishery is exported, mostly to Europe. The only squid sold locally is from the trawl by-catch. In all, the squid fishery provides employment for approximately 3 500 people, including land-based personnel (Roel 1998, Roel & Butterworth 2000).

Larger boats (>12m) are able to range as far as squid are distributed. Smaller vessels based in Port Elizabeth (about 15% of the fleet) can range from the Gamtoos River to Bird Island. Fishing location is chosen on the basis of communication with the fleet about current catch rate, checking existing marks, and skipper knowledge. The decision of where to fish is also influenced by weather and season. Boats must shelter when winds are >25 knots. In strong easterly winds the boats typically fish the Tsitsikamma area, but they fish anywhere in a westerly wind provided the swell is not too big (<4m). In winter, fishing is mostly on sea anchor in deep areas (100-200 m), whereas in summer fishing is mainly on nests in 20-60 m depth.

A typical trip lasts three weeks, with duration determined by crew morale, freezer capacity and catch rates. If catches are too slow to be economically viable (due to operating costs and the requirements for paying minimum wages) then the boats come in to port and tie up. The boats are all freezer boats, and food and fuel are not limiting factors for trip length. Fishing is typically close to port so it is not difficult to turn around trips quickly. If the catch rate drops below the estimated breakeven rate for a 3-week trip, then the boats will remain in port. Fishing decisions are subject to the MPAs at Sardinia, Bird Island and Tsitsikamma, closed seasons, and range is restricted by SAMSA regulations to 40 NM or 200 NM limit. There is also a crew limit (TAE).

The distribution of effort and catch for the squid jig fishery in the Algoa bay area for the period 2006-2011 is shown in Figure 25. The Algoa 1 site clearly overlaps with an important squid fishing ground with nearly 8% of the entire South African average annual effort and just over 1% of the average annual catch report from the grid block that overlaps the proposed ADZ. The discrepancy between effort and catch in this catch reporting block is largely due to the fact that vessels shelter from SW winds in the lee of Cape Recife, even during times when catches may be poor. Discussions with industry members suggests that the southern half of the proposed Algoa 1 is an important squid fishing ground and the industry would be strongly opposed to exclusion from this area (Figure 26). The ADZ could be resized by "trimming" the southern half of the proposed site and this would remove much overlap with the important squid fishing ground. Algoa 7 overlaps with an even more important fishing ground accounting for nearly 1.13% of the national annual catch (Figure 26). However, Algoa 7 also falls within the restricted area of the recently approved Addo MPA and this area would be closed to fishing regardless of whether Environmental Authorisation was granted for the ADZ or not. Algoa 6 and 7 do not overlap with significant squid fishing grounds. Algoa 6 does not constitute a fishing site for squid (Figure 26).

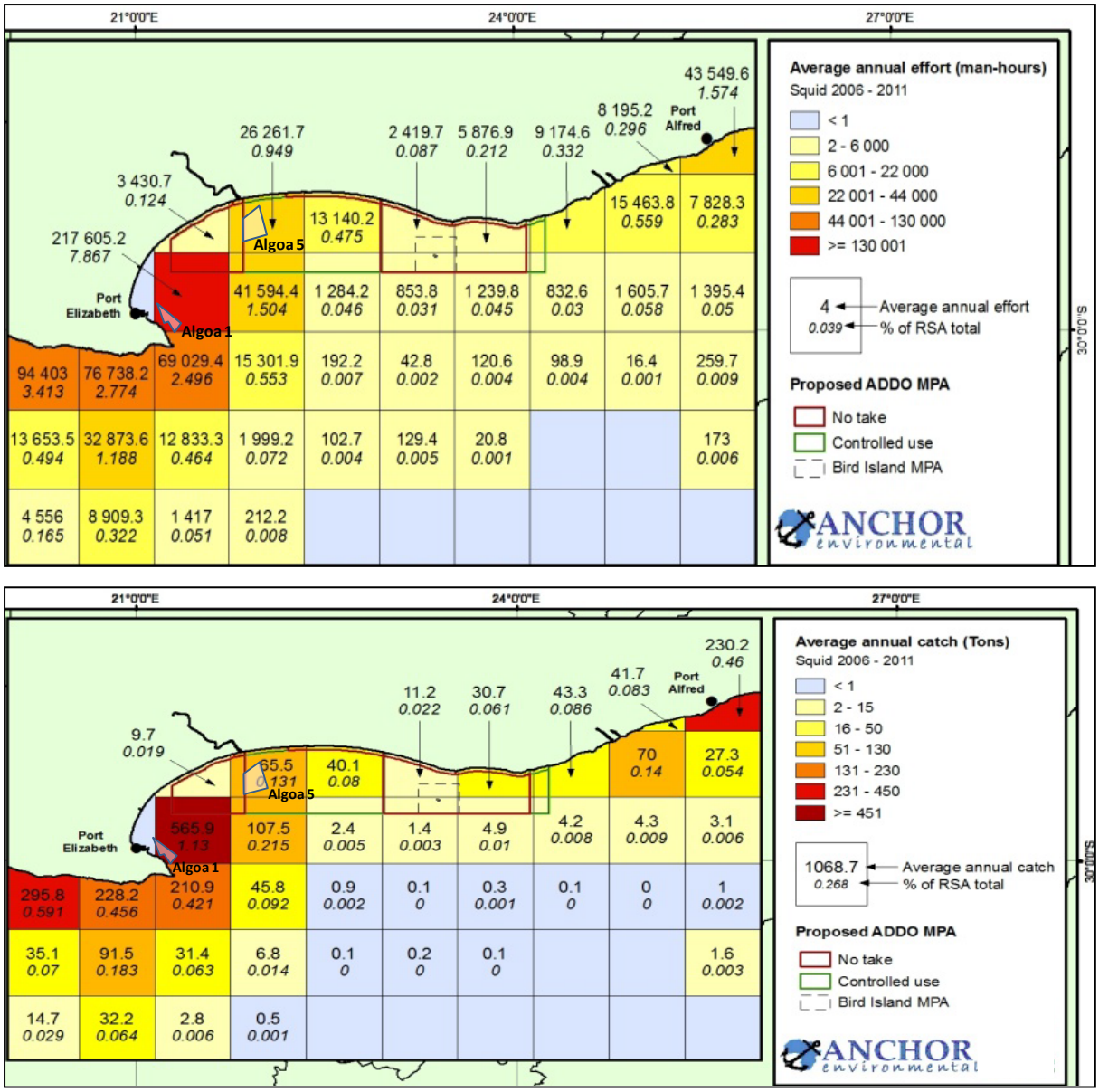

Figure 26 **Reported annual average catch and effort by the squid jig fishery in relation to the proposed ADZ within Algoa Bay, 2006-2011 (Data source: DAFF) (Hutchings *et al.* 2013a).**

Traditional line fishery

The South African commercial line fishery dates back to the 1500s (Thompson 1913). It is a boat-based fishery in which fish are caught on lines with no more than 10 baited hooks per line. The fishery thus operates inshore where fish are accessible on day or short overnight trips and in water shallow enough to be caught using manual labour with hand lines or rods and reels. By the late 1980's, the majority of vessels were highly mobile, trailable ski-boats that could follow aggregations of shoaling species such as yellowtail, snoek, geelbek and kob. When these aggregations occur far from the fishers' base, the boats are driven up to launch precincts closer to the fishing grounds, though this practice is more common in the Western Cape than in the Eastern Cape.

By the end of the 1990s there were approximately 3 000 fishing boats ranging from 3 m dinghies to 15 m deck boats carrying a total of around 3000 crew were involved in the commercial line fishery (Griffiths 2000, Mann 2000). This multispecies fishery landed about 250 species, although only about 20 were commercially important (Lamberth & Joubert 1999).

Despite its long history, lack of data has severely hindered the management of the fishery (Griffiths 2000). It was only in the 1980's and 1990's that life history studies and basic stock assessments were conducted for some of the more important linefish stocks (Mann 2000). A management framework that included a comprehensive suite of regulations was introduced in 1985, including revised minimum size limits equal to sizes at maturity (when known), daily bag limits, closed seasons, commercial fishing bans for certain species and the capping of the commercial effort at the 1984 level. These regulations were updated in 1992, but due to the continued lack of biological data, were still largely based on perceived vulnerability to exploitation (Mann 2000). Griffiths (2000) analysed fishery data over a 100-year period, and found that in spite of technological advances over this period, declines in catch rate were indicative of severe overexploitation (i.e. 75-99%). Angler surveys and stock assessments in the 1990's also suggested that the current line fish management framework was failing to provide adequate protection for line fish stocks (Attwood and Bennett 1995, Brouwer *et al.* 1997, Griffiths 1997a, b, Griffiths 2000, Griffiths *et al.* 1999, Mann *et al.* 1997, Sauer *et al.* 1997). This led to the development of a new Line fish Management Protocol (LMP) that uses stock data or trends in catch composition and catch rate to determine management actions (Griffiths *et al.* 1999). Apart from fast growing species such as snoek and yellowtail, most commercially-exploited line fishes are thought to have been depleted to dangerously low levels (DEAT 2005a). The Minister of Environmental affairs and Tourism declared an environmental emergency in the traditional line fishery in December 2000, and restricted the number of vessels and fishers in the commercial fishery, as well as bag and size limits for commercial and recreational line fishers. The commercial line fishery was split into three regional management zones, restricting the movement of vessels from one region to the next within the 2006-2013 long-term rights allocation.

Since 1985, all commercial line fish permit holders have had to submit catch returns to the National Marine Linefish System (NMLS) database. Although there are some problems with underreporting (Attwood and Farquhar 1999, Brouwer *et al.* 1997, Griffiths 2000, Mann *et al.* 1997, Sauer *et al.* 1997), these data provide a fair reflection of major trends (Penney 1997), are reliable in terms of CPUE and catch composition (Griffiths 2000, Attwood & Farquhar 1999), and can provide a useful basis for study of the fishery.

Until 2003 the commercial fleet was large (~3 000 vessels nationally) with a large number of part-time participants who typically had other fishing interests or alternative sources of income. The mobility of the fleet was also not restricted. After 2003 the number of licensed vessels in the commercial fleet were diminished to about a tenth of their former numbers. However, effective effort has not diminished to the same degree, since the ski boats have since became larger, with longer travel ranges, and have the ability to handle rougher weather. They are also now mostly operated and crewed by full time professional line fishers. Along with these changes, operating costs (particularly fuel and bait) have increased dramatically since 2003.

A total of 422 long-term traditional line fish rights have been issued in South Africa (valid January 2014 to 31 December 2020), of which 62 licences have been issued for management zone B (Cape Infanta to Port St Johns). Of these, about 25 vessels operate in the Algoa Bay area. With an average of 8 crew, the total crew employed is about 200, and these crew each support about 5 people.

Within the Algoa Bay area, line fishers target mainly reef fish (silverfish, red roman, santer, and red stumpnose), which are the mainstay in that they are consistent if not necessarily always the most abundant, followed by geelbek, yellowtail and kob when available. Fishers are constrained in terms of what species they can target, and by bag and size limits as defined by a species list attached to their permit conditions. A traditional line fishing rights holder who also holds a hake handline right may not activate both rights on the same day.

In the Eastern Cape, the decision to fish is not influenced by market conditions. Fishing effort is primarily limited by weather and sea conditions. Because the boats are small, ski boats go out when the wind is less than 15 knots. They are also affected by currents. Fishing takes place throughout the year but there is some seasonality in catches. Ski boats do not have any means of preservation on board and typically go out for about 12 hours if fish are biting (by day or night). Overnight trips are becoming more common to make catches. The range of the boats is limited to 40 NM out to sea (by SAMSA certification), and the actual distance travelled is influenced by safety and fuel concerns. Chukkies may take ice and stay out for two to four days, and are thus also able to fish further afield. Fishing location is chosen on the basis of recent fishing experience and the skippers' local knowledge, and apart from distance offshore is only constrained by MPAs (Bird Island MPA in Algoa Bay, Tstikamma west of Port St Francis).

Total catch in the traditional line fishery within the Algoa Bay region has averaged just over 500 tons per year during the period 2006 – 2010. The catch has been dominated by three species – geelbek, carpenter and kob, with geelbek making up 45% of catches and more than half of total landed value. The current landed value of the average annual catch is in the order of R12 million.

The fishery has changed considerably over time, however. In the long-term catch composition data (1985-2010) for the Algoa Bay area, reef-associated fish species (mostly Sparids) accounted for about 32% of the total line-fish catch. It must be noted that for much of this period (1985-2004) catches of hake and snoek were included, thus down weighting the contribution of reef fish in the catch composition. These species (hake and snoek) are no longer available to the line fishery, as after 2004, the hake handline fishery was managed as a separate sector and the official policy of reducing effort cross subsidization between sectors effectively removed the freezer boat (squid fishery) component of the line fishing fleet, largely reducing snoek catches that were historically made by these vessels offshore of Tsitsikamma. During the period 1985-2005, the average catches in the same area were 1252 tons per year on average (numbers of fishing rights were reduced in 2004), and the catch was dominated by carpenter, hake and kob, with geelbek only making up 10% (Figure 27).

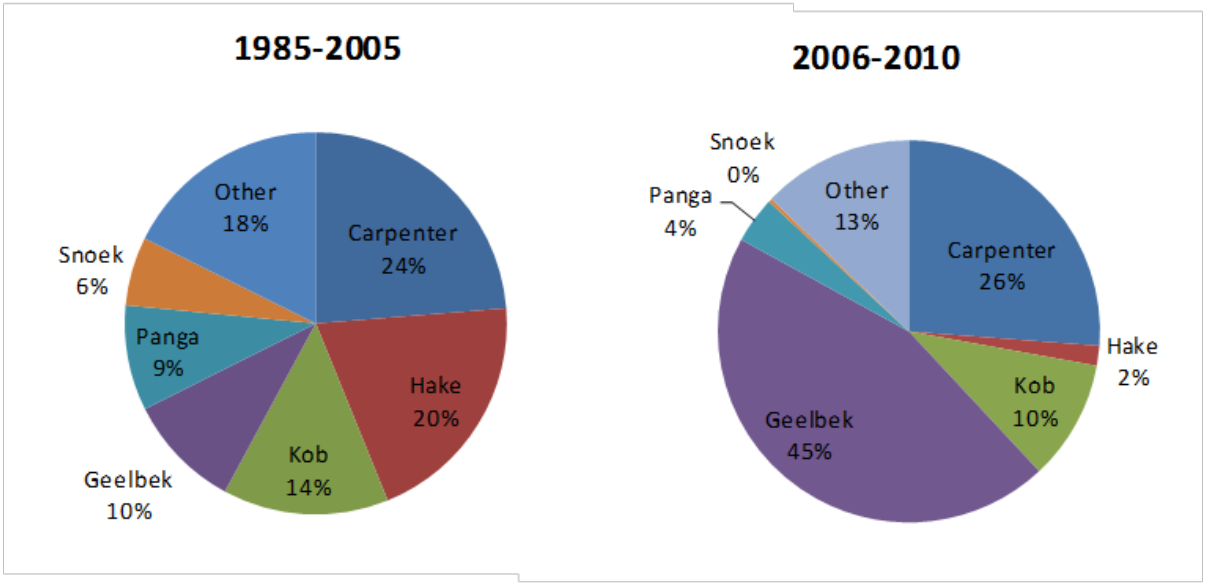

Figure 27 **Change in the composition of line fish catches in the Algoa bay area after 2006 (source Turpie *et al.* 2012).**

Effort and catch data were drawn from the National Marine Linefish System (NMLS) database for the period 2006 to 2011. Data from before 2006 do not provide a good reflection of the fishery as it is at present, as those catches included handline hake. Also, when hake were targeted there was no fishing inshore between Sundays Rivers and Bird Island, but that area is now an important fishing area. Post 2006 data is also better since the long term rights allocation in 2006 impacted the fishery. Prior to analysis, all trips where exclusively squid were reported were excluded as were tuna pole fishing trips. According to the fishers, the last two years are probably the most representative.

Spatial mapping of effort and catches in the line fishery is less accurate than in other sectors, because of the logbook method employed by fishers, which is to describe location in relation to numbered sections along the coast and estimated distance offshore. No bearings are given, and no GPS data are recorded by the fishers with which to calibrate these estimates. This means that in plotting the data, estimates of the bearings have to be made. These are done very coarsely as due east, south or southeast of the coast (for the coast east of Cape Agulhas). Our estimates of spatial patterns differ slightly from those of Chalmers (2012) because of differences in assumptions, and in both studies, these plots differ from the VMS data, which show effort to hug the coastline. Thus for example, fishing effort at the Rij banks appears to be only on the northern half, but in reality is more centred on the banks, and much of the fishing effort west of the point is probably closer inshore.

The overall plot of effort clearly shows the limited range of the traditional line fishing boats, and in the Algoa Bay area, effort by the PE based boats ranges mainly within the area up to the Sundays River and Rij banks, as well as around the point to the west of Cape Recife, whereas effort by the Port Alfred-based boats ranges westwards to Bird Island, where fishing is to the north and south of the Bird Island MPA (Figure 28).

In total, only 2-3% of the average annual reported catch and effort for the Algoa Bay area is for grid blocks that include the proposed ADZ. Given that the ADZ includes no reef substratum, it appears that they will have little negative effect on the commercial line fishery in terms of loss of fishing ground.

The same concerns about the possible introduction of diseases or genetic contamination of wild stocks by cultured fish (many potential cultured species are also targets of the linefishery, and their overexploited status makes the small populations particularly vulnerable to these impacts), as expressed for the recreational skiboat fishery above, are also valid for the commercial linefishery.

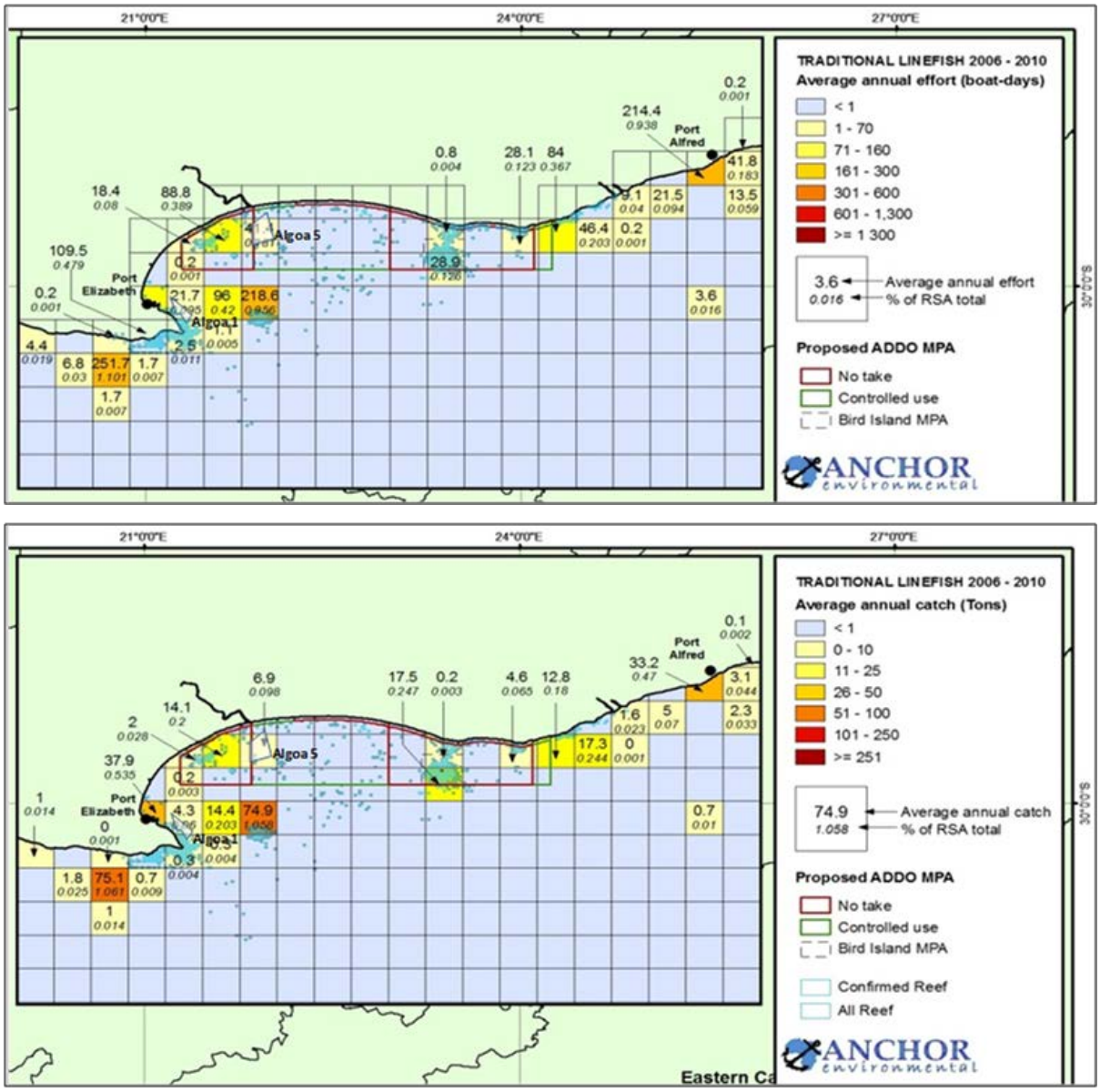

Figure 28 **Average annual linefish effort (top) and catch (bottom) over the period 2006-2010 in relation to the proposed ADZ within Algoa Bay (Hutchings *et al.* 2013a).**

Shark longline

Demersal sharks in South Africa are either targeted directly or caught as by-catch, with the bulk of the catches being taken by the traditional linefishery, the inshore trawl fisheries, and the demersal shark longline fishery (Da Silva and Bürgener 2007). Longline permits for the directed catching of sharks were first issued in 1991 (Crawford *et al.* 1993 in Da Silva and Bürgener 2007). At this time, more than 30 longline permits were issued to target shark (pelagic and demersal species combined). Many of the permit holders did not make use of these permits (due to interests in other fisheries) or sought to use their permits to exploit loopholes in the legislation to catch other species. As a result, the numbers of demersal shark longline permits was reduced to 11 in 2004 and finally 6 permits in 2005, when the decision was made to include catches of pelagic sharks with the pelagic tuna and swordfish sector. Demersal shark longlining then started to focus increasingly on three species – soup-fin shark *Galeorhinus galeus* common smooth-hound sharks *Mustelus mustelus* and bronze whaler sharks *Carcharhinus brachyurus* – which now dominate the catches. In the Algoa Bay area, the fishery targets smooth hound, soupfin, smooth hammerhead *Sphyrna zygaena*, bronze whaler, blacktip *Carcharhinus limbatus*, dusky *Carcharhinus obscures* and cow sharks *Notorynchus cepedianus*.

Currently, demersal shark longlining is restricted to coastal waters (up to 100 m depth), and are permitted to fish up as far as East London, and use longlines with up to 3 000 hooks. Vessels are tracked by a Vessel Monitoring System (VMS) and all landings are independently monitored and skippers are required to complete logbooks per longline set. There is generic reporting of skates and carcharhinids. There are a total of six rights holders in the demersal shark longline fishery. One of these operates in the Algoa Bay area, using a single vessel.

This operator fishes year-round, but some species (dusky, blacktip, bronze whalers and hammerheads) are reportedly more common in summer. Fishing is possible in winds of up to 25 knots. Wind direction influences the choice of where to fish – prevailing winds mean that fishing is more in the west during winter, and in the east (Sundays to Port Alfred) during summer. The time spent at sea is limited by the need to maintain the quality of fish, which is kept on ice. About three trips are undertaken per month, and vessels stay out for up to 9 days at a stretch. Boats do not stay on the same fishing grounds for long periods of time. Fishing is usually close to shore, as that is where the sharks are most abundant. Distance travelled is also influenced by the fact that the boat has to return to port to offload, thus the easterly limit for the PE-based fishery is East London and the westerly limit around Mossel Bay.

Algoa 1 and 7 overlap with areas where the shark longline operator is active with ~10% of the average annual reported catch and effort taking place within grid blocks that overlap with the proposed ADZ (Figure 29). Considering the potential future loss of fishing ground should the restricted zones of the recently approved Addo MPA come into effect (areas that account for around 20% of annual average catch and effort as estimated by Turpie *et al.* 2012); the further losses associated with ADZ declaration would be proportionately larger. Algoa 6 does not overlap with areas where the shark longline operator is active.

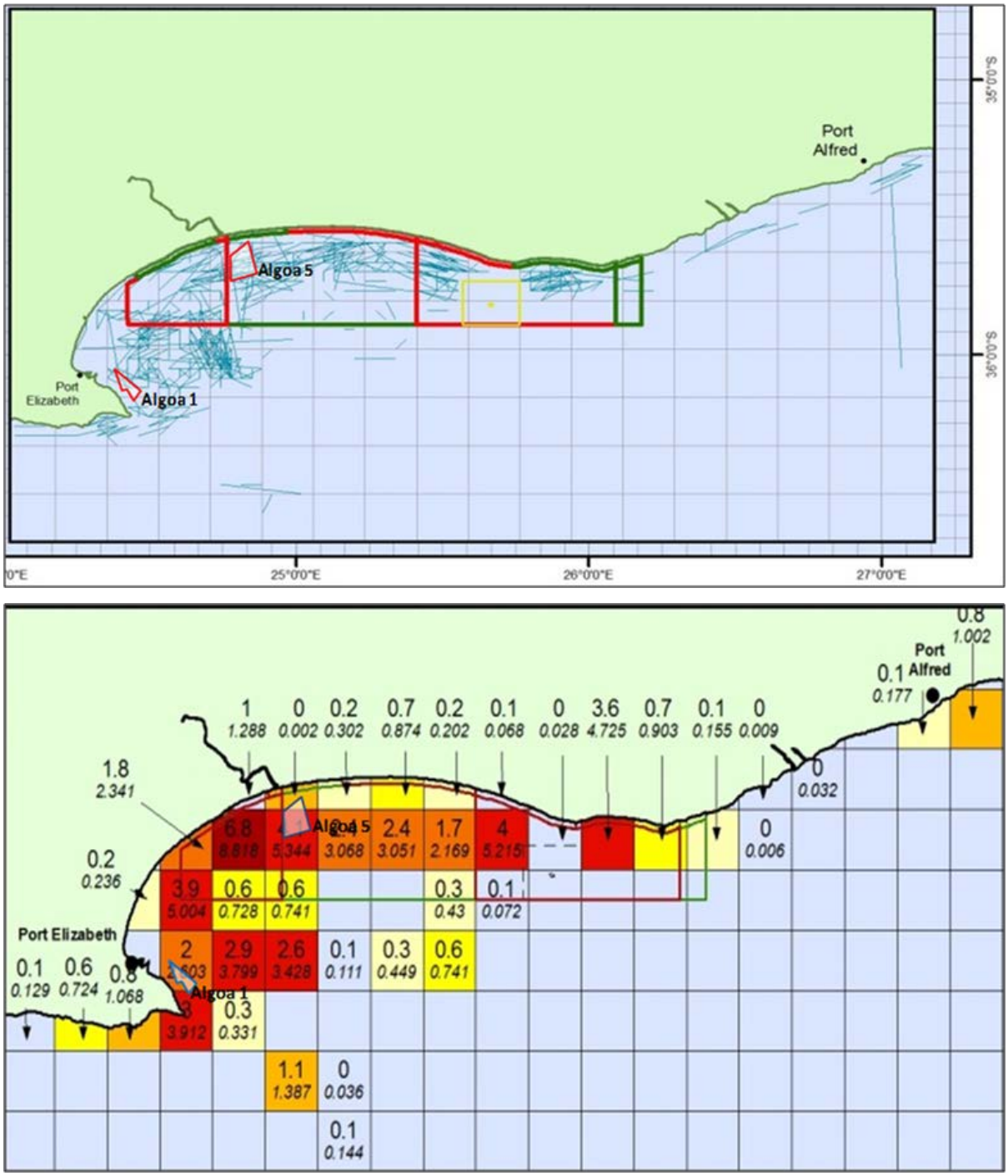

Figure 29 **Reported shark long line sets (top) and average annual catch (bottom) made by the PE based shark long line operator over the period 2006-2012. The recently approved Addo MPA is also shown (Data source: DAFF) (Hutchings *et al.* 2013a).**

8.5.2.3 Shipping and industry

The following section has been sourced from (Bloom 2013). Algoa Bay serves as the entrance to two ports nestled along the coast within the bay, namely Port Elizabeth and a new port at Ngqura (Coega) 20 km away. Agriculture and farming have always played an important role in the port's activities, principally deciduous and citrus fruit and the annual wool crop. More recently, container shipping have assumed a prominent role in the fortunes of the harbour, with Port Elizabeth serving its local industrial base and offering an alternate port of call to container ships whenever the Durban or Cape Town container terminals are congested. Other principal products handled at the harbour include manganese ore, which is railed from the Northern Cape, and petroleum products, which are imported from other South African ports. The motor industry has long been an important industrial activity for the Eastern Cape and the port plays a leading role in this regard, boasting a large open-area car terminal.

The fishing industry also makes extensive use of Port Elizabeth. There are no major ship repair facilities, but a slipway is available for fishing vessel repair. Passenger ships usually make use of one of the fruit terminal berths when calling at Port Elizabeth. The South African Navy has established a naval station at Port Elizabeth, but does not maintain any ships there. In future, some of the port's present commercial activity may be lost to the port of Ngqura (Coega), although the car terminal and possibly the container terminal will remain intact.

The entrance channel to Port Elizabeth is maintained at a depth of -14.5 m Chart Datum and has a generous width of 310 m. Limitations on vessels using the port are 11 m draught for passenger and dry cargo vessels, 11.2 m for container ships, 12.1 m for ore carriers and 9.6 m for tankers, all according to berthing. Deeper vessels may be accommodated with the permission of the harbour master. Tug assistance and pilotage is compulsory. Ships may anchor outside the port in Algoa Bay provided the approaches to the entrance channel are kept clear.

Port Elizabeth's main features are the container terminal, fruit terminal and manganese terminal. The container terminal has a capacity in excess of 375 000 TEUs and has the advantage of being able to load railway trains directly under the gantry cranes, without containers having to be double handled, thus speeding up delivery to inland destinations. A full range of ship chandelling and stevedoring as well as other support services is available (Transnet, 2011a/b).

The deep-sea port of Ngqura, which began commercial ship operations (containers) in October 2009, lies some 20 km northeast of Port Elizabeth at the mouth of the Coega River. An Industrial Development Zone (IDZ), known as the Coega IDZ, has been developed over the 12 000 ha site in the area including the river and port, with a 4 500 ha core development. The IDZ will serve as a primary location for new industrial development for export-driven industries.

The deep-water Ngqura port is capable of serving post-Panamax dry and liquid bulkers and the new generation of cellular container ships. The port consists of a main eastern breakwater, 2.7 km in length, extending into Algoa Bay to a maximum water depth of 18 metres, and a secondary western breakwater 1.125 km in length.

8.5.2.4 Marine ecotourism

Island, Sea & Sundowner Cruises enable one to see Cape fur seals, numerous sea birds, surrounding shipwrecks and sometimes even pods of whales and dolphins. The St Croix Island Marine Reserve is home to one of the larger breeding colonies of endangered African Penguins in South Africa, Cape fur seals and whales (http://www.nmbt.co.za). Marine ecotourism focuses on the conservation worthy aspects of Algoa Bay.

8.5.2.5 Marine aquaculture (sea-based and land-based)

A number of mariculture activities are/were prevalent in Algoa Bay and at the Port Elizabeth harbour, with the following on-going mariculture activities confirmed (Mr Dana, Capt. Sultan, Arno Nel) (Bloom 2013):

- A private fish breeding station on the harbour, producing only fish for bait purposes.
- A small oyster breeding station about 2 km from the harbour in the direction of Coega, maintained by Nelson Mandela Metropolitan University (NMU) for research purposes.

Mariculture projects that were operational in the past include fish-breeding projects – the reasons for their demise were unknown to participants in the primary discussions. One of these was managed by NMU and the other by Irvin & Johnson Ltd (I&J). An on-land fish-breeding project was supposed to be developed as a black empowerment project, but did not produce the expected outcomes (Anton Viljoen, Garry Scholtz, John Allen).

The Department of Science and Technology - in partnership with Irvin & Johnson Ltd - conducted a 2-year pilot project to ascertain the commercial, technical and environmental viability of sea-based cages for breeding three indigenous and overfished South African line-fish species, namely dusky kob (*Argyrosomus japonicus*), silver kob (*Argyrosomus inodorus*) and yellowtail (*Seriola lalandi*). Fish that reached 1 kg were sold through an uptake agreement with I&J. Four HDPE cages were deployed 1 km offshore near the Port Elizabeth harbour, which is relatively sheltered from the wind. In December 2007, 40 000 dusky kob fingerlings with an average mass of 8 g were added to one of the cages. The successful introduction of kob was followed in January 2008 by the introduction of 18 000 yellowtail fingerlings (average weight of 5 g) in the second sea cage. Both cages were equipped with locally produced predator nets together with an inside net; all nets are weighted to maintain the cage structure of the nets in the water. Fish sampling after the third production month indicated an average weight of 74.73 g for kob and 17.57 g for yellowtail, compared to the respective target weight of 53.32 g and 15 g (Department of Science and Technology, 2011a). The insight gained from this pilot project is hoped to assist with the development of a commercially viable model that would benefit the public and offer some BEE opportunities.

NMU undertook independent environmental monitoring and reported regularly to DAFF. No significant impact was detected. No whale or dolphin entanglements were observed, only one seal incident, two ragged tooth sharks breached the netting and were removed without harm, and one tern breached the bird netting. The only incident of disease involved dusky kob, which were treated with hydrogen peroxide.

At the conclusion of the pilot project in July 2010, the cages and mooring system were removed. The second phase for yellowtail was not realised due to the lack of fingerling availability and the project was closed in 2013 (*pers. comm*. G le Roux, Stellenbosch University 2018).

The Coega Development Corporation (CDC) is currently in the process of developing a 440 ha land-based aquaculture development zone (ADZ) in Zone 10 of the Coega Industrial Development Zone (IDZ) (Wolmarans M and Schroeder W. 2017). The overall purpose of the project is to establish an 'investment ready' platform for planned commercial aquaculture operations to establish within the Coega IDZ without having to obtain Environmental Authorisation (EA). The EA for the project was granted in February 2018 (CDC 2018).

8.5.2.6 Airports Company South Africa (ACSA) Port Elizabeth

According to the Airports Company South Africa (ACSA) Port Elizabeth the proposed Aquaculture Development Zone overlaps with the flight path of aircrafts landing at and departing from the Port Elizabeth International Airport. ACSA is concerned that aquaculture farms may attract birds and their aggregation would pose a risk to aircraft navigation. The ACSA submitted an appeal to the Environmental Authorisation that had been granted for Algoa 1.

"

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 Introduction

An environmental impact assessment assesses the positive and negative environmental consequences of a proposed development. The National Environmental Management Act (Act 107 of 1998) (NEMA) defines the environment as "the surroundings within which humans exist and that are made up of:

(i) The land, water and atmosphere of the earth;
(ii) Micro-organisms, plant and animal life;
(iii) Any part or combination of (i) and (ii) and the inter-relationship among and between them; and
(iv) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being".

The Department of Agriculture, Forestry and Fisheries (DAFF) intends to develop an Aquaculture Development Zone (ADZ) in Algoa Bay, Eastern Cape. Three potential precincts have been identified and will be considered in this impact assessment, namely Algoa 1, 6 and 7 (new site). Please refer to Chapter 3 for detailed project and site descriptions and site maps for the proposed areas.

Based on the knowledge and professional experience of the environmental assessment practitioner regarding the nature of the proposed development and associated receiving environment, the following key potential environmental impacts – positive and negative – were identified:

- Negative impacts on the marine environment;
- Positive and negative impacts on the social environment (e.g. employment, revenue generation, negative impacts on existing tourism operations and property prices);
- Negative impacts on visual and aesthetic characteristics of the area; and
- Negative impacts on maritime heritage resources

This basic assessment process includes the following specialist studies:

- Marine specialist study conducted by Anchor Research & Monitoring (Pty) Ltd;
- Maritime and Underwater Heritage Impact Assessment conducted by ACO Associates (cc)

Both reports are appended as standalone documents to this Basic Assessment Report (Appendix D). The key findings from these specialist studies have been integrated into this Chapter.

The marine specialist impact assessment for Algoa 1, 6 and 7 was compiled based on:

1. The marine baseline study (Porter *et al.* 2012) and impact assessment (Hutchings *et al.* 2013) conducted by Anchor as part of the previous EIA process;
2. A comparative review of these studies by Britz & Sauer (2016a) for Algoa 1 (and 5) (Appendix D); and
3. Benthic habitat mapping and dispersion modelling studies that Anchor completed for DAFF in November 2018 Dawson *et al.* (2019) and Wright *et al.* (2019) (Appendix D).

The socio-economic baseline study for the Algoa Bay area and the impact assessments for Algoa 1 (and 5) compiled by socio-economic specialist Professor Bloom during the previous EIA process (Bloom 2012 and 2013) constitute the backbone of the impact assessment process for the current application for environmental authorisation. Furthermore, the comparative review study for Algoa 1 (and 5) compiled by Britz *et al.* in 2016 are considered carefully in this current basic assessment process and have been included as a standalone document in Appendix (D). The impact assessment for Algoa 7 (the new site) is likely to be very similar when compared to Algoa 5 (which was assessed by specialists in the previous EIA process but is no longer considered in this BA process), which lies only 15 km to the east of Algoa 7. The inshore bivalve culture site, Algoa 6, is located within an industrial setting of Port Elizabeth and user conflict is limited to slight overlap with some fishing activities No additional socio-economic specialist studies were therefore conducted to complete the impact assessments for Algoa 6 and 7.

The visual and aesthetic baseline study and impact assessment for Algoa 1 (and 5) for the previous EIA process were undertaken by Visual Resource Management Africa cc (Stead *et al.* 2011 and 2013). The findings and recommendations by these studies have been integrated into this impact assessment pertaining to Algoa 1. The sense of place is unlikely to be impacted by Algoa 6 and 7 due to the fact that the shipping traffic and industrial activities already occur within the context of the harbour environments of the Ports of Elizabeth and Ngqura respectively. These precincts are therefore not considered to be situated in visually sensitive areas (refer to Section 8.3) and a specialist was not consulted for compiling the impact assessments for Algoa 6 and 7.

Impacts on maritime heritage resources may be caused by mooring the finfish cage, oyster long-lines and mussel rafts to the seafloor. Note that during the previous EIA process, the South African Heritage Resources Agency (SAHRA) did not request a specialist study due to the large area considered for the ADZ, but indicated instead that individual operators would be required to conduct an underwater survey for the specific areas chosen within the ADZ prior to commencement of the operational phase. A specialist desktop Underwater and Maritime Heritage Impact Assessment was, however, conducted for this BA process and the results and recommendations have been integrated into this BAR.

The specialist studies from the previous and current EIA processes contributed to the detailed site and project descriptions presented in Chapters 3 and 8, which were used to determine the significance of potential environmental impacts associated with each individual precinct. This information was then collated to choose the most favourable combination of precincts to take forward in the application process as the preferred alternative for the project. Potential impacts are denoted by first listing the phase of the development (i.e. CP = Construction Phase; OP = Operational phase) followed by the impact category. Impacts are numbered consecutively and separately for the construction and operational phases:

- ME = Marine Ecology
- VA = Visual and aesthetic
- SE = Socio-economic
- UMH = Underwater and Maritime Heritage Resources

9.2 Approach and Methodology

The assessment of impacts was based on specialists' expertise, Anchor Environmental's professional judgement, field observations and desk-top analysis.

The significance of all potential impacts that would result from the proposed project is determined in order to assist decision-makers. The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact was thus rated according to the methodology set out below:

Step 1 – Determine the **consequence** rating for the impact by determining the score for each of the three criteria (A-C) listed below and then **adding** them. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

Rating	Definition of Rating	Score
A. ***Extent – the area over which the impact will be experienced***		
Local	Confined to project or study area or part thereof (e.g. limits of the concession area)	1
Regional	The region (e.g. the whole of Namaqualand coast)	2
(Inter) national	South African land and waters and beyond	3
B. ***Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources***		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration – the time frame for which the impact will be experienced and its reversibility***		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years (state whether impact is irreversible)	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Combined Score (A+B+C)	**3 – 4**	**5**	**6**	**7**	**8 – 9**
Consequence Rating	Very low	Low	Medium	High	Very high

Example 1:

Extent	Intensity	Duration	Consequence
Regional 2	Medium 2	Long-term 3	High 7

Step 2 – Assess the **probability** of the impact occurring according to the following definitions:

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Example 2:

Extent	Intensity	Duration	Consequence	Probability
Regional 2	Medium 2	Long-term 3	High 7	Probable

Step 3 – Determine the overall **significance** of the impact as a combination of the **consequence** and **probability** ratings, as set out below:

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	Low	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	Medium	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	High	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	Very High	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

Example 3:

Extent	Intensity	Duration	Consequence	Probability	Significance
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH

Step 4 – Note the **status** of the impact (i.e. will the effect of the impact be negative or positive?)

Example 4:

Extent	Intensity	Duration	Consequence	Probability	Significance	Status
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	– ve

Step 5 – State the level of **confidence** in the assessment of the impact (high, medium or low).

Impacts are also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below. Depending on the data available, a higher level of confidence may be attached to the assessment of some impacts than others. For example, if the assessment is based on extrapolated data, this may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

Confidence rating	
Status of impact	+ ve (beneficial) or – ve (cost)
Confidence of assessment	Low, Medium or High

Example 5:

Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	– ve	High

The significance rating of impacts is considered by decision-makers, as shown below. Note, this method does not apply to minor impacts which can be logically grouped into a single assessment.

INSIGNIFICANT: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity.

VERY LOW: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity.

LOW: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity.

MEDIUM: the potential impact **should** influence the decision regarding the proposed activity.

HIGH: the potential impact **will** affect a decision regarding the proposed activity.

VERY HIGH: The proposed activity should only be approved under special circumstances.

Step 6 – Identify and describe practical **mitigation** and **optimisation** measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

- **Essential**: must be implemented and are non-negotiable; and
- **Best Practice**: must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Essential mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures.

Example 6: A completed impact assessment table

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional **2**	Medium **2**	Long-term **3**	**High** **7**	Probable	**HIGH**	**– ve**	High
Essential mitigation measures: xxxxx xxxxx								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Improbable	**VERY LOW**	**– ve**	High

Step 7 – Prepare a summary table of all impact significance ratings as follows:

Impact	***Consequence***	***Probability***	**Significance**	***Status***	***Confidence***
Impact 1: XXXX	Medium	Improbable	LOW	–ve	High
With Mitigation	Low	Improbable	VERY LOW		High
Impact 2: XXXX	Very Low	Definite	VERY LOW	–ve	Medium
With Mitigation:	*Not applicable*				

Indicate whether the proposed development alternatives are environmentally suitable or unsuitable in terms of the respective impacts assessed by the relevant specialist and the environmentally preferred alternative.

9.3 Marine ecological impacts

The proposed sea-based Aquaculture Development Zone has a wide range of potential impacts on the marine environment. Anchor conducted a marine specialist study to assess the impacts on the marine environment and recommend mitigation measures. The full specialist report is included in Appendix D of the Basic Assessment Report (Hutchings *et al.* 2019).

Information and data collected and analysed by the marine specialists during the previous and current EIA processes (Hutchings *et al*. 2013a/b, Dawson *et al*. 2019 and Wright *et al*. 2019) and the findings of the comparative socio-economic feasibility study compiled by the Rhodes University in 2016 (Britz *et al*. 2016a/b and Britz and Sauer 2016)[2] informed this marine ecological impact assessment. Existing information was reviewed and updated using available desktop information pertaining to the nature of the marine environment, the aquaculture industry and potential impact and mitigation measures where required. The Terms of Reference for the marine ecological specialist study are as follows:

1. A summary description of the receiving environment highlighting sensitive and significant habitats, fauna and flora including maps with locations of sensitive/significant features and habitats;
2. A summary of the findings of the dispersion modelling study and the benthic habitat mapping study;
3. A recommendation of species to consider for the ADZ;
4. Description and assessment of potential impacts associated with the operation of the ADZ;
5. A site recommendation considering the preferred as well as the alternative sites from an ecological perspective; and
6. Recommendations on measures to be adopted/implemented that are expected to mitigate negative impacts on the ecology of the area.

This marine specialist study describes and assesses potential environmental impacts associated with each of the three precincts (Algoa 1, 6, and 7) individually first, and subsequently in combination in the form of alternate options as they have been configured for this EIA process (i.e. Option A, B and C, see table above) together with the No-Go option (Alternative D).

9.3.1 Impact assessment summary for Algoa 1, 6 and 7

The tables below summarise the impacts that may be experienced during the construction and operational phases of the project for finfish mariculture in Algoa 1 and 7, and bivalve mariculture in Algoa 1 and 6, before and after mitigation (Table 9 to Table 11). The installation of the finfish cages and bivalve longlines and rafts is very swift and the only impact identified for this phase was the disturbance of subtidal habitat, which was rated **low** and **very low** without and with mitigation measures respectively. Fourteen impact types were identified during the operational phase.

[2] Britz *et al.* 2016a/b and Britz and Sauer 2016, Dawson *et al.* 2019, and Wright *et al.* 2019 have been included as standalone reports in Appendix D of this Basic Assessment Report.

Two impacts either did not require mitigation due to low significance, or because there was no feasible mitigation possible. Six impacts were rated **very high** or **high** before mitigation, but only one impact was rated **high** post mitigation (rated **very high** before mitigation). Eight impacts were rated **medium** before mitigation but all of these were rated **low** post mitigation. Four impacts were rated **low** or before mitigation, most of which were rated **very low** post mitigation. Overall post mitigation, one **high,** four **medium** and 13 **low** impacts remained.

Table 9 **Summary of potential marine ecology impacts for the construction of the proposed ADZ mariculture development (finfish and shellfish) in Algoa Bay.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
CP-ME 1	Disturbance of subtidal habitat	Low	Definite	**LOW**	-ve	High
	With mitigation	Very Low	Definite	**VERY LOW**	-ve	High

Table 10 **Summary of potential impacts of *finfish culture* on marine ecology (denoted ME) for the *operation* of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. OP stands for Operation Phase.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 1	Disease and parasite transmission to wild fish stocks (ongoing, may be reversible).	Very High	Definite	**VERY HIGH**	-ve	High
	With mitigation	High	Probable	**HIGH**	-ve	Medium
OP-ME 2	Organic waste discharge impacting on the water column and benthic environment arising from mariculture operations (ongoing but reversible).	High	Definite	**HIGH**	-ve	High
	With mitigation	Medium	Definite	**MEDIUM**	-ve	Medium
OP-ME 3	Genetic contamination of wild stocks with escapees from finfish cage culture at Algoa 1 & 7 (ongoing and irreversible).	Very High	Possible	**HIGH**	-ve	Low
	With mitigation	Medium	Improbable	**LOW**	-ve	Low
OP-ME 4	Use of chemical therapeutants and antifoulants in finfish cage culture at Algoa 1 (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
	Use of chemical therapeutants and antifoulants in finfish cage culture at Algoa 7 (ongoing but reversible).	High	Probable	**HIGH**	-ve	Medium
	With mitigation	Low	Probable	**MEDIUM**	-ve	Low

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 5a	Accidental entanglement of cetaceans in mariculture infrastructure (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Low
OP-ME 5b	Possible impacts on cetaceans resulting from alterations in habitat use or migration patterns (ongoing but reversible).	Low	Probable	**LOW**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
OP-ME6	Piscivorous marine animals interfering with finfish cage culture operations at Algoa 1 (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
	Piscivorous marine animals interfering with finfish cage culture operations at Algoa 7 (ongoing but reversible).	High	Probable	**HIGH**	-ve	Medium
	With mitigation	Medium	Probable	**MEDIUM**	-ve	Low
OP-ME7	Possible impacts on the proposed Addo Elephant MPA, Algoa 7 (irreversible).	Medium	Definite	**MEDIUM**	-ve	High

Table 11 **Summary of potential impacts of *bivalve culture* on marine ecology (denoted ME) for the *operation* of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. OP stands for Operation Phase.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 8a	Introduction of alien bivalve species (Mediterranean mussel *Mytilus galloprovincialis*) to the wild.	Low	Improbable	**VERY LOW**	-ve	Medium
	No mitigation required	N/A	N/A	N/A	N/A	N/A
OP-ME 8b	Introduction of alien bivalve species (Pacific oyster *Crassostrea gigas*) to the wild	High	Possible	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 9	Introduction of alien fouling species to the wild and provision of habitat to alien fouling species	Medium	Definite	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Medium

	Impact identified	Consequence	Probability	Significance	Status	Confidence
OP-ME 10	Disease and parasite transmission to wild bivalve stocks (ongoing, may be reversible).	Very High	Definite	**HIGH**	-ve	High
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 11	Organic pollution and habitat modification (ongoing but reversible).	High	Possible	**MEDIUM**	-ve	High
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 12	Genetic contamination of wild stocks from bivalve mariculture at Algoa 1 and 6 (ongoing and irreversible).	Low	Improbable	**VERY LOW**	-ve	Medium
OP-ME 13a	Accidental entanglement of cetaceans in bivalve mariculture infrastructure (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Low
OP-ME 13b	Possible impacts on cetaceans resulting from alterations in habitat use or migration patterns (ongoing but reversible).	Low	Probable	**LOW**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low

Due to the presence of sea bird and seal colonies and the anticipated increase in abundance of wild fish and other biota in the Addo MPA, the use of chemical therapeutants and antifoulants, genetic contamination of wild stocks and interactions with piscivorous marine animals (cetaceans sharks, seabirds) with finfish cage culture operations are ranked as having a higher negative impacts on the marine environment at Algoa 7 compared to Algoa 1.

9.3.2 Impact significance of alternative options A, B, C and D

DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore three combinations of precincts have been considered as alternatives in the Basic Assessment process. These three options allow for varying degrees of farming intensities by excluding finfish farming at Algoa 1 (Option B) or excluding Algoa 1 as a whole (Option C).

Assessing the four proposed development alternatives (A, B, C and D as shown in Table 12) in terms of the number of medium and high significance impacts, favours alternatives B and C over alternative A (see table below). This is simply a result of more mariculture development having more impacts (i.e. having two fish farming sites with a greater total number of cages and higher biomass of farmed fish versus only one). Decision making authorities must, however, be cognisant of the fact that this development is likely to result in a number of moderately significant impacts after mitigation even for the smaller scale of development in options B and C.

The Status Quo Alternative (i.e. Option D) proposes that the Algoa Bay ADZ does not go ahead. This would mean that the negative impacts on biodiversity and conservation efforts in Algoa Bay will not be realised. Impact levels as currently observed will be continued.

Table 12 **Comparison of the sum of negative impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone on marine ecology (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the worst case scenario (i.e. finfish) was considered.**

Impact significance after mitigation	**A**	**B**	**C**	**No-go**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	2	1	1	0
Medium	6	5	5	0
Low	23	18	10	0
Very low	0	0	0	0
Insignificant	0	0	0	0

9.3.3 Recommendations

Due to the impact level observed even after mitigation and the inclusion of Algoa 7 (MPA site) in options A, B and C, it is recommended that no more than three fin fish operators should be approved for an initial pilot phase, with a total annual production for the ADZ not exceeding 1 000 tonnes in the first year. Should monitoring reveal acceptable impacts as defined by the environmental quality objectives, indicators and performance measures, operators should be permitted to increase production from pilot phase to full commercial scale (not exceeding the carrying capacity at each site for *Seriola lalandi* and *Argyrosomus* sp. as recommended in Wright *et al*. 2019) over at least a three year period, provided that resource quality objectives are maintained.

Furthermore, the specialist study recommends the following mitigation measures:

- Cages should not be moored over long lived biogenic habitats (i.e. potential reef area identified within Algoa 1 should be excluded) and ensuring minimal movement of moorings during operation or maintenance to keep impact footprint to a minimum;

- A biosecurity management plan should provide mitigation measures to (1) reduce the likelihood of escape occurring; (2) ensure comprehensive training of staff; (3) monitor stock comprehensively for disease and/parasites as part of a formalised stock health monitoring programme and take necessary action to eliminate pathogens through the use of therapeutic chemicals or improved farm management (lowest effective dose); (4) locate cages stocked with different cohorts of the same species as far apart as possible (no less than 100 m).
- If possible, different species should be stocked in cages successively, and stocking option and cage set up recommendations as outlined in the dispersion modelling report should be implemented. Site selection should be influenced by dispersion potential (i.e. well-flushed, deep and productive areas). A comprehensive sediment and water quality monitoring program to determine intensity of impacts should be developed and implemented prior to the operational phase.
- Genetic compatibility between wild and cultured stock by implementing the "Genetic Best Practice Management Guidelines for Marine Finfish Hatcheries" developed by DAFF and ensure adequate genetic monitoring.
- Suitable predator nets and visual deterrents should be installed and maintained. A protocol for dealing with problem piscivores in conjunction with experts and officials should be developed.
- South African oyster hatcheries should be developed to reduce the reliance on spat import, and hence the risk of non -intentional introduction of associated alien species. The cleaning of biofouled infrastructure (ropes etc.) must be conducted in such a way as to minimise deposition to the seafloor beneath the farms (i.e. biofouling must be collected as deposited of at a suitable onshore disposal facility). Routine surveillance on and around marine farm structures, associated vessels and infrastructure must be undertaken for indications of non-native fouling species. If spat import cannot be avoided, culture facilities should only be permitted to use spat sourced from biosecure certified hatcheries and/or quarantine facilities.

In conclusion, the impact assessment of the alternative options provided by the applicant show that Option C has the lowest overall impact on marine ecology. However, the competent authority must consider that there are a number of moderately significant impacts and at least one highly significant negative impact after mitigation for all options. The impact significance of the proposed development on conservation objectives (protection of biota and ecosystem functioning), has been ranked as medium and there are no feasible mitigation measures that could reduce this impact. A comprehensive, site specific Environmental Management Programme (EMPr), which includes the conditions of the overarching ADZ EMPr must be developed and implemented for each aquaculture farm within the ADZ. This EMPr must require independent monitoring of sufficient indicators in order to detect and quantify any of the environmental impacts described in this Basic Assessment Report, and must specify thresholds of concern which require remedial action. The development of the ADZ should be phased in so that cumulative impacts can be detected as they arise, and rigorous adaptive management implemented.

9.4 Visual aesthetics

Visual impacts are defined as, "The effect of an aspect of the development on a specified component of the visual, aesthetic or scenic environment within a defined time and space" (Oberholzer B. 2005). As identified in this definition, 'landscapes are considerably more than just the visual perception of a combination of land form, vegetation cover and buildings, as they embody the history, land use, human culture, wildlife and seasonal changes to an area' (U.K IEMA 2002). These elements combine to produce distinctive local character that will affect the way in which the landscape is valued and perceived.

A visual impact assessment (or VIA) is the analysis of the potential visual impacts to the landscape and landscape views resulting from a proposed development or land management action. Visual impact is determined through the subjective assessment of sensitivity of the visual receptors (i.e. residents, outdoor recreational users) and the magnitude (scale) of the change in view. The proposed development is sea-based and landscape views that may be impacted therefore include the views from land looking out to sea.

Visual Resource Management Africa CC (VRM) Africa was appointed by CapeEAPrac to conduct the Visual Baseline and Impact Assessment for Algoa 1 and 5 during the previous EIA process (Stead *et al.* 2013). The impact assessment and other applicable sections of the Final Visual Impact Assessment (VIA) study produced by VRM in July 2013 have been integrated into the section below and have been updated where required. Please refer to Appendix D for a detailed methodology and results pertaining to applicable receptors, exposure of receptors, visibility and contrast ratings undertaken from Key Observation Points (KOPs) for Algoa 1. The results of this study are not repeated here and the reader is encouraged to consult the Final Visual Specialist Study compiled by Stead (2013).

Where the views of ships and other industrial and traffic activities are seen within the context of a harbour environment, the sense of place is unlikely to be impacted significantly by the proposed aquaculture development. This is applicable to Algoa 6 and 7, which are situated within the harbour environment of the Ports of Elizabeth and Ngqura respectively. These precincts are therefore not considered to be situated in visually sensitive areas (refer to Section 8.3) and a specialist was not involved in compiling the impact assessment for these additional precincts.

The proposed ADZ includes the culture of bivalves and finfish. Examples of finfish cages and longlines used for mussel and oyster culture are shown in the project description in Chapter 3. The project components which may cause a visual impact and potentially change the sense of place include, floating structures (including boys and cages), maintenance vessels and lights at night. Floating structures will protrude out of the water by a maximum of 10 m (on average 2 m), while lights at night are limited to 5 m above sea level (Stead *et al.* 2013).

The view catchment area is the geographic area from which the project site and associated structures would be visible. Visibility is often reduced due to screening by existing trees and buildings. Stead (2013) determined that Algoa 1 would be highly visible due to its location in the open ocean where numerous receptors would be exposed to the proposed development. Algoa 6 and 7 are therefore considered to have high visibility as well.

However, although visibility is high for all precincts, visual receptors differ significantly between the precincts. Visual receptors are defined by the United States Bureau of Land Management as the people located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. The following receptors and landscape features were identified in the viewshed of the proposed ADZ precincts:

Algoa 1:

- Marine Drive and Beach Road
- Beach users
- Main hotels along Marine Drive
- Diving and yachting activities within the bay
- Cape Recife Nature Reserve

Algoa 6:

- Settlers Highway
- Residential views within central Port Elizabeth close to the R102

Algoa 7:

- Diving and yachting activities within the bay
- Marine ecotourism

The visual receptors are shown in relation to each site in Figure 30 to Figure 32. The impact on the landscape character for each site is assessed in this impact assessment. Due to the swift installation of the cages and longlines, impacts during the construction are of very short duration and have not been assessed separately.

9.4.1 Potential impact OP-VA1: Negative impact on seascape character

Due to the flat sea surrounding the site, the extent of the impact caused by the project would be high for all precincts, even though the height of the proposed project is limited to 2 m (bivalve farms are even lower). The project would be long-term and large in scale if the project is viable and scalable. The intensity of the visual impact would vary depending on the location of the site, the size and location of the farms within the boundary of the proposed development area (i.e. depending on how many farms will be established within one site). Visual surface area infrastructure is approximately 7% of the total sea floor infrastructure area i.e. where 210 ha infrastructure is located on the sea floor only 15 ha will be visible on the surface and where 63 ha infrastructure is located on the sea floor only 4.5 ha will be visible on the surface. Location in close proximity to diving or yachting receptors, as well as locations in front of the beach front, would result in higher levels of visual impact and subsequently, high significance given the importance of tourism for the city of Port Elizabeth. Each precinct was assessed separately for the impact that it may have on landscape character. However, DAFF proposes to farm both bivalves and finfish in Algoa Bay and therefore three combinations of precincts have been considered as alternatives in the Basic Assessment process. The impact significance of alternative options A-D were then assessed in Section 9.4.3.

9.4.1.1 Algoa 1

Algoa 1 is situated within view of the following receptors (Figure 30):

- Marine Drive and Beach Road
- Beach users
- Main hotels along Marine Drive
- Diving and yachting activities within the bay
- Cape Recife Nature Reserve

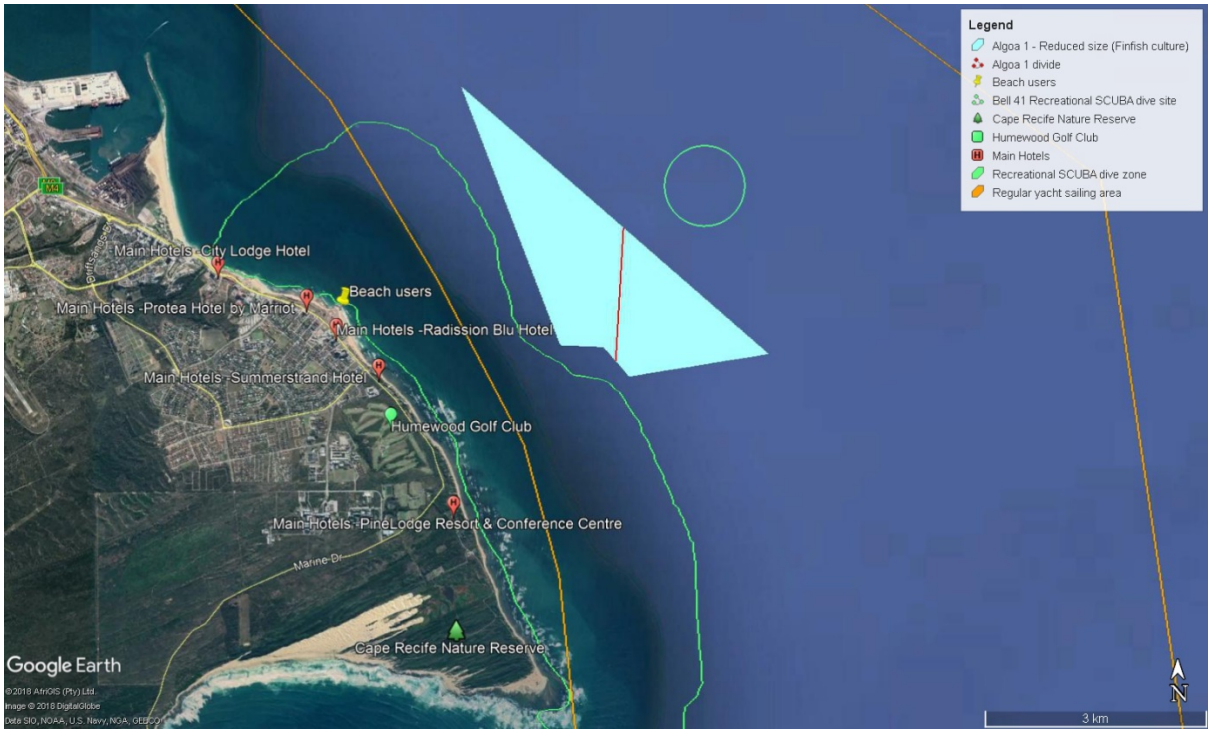

Figure 30 **Visual receptors for Algoa 1 site of the proposed sea-based Aquaculture Development Zone in Algoa Bay, Eastern Cape.**

Without the implementation of mitigation measures, Algoa 1 is expected to have a high visual impact on all receptors. VRM recommended in their VIA (Stead *et al.* 2013) that Algoa 1 could accommodate three finfish operators at 70 ha each, provided that they would be located within the southern or central portion of Algoa 1 (Figure 31) to reduce visibility. A 3 km buffer around the beach front and a 1 km buffer around the Bell Buoy was recommended (Figure 31) as the latter is a key point related to historic yachting regattas, power boat and swimming races related to the Port Elizabeth beach front tourism. The importance of this buoy for the regattas and races relates to proximity of the beach front spectators which is a key factor in event sponsorship. Stead (2013) further recommended that should expansion of the project be required, a public survey would need to be undertaken to assess the impacts based on the findings of the impacts of Phase 1 (3 x 70 ha cages).

With mitigation, Algoa 1 was found to have a visual impact significance of **moderate** and **very low** for finfish and bivalve farming respectively (Table 13).

Figure 31 **Recommended approximate location of 3 x 70 Ha (sea floor area) fin fish cages in Algoa 1 area with a three kilometre exclusion zone buffer from the beach front (blue circle) and a one kilometre buffer exclusion zone buffer around Bell Buoy (Bell SQ) indicated as a red circle (Source Stead *et al.* 2013).**

Table 13 **OP-VA1a –Negative impact on seascape character resulting from finfish and bivalve culture at Algoa 1. Note finfish and bivalve culture are assessed separately in this table. Impact significance after mitigation is shown in the last two rows.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Finfish	Local (1)	High (3)	Long-term (3)	High (7)	Definite	**HIGH**	-ve	Low
Bivalve	Local (1)	High (3)	Long-term (3)	High (7)	Definite	**HIGH**	-ve	Low
Essential mitigation measures: • A one kilometre exclusion buffer needs to be maintained around Bell SQ. • Locate the concession areas in the south or central areas (away from beach front areas) outside of the three km exclusion zone buffer around the beach front • If possible, arrange the concession areas in a triangular shape (as depicted in Figure 31 to break the effect of a long linear line • Use exclusively long-lines for bivalve culture (i.e. no rafts). • Use grey based hues for all project components (rafts, cages, barrels, buoys/flotation devices) visible above the surface of the water as far as possible. • Ensure project components are of a similar style and scale to promote visual cohesiveness. • Utilise the minimum number of safety / warning buoys as far as possible. Only demarcate the corner points of each precinct and the minimum interval distance along the precinct boundary to meet Ports Authority (Transnet) safety requirements. • Maintain all project infrastructure in good working order. • Lights at night should be safety dependent. • Once the first phase is operational, implement a public survey prior to expansion phase.								
Finfish	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Definite	**MEDIUM**	-ve	Low
Bivalve	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**	-ve	Low

9.4.1.2 Algoa 6

Algoa 6 is situated within the Port Elizabeth harbour within an industrial context. The only visual receptors for this site are the Settlers Highway, which hugs the coastline at the site. This road is, however, also situated landward of the railway and is not a known scenic route. The bivalve site will likely also be visible from central Port Elizabeth, although only within close range of the R 102. In most areas, the views are blocked by other residential houses and industrial buildings (Figure 32).

Figure 32 **Visual receptors for Algoa 6 precincts of the proposed sea-based Aquaculture Development Zone in Algoa Bay, Eastern Cape.**

While mussel rafts would be expected to have a similar visual impact when compared to finfish cages, longlines for oyster culture are simply comprised of straight lines in the water accentuated with buoys (see description and images in Section 3.2). Mitigation measures include various methods to ensure the blending of the structures into the background as much as possible. No buffers of restriction in size are recommended for Algoa 6. With mitigation measures, the impact of Algoa 6 on the landscape character is **very low**.

Table 14 OP-VA1b –Negative impact on seascape character resulting from bivalve culture at Algoa 6.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Definite	**LOW**	- ve	Medium
Essential mitigation measures: • Use grey based hues for all project components (rafts, cages, barrels, buoys/flotation devices) visible above the surface of the water as far as possible. • Ensure project components are of a similar style and scale to promote visual cohesiveness. • Utilise the minimum number of safety / warning buoys as far as possible. Only demarcate the corner points of each precinct and the minimum interval distance along the precinct boundary to meet Ports Authority (Transnet) safety requirements. • Maintain all project infrastructure in good working order								
With mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**	- ve	Medium

9.4.1.3 Algoa 7

Algoa 7 is situated approximately 3 km from the Port of Ngqura adjacent to the shipping channel leading into the harbour and immediately north of an anchorage area. Algoa 7 is situated within the main yachting route in Algoa Bay. Ecotourism and diving activities also take place in this area, although less frequent than compared to Algoa 1. Due to the remoteness of the site in terms of access by receptors, the intensity of the visual impact would be **low** without, and **very low** with mitigation.

Table 15 OP-VA1c –Negative impact on seascape character resulting from finfish culture at Algoa 7.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Definite	**LOW**	- ve	Medium
Essential mitigation measures: • Use grey based hues for all project components (cages, barrels, buoys/flotation devices) visible above the surface of the water as far as possible. • Ensure project components are of a similar style and scale to promote visual cohesiveness. • Utilise the minimum number of safety / warning buoys as far as possible. Only demarcate the corner points of each precinct and the minimum interval distance along the precinct boundary to meet Ports Authority (Transnet) safety requirements. • Maintain all project infrastructure in good working order								
With mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**	- ve	Medium

9.4.2 Cumulative impacts

Cumulative environmental effects can be defined as effects on the environment which are caused by the combined results of past, current and future activities. Algoa Bay is currently not an established sea-based large-scale marine culture site. Passing and anchored ships as well as squid fishing vessel lights by night are part of the current seascape at all precincts. Consequently the proposed activity would constitute the first *permanent* disturbance to the seascape vistas at Algoa 1 and the incremental cumulative impact would be considered high for the visual receptors at this precinct.

The only existing sea-based aquaculture ventures in Algoa Bay include the Two Oceans and Zwembesi oyster farms at Algoa 6 approximately 1 km from the shore within an area zoned for aquaculture. Additional aquaculture infrastructure, if realised for the entire precinct, would become a permanent landscape feature, which is likely to blend into the industrial character of the harbour environment. The cumulative impact would therefore be of low significance.

Although the infrastructure would constitute a new visual impact type on the seascape at Algoa 7, cumulatively, the proposed projects are likely to contribute little to the already existing harbour character of the seascape in the area.

9.4.3 Impact significance of alternative options

DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore three combinations of precincts have been considered as alternatives in the Basic Assessment process (Table 16). These three options allow for varying degrees of farming intensities by excluding finfish farming at Algoa 1 (Option B) or excluding Algoa 1 as a whole (Option C). After mitigation, Option A has the highest impact on the sea-scape character of Algoa Bay (medium impact at Algoa 1), followed by Option B and Option C (Table 16).

The Status Quo Alternative (or No-go option D) proposes that the Algoa Bay Marine Aquaculture development not go ahead. The seascape will remain the same at all precincts, which would be considered a positive outcome for the visual receptors at Algoa 1. In contrast, not much would be gained by pursuing the No-go option for the Algoa 6 and 7 precincts due to the low number of visual receptors and existing industrial and harbour seascape character. The 'No-go/Status Quo' alternative will limit the potential associated with the area as a whole for implementing sea-based aquaculture as there are only a limited number of areas along the South African coastal considered potentially suitable for this activity.

Table 16 **Comparison of the sum of impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone on the seascape character (negative impact after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the worst case scenario, i.e. finfish farming was considered.**

Impact significance after mitigation	A	B	C	No-go

Activities	Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish	Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish	Algoa 6: bivalves Algoa 7: finfish	No Go
High	X	X	X	X
Medium	1	X	X	X
Low	X	X	X	X
Very low	2	2	2	X
Insignificant	X	X	X	X

9.5 Socio-economic impacts

Social impacts can be defined as, "The consequences to human populations of any public or private actions (including policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society". These impacts manifest at various levels, including at the individual level, family or household level, community, organisation or societal level. Some social impacts are experienced as a physical reality, while other social impacts are perceptual or emotional (Vanclay 2003). The issue of social impacts is complicated by the way in which different people from different cultural, ethic, religious and educational backgrounds view the world. This is referred to as the "social construct of reality". The social construct of reality informs people's worldview and the way in which they react to changes (Barbour 2007).

A Social Impact Assessment is the process of analysing (predicting, evaluating and reflecting) and managing the intended and unintended consequences on the human environment of planned interventions (policies, programmes, plans and projects) and any social change processes invoked by those interventions so as to bring about a more sustainable and equitable biophysical and human environment (Vanclay, 2003).

The Terms of Reference for the study were to:

- Integrate, into the impact assessment, the findings of the socio-economic baseline study and specialist study conducted by Bloom (2012,2013) for the previous EIA process;
- Integrate, into the impact assessment, the findings of the comparative socio-economic feasibility study compiled by the Rhodes University in 2016 (Britz *et al.* 2016a/b and Britz and Sauer 2016) (Appendix D)
- Integrate literature, internet resources, previous studies and information provided by stakeholders relating to the socio-economic environment of the study area to update the existing impact socio-economic baseline and assessment where necessary;
- Assess the significance of the socio-economic impacts using the Anchor Environmental' s impact rating methodology;
- Identify mitigation measures for the reduction of the significance of negative impacts (and enhancement of benefits) and re-rate the impact significance assuming the effective implementation of mitigation measures.

In this context it must be noted, specifically with regards to social impacts, that:

- These impacts are not easily measured objectively and therefore often need to be inferred rather than measured. A combination of insight into social processes in general and knowledge of the community under study are important to draw valid inferences;
- Social impacts are often multifaceted and inter-connected and therefore not easily disaggregated into separate impacts;
- Communities are dynamic and in a continual process of change. The proposed ADZ in Algoa Bay is one factor contributing to such change, but it is often difficult to identify when an impact is attributable to the project or to other factors (or a combination thereof); and
- Human beings are naturally continuously adapting to changes in their environment, including project impacts. As such these impacts change in significance for those affected.

The socio-economic baseline study for the Algoa Bay area and the impact assessments for Algoa 1 (and 5) compiled by socio-economic specialist Professor Bloom during the previous EIA process (Bloom 2012 and 2013) constitute the backbone of the impact assessment process for the current application for environmental authorisation.

Following the suspension of the environmental authorisation in 2014 as a result of the 28 appeals submitted by stakeholders, DAFF commissioned Rhodes University to conduct a comparative feasibility study for Algoa 1 and 5, which was informed by a survey of public perception of the social trade-offs associated with the ADZ and input by economic and aquaculture industry specialist. Aquaculture industry specialists, Messrs Willem Schoonbee and Gavin Johnson, provided a perspective on the economic viability of a cage aquaculture operation in Algoa Bay based on industry benchmarks. This included a market perspective, operational considerations, cost estimates, revenue, employment and a high level financial model. The standalone reports produced by the Rhodes University are included in Appendix D of this BAR.

Any additional information that arose from the comparative review studies compiled by Britz *et al.* in 2016 is also considered in this current impact assessment for Algoa 1.

It is assumed that I&APs concerns and objections to Algoa 1 have not changed since the survey of public perception of the social trade-offs associated with the ADZ was conducted in 2016 (Britz *et al.* 2016). Algoa 7 (the new site) is expected to have very similar socio-economic impacts when compared to Algoa 5 (screened out and not considered in this assessment) due to the fact that it is also situated within the recently approved boundaries of the Addo Marine Protected Area (MPA). The inshore bivalve culture site, Algoa 6, is located within an industrial setting of Port Elizabeth and stakeholders indicated during the previous impact assessment process that the inshore site would be preferred due to limited user conflict (Bloom 2013). Algoa 6 was excluded from the previous application process as it is not suitable for finfish farming, however, this site is suitable for bivalve culture and is therefore considered for this application for environmental authorisation. Considering the perceptions summarised above and the proximity of Algoa 7 to Algoa 5 (screened out), a specialist study was not considered for the impact assessment conducted for Algoa 6 and 7 in this BA process.

The socio-economic baseline study and specialist impact assessment conducted as part of the previous EIA in 2012 and 2013 respectively (Bloom 2012 and 2013), identified the following impacts

that could occur as a result of the proposed ADZ (note that the list has been adapted in the present impact assessment):

- User conflict relate to several impacts as stated below:
    - Specialist tourism and eco-tourism activities (e.g. shark cage diving, whale watching, recreation fishing)
    - Recently approved Addo MPA - where fish farming causes damage to other marine life in proximity to the farm:
        - pollution
        - alien invasive species
    - Port Traffic Zones – ships entering the bay, holding before proceeding to port, and movement between Port Elizabeth and Coega ports
    - Fishing grounds and vessel navigation routes in Algoa Bay
    - Existing marine aquaculture activities (pilot plant)
- Potential impact on existing fish industries that operate in the area (i.e. squid fisheries/recreational/commercial fisheries)
- Impact on infrastructure (land-based infrastructure (harbours/fishing factories/road infrastructure)
- Impact of limited available skilled labour for finfish cage culture;
- Impact on direct and indirect employment during the establishment and operational phases
- Impact on coastal real estate due to aesthetic nature of views and sense of place (assessed separately)
- Ability of local businesses to supply goods and services including fish processing, nets and maintenance, transportation, packaging, containers, diving services, machinery and equipment
- Seasonality in traditional fishing sector vs all year round source of income and employment in an area that has a small agriculture and fishing sector and few alternatives to seasonal fishing and agriculture
- Accessibility to and opportunities for development of an export market for marine aquaculture product.

No additional impacts have been identified during the current BA process. Relevant sections of the baseline and impact assessment report of 2012/2013 have been integrated into this impact assessment and have been updated where required.

9.5.1 Assessment of impacts: construction phase

Two potential socio-economic impacts were identified during the construction phase:

- CP-SE1:Investment in the local, regional and national economy; and
- CP-SE2: Increased employment, income and skills development.

The impacts are considered to be the same for Algoa 1, 6 and 7 and the precincts have therefore not been assessed separately.

9.5.1.1 Potential impact CP-SE1: Investment in the local, regional and national economy

Farms will be commissioned over time, in response to market demand and available funding and as such, investment is likely to occur in stages. The impact assessment for the construction phase assumes that the ADZ precincts will be developed to their full capacity. The total capital investment required for a 3000 t per annum commercial scale cob or yellow-tail farm is estimated at R38.5 million (Britz *et al.* 2016). Note that investment cost is applicable to *one farm* and may differ if calculated for other species. Model results indicate that all recommended carrying capacity tonnages for Algoa 1 and 7 for both species under consideration (yellowtail *Seriola lalandi* and meagre *Argyrosomus regius*) exceed the required 3 000 t per annum (Wright *et al.* 2019).

The capital investment for the facility during the construction phase is unknown but is thought to be close to the total capital investment value due to the fact that construction is not very labour intensive and that most of the investment will lie with the purchase of the equipment. The total capital investment for a single 500 t per annum mussel project or a 200 t per annum oyster longline production facility is estimated at R22 and R20 million respectively.

The total maximum amount of bivalve that is projected to be farmed in Saldanha Bay ADZ per hectare per annum is 8.13 t (SRK Consulting 2017). Due to lower productivity on the east coast when compared to the west coast, this may represent an overestimate of the maximum that can be produced in a less productive marine environment such as Algoa Bay. The Feasibility Study for Oyster and Mussel Aquaculture in South Africa (DAFF 2017) indicated that lower growth rates were observed in Pacific oyster nurseries in Algoa Bay when compared to Saldanha Bay due to less reliable supply of phytoplankton available in the water column. Although unlikely, Algoa 6 could produce a maximum of 4000 t per annum on 495 ha.

The extent of the economic investment is deemed national, as materials and expertise required during construction are likely to be sourced from outside the Eastern Cape. Specialised equipment is likely to be sourced from abroad, which would dilute the benefit accruing locally. The significance of this benefit has been rated as **low** without and with the implementation of benefit-enhancing measures.

Table 17 CP-SE1 – Investment in the local, regional and national economy for Algoa Bay. All precincts have a similar impact and have been assessed together.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	National (3)	Low (1)	Medium (2)	Medium (6)	Possible	**LOW**	+ ve	Medium
Benefit-enhancing measures: • Procure goods and services from local, provincial or South African suppliers as far as possible, giving preference to Black Economic Empowerment (BEE) suppliers. • Procure ancillary services for goods and services purchased overseas from South African companies as far as possible (e.g. installation, customisation and maintenance).								
With mitigation	National (3)	Low (1)	Medium (2)	Medium (6)	Possible	**LOW**	+ ve	Medium

Cumulative Impact

The investment into the local, regional and national economy will cumulatively contribute toward the economic success of the aquaculture sector.

9.5.1.2 Potential impact CP-SE2: Increased employment, income and skills development

The development of fish farms will contribute towards the creation of direct and indirect employment opportunities for people with different types and levels of skills.

The number of direct employment opportunities created during the construction phase is unknown. Direct employment is expected to be relatively small, as the installation of mariculture structures is quick and simple. While construction employment will be temporary, workers have the opportunity to improve their economic prospects in the longer term if they take full advantage of the income, experience and skills transferred to them through the project. Aquaculture farms will be commissioned sequentially and construction will therefore occur over the medium term.

The ADZ development will also create or sustain indirect employment at suppliers of materials and other services. It is not possible to quantify indirect employment and income that will be generated by the project during the construction phase, but it is likely to be relatively limited. The extent of the benefit is deemed local, as the majority of construction workers and skills are likely to be procured within the local community. Note that when assessing this impact, the scoring of the extent is reversed, as it is more favourable to employ people locally given the high unemployment levels in this region. The intensity of the benefit is considered low, as the number of jobs created is relatively low, extending over the medium term.

The benefit is assessed to be of **very low** (positive) significance without and **low** with the implementation of mitigation (Table 18).

Table 18 **CP-SE2 – Increased employment, income and skills development. All precincts have the same impact and have been assessed together. Note that when assessing this impact, the scoring of the extent is reversed, as it is more favourable to employ people locally given the high unemployment levels in this region.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Low (1)	Medium-term (2)	Low (5)	Possible	**VERY LOW**	+ ve	Low
Benefit enhancing measures: • Use local and regional labour (Nelson Mandela Bay Municipality, Sarah Baartman District Municipality). • Preferentially employ previously disadvantaged individuals.								
With mitigation	Local (3)	Low (1)	Medium-term (2)	Medium (6)	Possible	**LOW**	+ ve	High

Cumulative impact

The proposed ADZ will contribute positively and cumulatively to the job market. During the construction phase contributions are likely to be insignificant though.

9.5.2 Assessment of impacts: operation phase

A number of potential impacts were identified during the operation phase and are listed below.

- Investment in the local, regional and national economy;
- Impact on direct and indirect employment during the establishment and operational phases
- Specialist tourism and eco-tourism activities (e.g. shark cage diving, whale watching, recreation fishing);
- Recently approved Addo MPA - where fish farming causes damage to other marine life in proximity to the farm:
    - pollution
    - alien invasive species;
- Collision of vessels with aquaculture farms (Vessel navigation routes, anchorage areas and general boat traffic);
- Existing land-based and sea-based marine aquaculture activities;
- Potential impact on existing fish industries that operate in the area (i.e. squid fisheries/recreational/commercial fisheries);
- Impact on infrastructure (land-based infrastructure (harbours/fishing factories/road infrastructure);
- Impact on coastal real estate due to aesthetic nature of views and sense of place;
- Local community development;
- Provision of goods and services by local businesses (leakages); and
- Small business, individual and informal sector development.

Note that user conflict impact concerned with the recently approved Addo MPA is covered in detail in the marine specialist study and is not repeated here. This user conflict is concerned with the potential impact that finfish farming could have on the ecological health of the MPA by means of pollution and the introduction of alien invasive species.

The general perception is that aquaculture offers strategic entry points for short and long-term investment opportunities to contribute to food security (Tidwell and Allan 2001, DAFF 2017). It is argued that aquaculture (including marine finfish culture) could positively contribute to addressing the increasing demand for fish products, with major increases in fish food production being forecasted to come from aquaculture. Mariculture holds more potential for sustained growth in the face of declining fishing catches worldwide.

In their review of the socio-economic specialist study of the previous EIA process, Britz *et al.* (2016) found limited support for the aquaculture projects claim to improve food security. The principle food for piscivorous finfish is pellets made from wild fish. It seems that a greater mass of wild fish have to be harvested than can be delivered as finfish product. The finfish farming projects do not offer a substitute to wild fish harvesting if the latter is required as a production input for the former. The project is more accurately described as one to convert low (market) value wild fish into high (market) value finfish. There is economic merit in such production, but it cannot be claimed as a sustainable alternative to wild fish harvesting, if wild fish are a necessary production input. Fish with lower feed conversion ratios or could potentially improve the impact.

Bivalve culture may be more pertinent in contributing to food security due to low food input requirements of these species and proven viability of current farms and projected economic feasibility in South Africa (Advance Africa Management Services 2017). However, it must be noted that much of the cultured bivalve is exported to other countries, which makes the industry viable and therefore constitutes a limited source of protein to South African previously disadvantaged communities.

Indirectly, however, additional finfish farms will contribute to the establishment and growth of the South African aquaculture industry, which in turn will provide employment opportunities and therefore constitute a potential income for poor communities. We argue that in South Africa, there is no evidence that supports the general perception that aquaculture can directly contribute to improving food security in the country at this point in time. This impact was therefore not assessed here.

9.5.2.1 Potential impact OP-SE1: Investment in the local, regional and national economy

Farms will be commissioned over time, in response to market demand and available funding and investment is likely to occur in stages. The impact assessment for the operation phase assumes that the ADZ precincts will be developed to their full capacity. The total capital investment required for a 3000 t per annum commercial scale cob or yellow-tail farm is estimated at R154.5 million (Britz *et al.* 2016). Note that investment cost is applicable to *one farm* and may differ if calculated for other species. Model results indicate that all recommended carrying capacity tonnages for Algoa 1, 5 and 7 for both species under consideration (yellowtail *Seriola lalandi* and meagre *Argyrosomus regius*)

exceed the required 3 000 t per annum, with total projected biomass production of between 3 252 t *S. lalandi* per farm and 14 734 t *A. regius* per farm.

The total capital investment for a single 500 t per annum mussel project or a 200 t per annum oyster longline production facility is estimated at R22 and R20 million respectively. The capital investment includes infrastructure and requirements for land-based facilities (Advance Africa Management Services 2017[3]).

Project and private expenditure is likely to take place in the region and the extent of the benefit is therefore considered regional. The intensity of the benefit is considered medium, as revenue is likely to be volatile, over the long-term. The probability of the benefit occurring was rated as 'possible' due to the fact that this benefit will only be realised if the farms prove to be viable and are expanded to full capacity. The benefit is assessed to be of **medium** significance without and with the implementation of mitigation (Table 19).

The confidence was rated as high as these numbers are based on feasibility studies conducted by specialists and modelling of potential carrying capacity of Algoa 1, 5 and 7 (Advance Africa Management Services 2017, Britz *et al.* 2016, Wright *et al.*2019).

Table 19 OP-SE1 – Investment in the local, regional and national economy. All precincts have a similar impact and have been assessed together.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Medium (2)	Long-term (3)	High (7)	Possible	**MEDIUM**	+ ve	High
Benefit enhancing measures: • Use local and regional labour (Nelson Mandela Bay Municipality, Sarah Baartman District Municipality). • Preferentially employ previously disadvantaged individuals.								
With mitigation	Regional (2)	Medium (2)	Long-term (3)	High (7)	Possible	**MEDIUM**	+ ve	High

Cumulative Impact

The investment into the local, regional and national economy will cumulatively contribute toward the economic success of the aquaculture sector.

[3] Advance Africa Management Services conducted a Feasibility Study of Oyster and Mussels Aquaculture in South Africa on behalf of DAFF. The study was published in June 2017.

9.5.2.2 Potential impact OP-SE2: Increased employment, income and skills development

The fishing quota system has been blamed for many direct and indirect job losses throughout the fishing industry, including the NMB area. Management interventions to optimize the potential social and economic benefits of marine resources continue to be constrained, primarily by institutional capacity (Kleinschmidt *et al.* 2010). The reduced fishing quotas along most of the South African coastline together with the declining fish supply have resulted in a high level of unemployment among Algoa Bay residents with experience in the fishing industries. The seasonality of the traditional fishing sector creates many problems, as there is often no alternative employment for those without any other skills. This could also be addressed through aquaculture projects as the different links in the value chain could provide source of income and employment all year round in an area with a small agriculture and fishing sector and few alternatives. Mariculture typically requires a high degree of input in terms of local manpower and ancillary services, which could provide greater job security for the local community, especially where other opportunities and entrepreneurial enterprise are limited. International trends indicated an average employment multiplier of at least 1.1 jobs linked to every fishing job (Burbridge *et al.* 2001). Although most of the actual fishing activities are done by men, women play a significant role in the fish processing (59% of all jobs), resulting in approximately 31% of all jobs in mariculture. The expansion of mariculture in areas where there are few alternatives for job creation can make a significant contribution towards job creation and improving the quality of people's live. This is of particular importance if the new opportunities are available close to traditional fishing ports where unemployment among former fishermen prevails. There are a number of people residing in the Algoa Bay area that are (semi)skilled in the fishing industry that could be employed by the fish farms and associated activities.

Direct employment in the production component of an offshore finfish farm in Algoa Bay is expected to roughly 50 employees for a 1000t/annum pilot scale operation (1 employee per 20 ton) and 80 employees for a 3000t/annum commercial unit (1 employee per 37.5 tons) (Britz *et al.* 2016). Further employment opportunities could present themselves in services and value adding, with the most significant the increase in processing workers within Fish Processing Establishments to absorb the extra fish production for the region. The actual number of employment opportunities is difficult to estimate as the existing industries in the region will most likely be able to meet the demand for services in an initial marine aquaculture development phase. Service industries will scale with the development of the sector and success from the first commercial operator will signal whether the industry has a viable future. Services could include boat maintenance, net manufacturing and repairs and commercial diving. Initially however, most services required for a pilot scale operation could be supplied by existing businesses. A figure of one direct on farm employee to one service sector employee has been suggested as an approximation of indirect jobs (Britz 2014). Thus 100 total jobs for a 1000 t production unit and 160 for a 3000 t unit are projected. Based on these estimates and on numerical modelling results approximately 3000 – 4000 t of finfish can be produced per site per year. This means that finfish farming (if fully developed at Algoa 1) would create approximately 320 job opportunities.

The Feasibility Study of Oyster and Mussels Aquaculture (Advance Africa Management Services 2017) estimated that an oyster and mussel facility would employ approximately 34 and 40 people during the operational phase (this number includes processing of the product). If the same ratio of

direct to indirect jobs is applied, oyster and mussel farming should generate approximately 68 and 80 employment opportunities per farm. If the production estimates for Saldanha Bay (See CP-SE 1) are applicable in Algoa Bay, Algoa 6 could potentially accommodate 5 farms of each bivalve type and therefore create approximately 740 direct and indirect job opportunities at full capacity.

The probability of the benefit occurring was rated as 'possible' due to the fact that this benefit will only be realised if the farms prove to be viable and are expanded to full capacity. The confidence was rated as high as these numbers are based on feasibility studies conducted by specialists (Advance Africa Management Services 2017, Britz *et al.* 2016). The positive impact of employment as a result of the proposed aquaculture development was rated as **medium** without and **high** with benefit enhancing measures (Table 20).

Table 20 **OP-SE2 – Increased employment, income and skills development for Algoa Bay. All precincts have the same impact and have been assessed together. Note that when assessing this impact, the scoring of the extent is reversed, as it is more favourable to employ people locally given the high unemployment levels in this region.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Low (1)	Long-term (3)	Medium (6)	Possible	**LOW**	+ ve	High
Benefit enhancing measures: • Use local and regional labour (Nelson Mandela Bay Municipality, Sarah Baartman District Municipality). • Preferentially employ previously disadvantaged individuals. • Where non-local specialist staff is required, implement a training programme to up skill local labour to assume these positions over a period of five years.								
With mitigation	Local (3)	Low (1)	Long-term (3)	High (7)	Probable	**HIGH**	+ ve	High

Cumulative impacts

The proposed ADZ will contribute positively and significantly to cumulative efforts to create employment opportunities, provided that other sectors do not experience significant job losses and the proposed ADZ creates a net gain of job opportunities.

9.5.2.3 Potential impact OP-SE3: Specialist tourism and recreational businesses

The proposed ADZ may have a negative impact on beach and offshore tourism and recreational activities in the Algoa Bay area.

Algoa Bay is home to a number of beaches that are located southeast of the Port Elizabeth harbour. The popular Hobie Beach in the vicinity of Shark Rock Pier and the Boardwalk, is a favourite for swimming, sunbathing and body surfing, and the venue for the annual "Splash Festival", beach volleyball and world boardsailing championships. Pollock Beach is favoured by surfers because of its excellent waves and surfing opportunities, whilst Humewood Beach is ideal for families. Summerstrand and Kings Beach are located a bit further away from the harbour in probably the most popular tourism area.

Island, Sea & Sundowner Cruises enable one to see Cape fur seals, numerous sea birds, surrounding shipwrecks and sometimes even pods of whales and dolphins. The St Croix Island Marine Reserve is home to one of the larger breeding colonies of endangered African Penguins in South Africa, Cape fur seals and whales (http://www.nmbt.co.za). Port Elizabeth also offers various adventure and sport activities, including national and international sporting events. Labelled as the "Water sport Capital" of Africa, PE offers surf lifesaving, rubber ducking, jet-skiing, canoeing, surfing, paragliding and power-boating events on a regular basis.

A mixed-use waterfront development has been proposed for the south side of the harbour and Kings Beach Precinct, with the proposed plan including freight handling, residential and tourist facilities, and commercial operations geared at increasing the economic development and financial sustainability capacity of Nelson Mandela Bay.

All of these activities could be impacted by Algoa 1, as the finfish cages will have a visual impact and affect the movement of private and pleasure boats in the harbour. The Visual Impact Assessment indicated that floating structures and maintenance vessels, as well as lights at night, would have a high visibility during both the construction and operation phases. For Algoa 1, the receptors include Marine Drive, beach users, the main hotels along Marine Drive as well as diving and yachting activities. Sea-scape based tourism is a key focus of the Marine Drive area, where Algoa 1 would be clearly visible in the middle-ground area from the tourist receptors along the beach front and hotels. In fact, the viewshed of the Mariculture project could extend without restriction to approximately 11 km from the site. Visibility of the project will extend several square kilometres and is defined as **high** (VRM Africa 2013).

Interested and affected parties expressed concern that the fish farms can lure sharks to the area, which will have a negative impact on the swimmers and surfers visiting the bay area (John Allen and Lloyd Edwards). Stakeholders also proposed that any area in which more than 15% activity of any documented recreational activity is undertaken, should be excluded from consideration (Anchor Environmental, 2011). A number of SCUBA divers expressed their disapproval of the proposed fish farms in Comments on the Draft Environmental Impact Report (DEIR), in particular due to the potential damage to reefs that are currently attracting diving tourists. It was generally felt that it is unwise to take a resource from recreational users of South Africa's third largest coastal city and give it to another user, i.e. mariculturists.

The Algoa 7 precinct is located further away from the popular Port Elizabeth beaches, although it lies on the edge of the recently approved Addo Elephant Park MPA (note that the Department of Environmental Affairs has indicated that if Environmental Authorisation was granted for Algoa 7 the area could be excised from the MPA upon declaration). This raises concerns regarding its potential impact on conservation and ecotourism activities linked to the MPA. It can also have an impact on whale watching close to Bird Island and discourage people enjoying some of the other recreational activities, such as diving and water skiing. The impact on whale and dolphin watching was also a particular concern in Mossel Bay where a mariculture project encompassing 36 finfish cages was proposed by Irvin & Johnson. The main receptors for Algoa 7 are diving and yachting activities within the bay.

The potentially negative impact on specialist tourism and recreational businesses by the proposed development must be weighed against the benefit of creating new jobs and opportunity to develop skills in the mariculture sector.

The Bloom (2013) assessment and the objections submitted by stakeholders to the proposed ADZ approval in Algoa Bay identified many possible external costs that should have been incorporated with the feasibility analysis conducted by Britz *et al.* 2016. However, within the timeframe and budget provided for the previous EIA (Bloom 2012, 2013), comparative feasibility study (Britz *et al.* 2016) and current BA process, such costing is not feasible, and given the speculative estimates of the revenue production costs, precision in the calculation of external costs is not warranted.

The impact assessment was therefore completed based on qualitative data, i.e. the perceptions expressed during the previous EIA process and the results of the social choice modelling experiment conducted by Britz *et al.* (2016) (Table 21). The rating confidence is therefore **medium**.

The degree of negative economic impact differs according to the precinct as well as the type of activity (i.e. finfish vs bivalve) and have therefore been assessed separately (Table 21 and Table 22). Mitigation measures for this impact include those listed in the visual impact assessment (including site reduction), as well as a detailed socio-economic monitoring study and impact assessment. The mariculture operations should only be scaled up if socio-economic impacts are considered acceptable. Negative economic impacts on specialist tourism and recreational businesses are generally greater for finfish culture and at Algoa 1 precinct and were rated as **medium** and **low** after mitigation for finfish and bivalve culture respectively. In comparison bivalve culture at Algoa 6 is likely to have a **very low** negative impact after mitigation measures are implemented. The impact of finfish culture at Algoa 7 is likely to have a low intensity and therefore is likely to constitute a **very low** impact after mitigation measures are implemented.

Table 21 **CP-SE3 – Negative economic impact on specialist tourism and recreational businesses (i.e. loss of jobs and income) without and with mitigation measures for *finfish* culture at Algoa Bay Aquaculture Development Zone precincts 1 and 7.**

Site	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1	Local (1)	High (3)	Long-term (3)	High (7)	Definite	HIGH	- ve	Medium
Algoa 7		Medium (2)		Medium (6)	Probable	MEDIUM		
Essential mitigation measures: 1. Implement mitigation measures recommended in the visual impact assessment. 2. Careful monitoring of socio-economic impacts (and marine ecology impacts that could have knock on effect on the socio-economic environment), only scale up if socio-economic impacts are acceptable.								
Algoa 1	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Definite	MEDIUM	- ve	Medium
Algoa 7		Low (1)		Low (5)	Probable	LOW		

Table 22 **CP-SE3 – Negative economic impact on specialist tourism and recreational businesses (i.e. loss of jobs and income) without and with mitigation measures for *bivalve* culture at Algoa Bay Aquaculture Development Zone precincts 1 and 6.**

Site	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Definite	MEDIUM	- ve	Medium
Algoa 6		Low (1)		Low (5)	Improbable	VERY LOW		
Essential mitigation measures: 1. Implement mitigation measures recommended in the visual impact assessment. 2. Careful monitoring of socio-economic impacts (and marine ecology impacts that could have knock on effect on the socio-economic environment), only scale up if socio-economic impacts are acceptable.								
Algoa 1	Local (1)	Low (1)	Long-term (3)	Low (5)	Definite	LOW	- ve	Medium
Algoa 6		Low (1)		Low (5)	Improbable	VERY LOW		

Cumulative impacts

Specialist tourism and recreational activities are reliant on conservation of the natural environment and generally safe water quality conditions for users of the coastal and marine waters. Port Elizabeth and Ngqura harbour are major industrial nodes, which are reliant on the ocean to assimilate stormwater and effluent produced on land (e.g. COEGA SEZ). Humewood beach is South Africa's oldest blue flag beach and with the recent approval of the Addo MPA, Algoa Bay now balances conservation and environmental protection with economic growth fairly well. It can therefore be concluded that cumulatively, the proposed ADZ will not impact significantly on specialist tourism and recreational activities.

Potential impact OP-SE3a: Impact on recreational water sport participants

Algoa 1 and 7 are situated offshore from popular swimming beaches and surf spots. There has been concern expressed by I&APs that fish farm development at Algoa 1 and 7 could affect/pose a risk to recreational water sport participants and bathers. Water sports people and bathers are at risk of being bitten by a shark anywhere along South Africa's coastline (the probability of a shark bite incident increases with both the density of sharks and the density of water users, and the probability of an incident occurring in a popular water sports area such as Port Elizabeth is relatively higher than in remote areas with few water users). It is probable that marine predators, such as sharks, will be attracted to finfish cages that may appear to be a source of food.

The possible impact of finfish culture on non-motorised recreational water sport participants was rated as **low** and **very low** at Algoa 1 and 7 respectively. Although there are some SCUBA diving sites nearby Algoa 7, the intensity for encounters with large piscivores is considered low. The impact for these two precincts was therefore rated collectively as **very low** (Table 23). Recommended mitigation measures are focused on monitoring with the goal to reduce interactions of humans with large piscivorous mammals and fish. Consequently, the intensity is unlikely to be reduced as a result of the mitigation measures proposed and the impact rating remains the same with mitigation measures in place. The confidence in the significance rating is low due to the fact that changes in large shark distribution patterns in response to the presence of finfish farms is unknown.

Bivalve culture, however, is much less likely to attract sharks when compared to finfish cages and the impact significance was therefore rated lower for Algoa 6 and bivalve culture at Algoa 1 (Table 24). Algoa 6 is situated inshore in an area that does not have attractive beaches and available information suggests that non-motorised recreational activities are unlikely to occur here.

A number of surfers submitted comment during the previous EIA process, expressing concern about the possibility that mariculture structures at Algoa 1 could attenuate wave formation offshore and change wave conditions at popular surf spots. This impact is considered to be the same for bivalve and finfish culture. In the absence of modelling results the impact rating had low confidence.

Table 23 **CP-SE3a – Assessment of negative impacts on water sport recreational activities without and with mitigation measures for *finfish* culture at Algoa Bay Aquaculture Development Zone precincts 1 and 7.**

Site	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1 & 7	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**	- ve	Low
Essential mitigation measures: • Keep a log of all cetaceans recorded in the vicinity of fish farms including behavioural observations • Establish a cetacean monitoring programme in order to detect potential changes in cetacean habitat use in the broader Algoa Bay to try reduce interaction of people with large marine piscivores. • Monitor large shark movement patterns before and after ADZ development as per recommended EMPr monitoring components.								
Algoa 1 & 7	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**	- ve	Low

Table 24 **CP-SE3a – Assessment of negative impacts on water sport recreational activities without and with mitigation measures for *bivalve* culture at Algoa Bay Aquaculture Development Zone precincts 1 and 6.**

Site	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1 & 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**	- ve	Low
Essential mitigation measures: • Keep a log of all cetaceans recorded in the vicinity of fish farms including behavioural observations • Establish a cetacean monitoring programme in order to detect potential changes in cetacean habitat use in the broader Algoa Bay to try reduce interaction of people with large marine piscivores. • Monitor large shark movement patterns before and after ADZ development as per recommended EMPr monitoring components.								
Algoa 1 & 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Improbable	**VERY LOW**	- ve	Low

Potential impact OP-SE3b: Impact on recreational SCUBA diving activities

Recreational scuba diving is a popular activity within Algoa Bay and at least four dive shops located within Port Elizabeth supply training and equipment. None of these diving sites overlap with any of the proposed precincts (one of the site selection criteria in the Strategic Environmental Assessment excluded known reef areas), and as such loss of access to any of these dive precincts by recreational scuba divers will not occur. Five of these precincts are however, 500-1000 m from the border of Algoa 1.

Model results indicate that both Algoa 1 and Algoa 7 have acceptable dispersion potential and water quality standards are predicted to be met within the ADZ boundaries (Wright *et al* 2019). Nutrient loading is likely to be significantly lower for bivalve farms as bivalves produce less waste (solid and nutrients) when compared to finfish. However, the intensity of the impact is more strongly determined by the proximity of diving sites and was found not to change the overall impact rating. Table 25 is therefore applicable to finfish and bivalve culture, but has been separated by precinct.

The presence of elevated nutrients/suspended solids is usually attributed to a reduction in the clarity of water, i.e. light penetration or visibility. Suspended solids usually remain in suspension in the water column since their density is similar to that of seawater and turbulence in the water column. Under calmer conditions, solids may settle out from the water column and be deposited onto the substratum. Increased nutrients within the water column, which can stimulate phytoplankton growth, can also result in lowered light penetration due to the presence of loom.

Algoa 1 lies just offshore from very popular diving sites and the impact was therefore rated higher when compared to Algoa 6 and 7, which are considered to have a **very low** impact even without mitigation measures (Table 25). Overall the impact on SCUBA diving was rated to be **very low** with mitigation measures for all precincts (Table 25).

Table 25 **CP-SE3b – Assessment of negative impacts on SCUBA diving activities without and with mitigation measures for Algoa Bay Aquaculture Development Zone precincts 1, 6 and 7.**

Site	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**	- ve	Medium
Algoa 7		Low (1)		Low (5)	Possible	**VERY LOW**		
Algoa 6		Low (1)		Low (5)	Improbable	**VERY LOW**		
Essential mitigation measures: • Implement mitigation measures recommended in the marine specialist study for reducing organic and chemical pollution. • Implement recommended benthic monitoring and adaptive management EMPr monitoring components								
Algoa 1	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**	- ve	Medium
Algoa 7		Low (1)		Low (5)	Possible	**VERY LOW**		
Algoa 6		Low (1)		Low (5)	Improbable	**VERY LOW**		

9.5.2.4 Potential impact OP-SE4: Collision of vessels with aquaculture farms (Vessel navigation routes, anchorage areas and general boat traffic)

The main concern of an aquaculture site situated within navigation routes of any type of vessel is collision of the vessel with the aquaculture farm, thereby damaging both the vessel and the aquaculture farm. Distance from port infrastructure to the centre of the site is a key determinant of the economic feasibility of cage aquaculture. This requirement inherently increases the risk of aquaculture precincts hindering vessel traffic.

Furthermore, collision of vessels with the aquaculture farm could occur where the aquaculture farm is situated adjacent to an anchorage area (Algoa 6 and 7). Port traffic and anchorage areas must therefore be avoided and represent a fatal flaw if the site overlaps with a shipping lane or anchorage area. For this reason, Algoa 2, 3 and 4 were excluded from the previous impact assessment process due to their position in major shipping channels. Algoa 1 is situated 4 km from the Port Elizabeth harbour and is not within proximity of any anchorage area. Algoa 1 has therefore not been assessed for with respect to drifting of anchored ships into the site (Impact OP-SE4a). DAFF engaged with the TNPA early on in the Algoa 7 site selection process and confirmed that Algoa 7 is indeed situated outside of anchorage areas and does not overlap with shipping channels leading to Ngqura harbour. Due to the fact that overlap of a site with an anchorage area or shipping lane constitutes a fatal flaw, site selection was not considered as a mitigation measure in this impact assessment. Algoa 6 is situated inshore and does not overlap with shipping lanes of either of the ports, however, this site lies adjacent to an anchorage area of the Port Elizabeth harbour.

Potential impact OP-SE4a: Risk of collision between vessels and aquaculture farms as a result of drifting ships from the anchorage area

Finfish and bivalve culture pose the same collision risks and have therefore not been assessed separately. Algoa 6 is situated downwind from the existing anchorage area (to the east) and therefore constitutes a risk with regards to collision between the farms and drifting ships. A 100 m buffer zone between Algoa 6 and the anchorage area has already been considered and does not constitute a mitigation measure in this respect. Easterly winds occur strongest and most frequently during the summer months (Windfinder 2018) but on average do not exceed 10 knots (Figure 33). The risk of anchored ships drifting into Algoa 6 is therefore considered **low** without and **very low** with mitigation measures (Table 26).

On average, Port Elizabeth experiences strongest winds from the west-south-west (20 knots) (Figure 33), which reach greatest speeds and occurrence during winter (Windfinder 2018). Furthermore, the existing buffer zone between Algoa 7 and the anchorage area to the south is only 60 m. Consequently, Algoa 7 constitutes a greater risk when compared to Algoa 6 and the risk has been rated as **high** without and as **low** with mitigation measures (Table 26).

An additional buffer zone within the boundary of the proposed site would decrease the size of the potential aquaculture area and as such would not be ideal for the project. It would be more favourable if an appropriate buffer area could be determined by the TNPA and implemented within the boundaries of the existing anchorage areas.

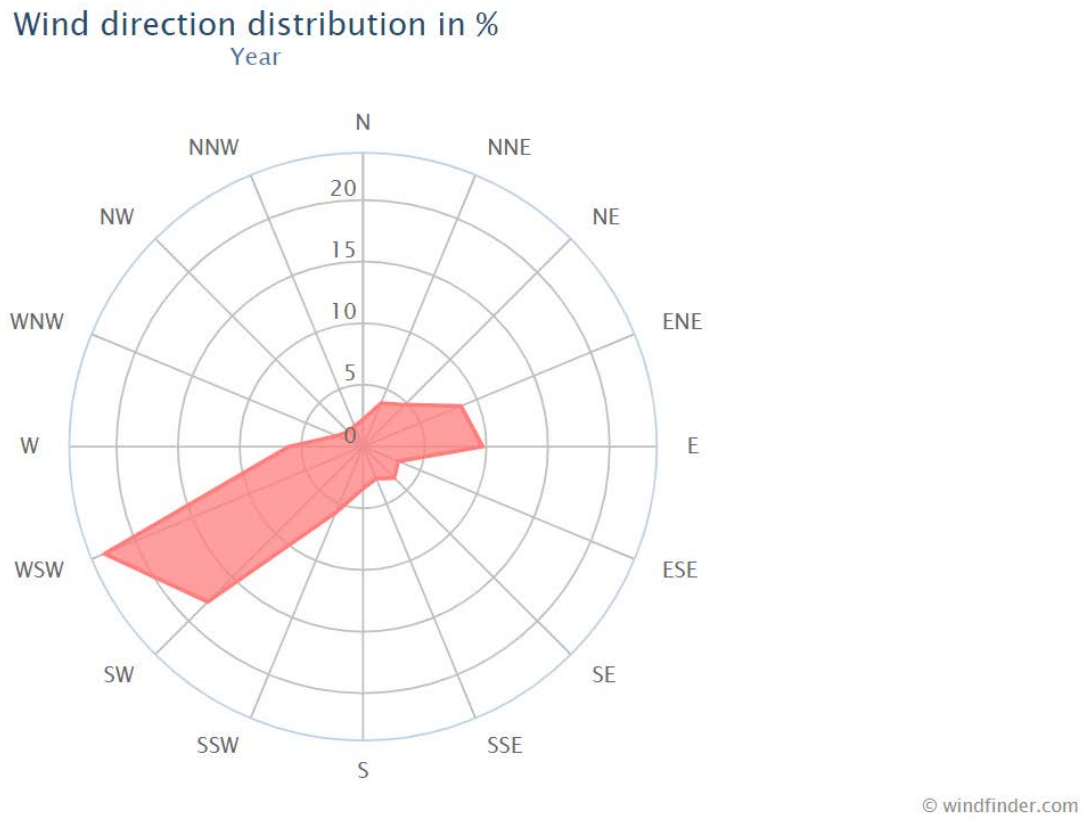

Figure 33 **On average, Port Elizabeth experiences strongest winds from the west-south-west (on average 20 knots) and weaker wind from the east generally less than 10 knots (Source: Windfinder.com).**

Table 26 **OP-SE4a – Risk of collision between vessels and aquaculture farms as a result of drifting ships from the anchorage area. Impacts were assessed without and with mitigation measures. Drifting is dependent on wind direction and strength and the risk for Algoa 6 and 7 has therefore been assessed separately.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 6	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**	- ve	High
Algoa 7	Local (1)	High (3)	Long-term (3)	High (7)	Probable	**HIGH**		
Mitigation measures: • Consider additional buffer zone on the northern boundary of the anchorage area adjacent to the site. • Clearly identified beacons and shipping channels must be identified in relation to the ADZ to assist vessels to navigate safely through the area. • Install navigational markers and lights as required by SAMSA regulations. • Include position of ADZ on navigational charts. • Ongoing consultation with user groups to keep them informed of the ADZ developments								
Algoa 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Improbable	**VERY LOW**	- ve	High
Algoa 7	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**LOW**		

Potential impact OP-SE4b: Negative impact on vessel navigation routes

Finfish and bivalve culture equally impact navigation routes and have therefore not been assessed separately. Yacht sailing within Algoa Bay takes place across a large area between Cape Recife and the Sundays River mouth and overlaps completely with Algoa 1 and 7. Fish cage farming could pose a navigational hazard to yachts and race courses may have to be adjusted to avoid fish farm infrastructure. To minimize this hazard, all fish cage infrastructure would have to be clearly marked on charts and by navigational markers as required by the South African Maritime Safety Authority. It is acknowledged that yachting may be affected by ADZ development within Algoa Bay, however, the relatively large area utilized by yachts within Algoa Bay and relatively small proposed ADZ areas, means that these activities should not be mutually exclusive.

All precincts overlap to some extent with at least one type of fishing activity, while diving sites are located in proximity of Algoa 1 and 7 and are situated within close range of marine eco-tourism boating tours (See section 8.5.2 for more information on affected user groups). Collision of all these types of vessels with the aquaculture farm is possible and the collective risk of collision has been assessed in Table 27. The intensity of collision is considered high and the risk of collision remains applicable throughout the project phase (long-term). The consequence is therefore considered high. The probability of a collision occurring is relatively low without mitigation measures, but is reduced to improbable when mitigation measures are implemented. The impact significance remains **medium** with the implementation of mitigation measures (Table 27).

Table 27 **OP-SE4b – Negative impact on vessel navigation routes with mitigation measures by Algoa Bay Aquaculture Development Zone precincts 1, 6 and 7. All precincts pose a potential hindrance to vessel traffic and collision risk is therefore considered the same for all precincts.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	High (3)	Long-term (3)	High (7)	Possible	**MEDIUM**	- ve	High
Mitigation measures: • Clearly identified beacons and shipping channels must be identified in relation to the ADZ to assist vessels to navigate safely through the area. • Install navigational markers and lights as required by SAMSA regulations. • Include position of ADZ on navigational charts. • Ongoing consultation with user groups to keep them informed of the ADZ developments								
With mitigation	Local (1)	High (3)	Long-term (3)	High (7)	Improbable	**MEDIUM**	- ve	High

Cumulative impacts

There are no existing sea-based aquaculture obstructions present at this time. A number of bivalve and fish farms could have a significant impact on vessel movement within the Algoa Bay area. However, these impacts are well mitigated and cumulative impacts are unlikely to be enhanced by the proposed ADZ.

9.5.2.5 Potential impact OP-SE5: Existing land-based and sea-based marine aquaculture activities

Cumulatively, sea-based aquaculture farms could potentially contribute to deterioration of water quality in the bay, which, in turn would adversely impact existing marine aquaculture production. Water quality deterioration is assessed in detail in the marine ecology impact assessment and it is assumed that the impact of water quality deterioration on the ecosystem would be representative of the impact to the marine aquaculture activity. This assessment of this impact is therefore not repeated here.

Existing mariculture activities in the Algoa Bay area can also benefit from the proposed ADZ, which could assist in the development of a local and export market for a variety of species and generate critical mass and economies of scale for this sub-sector. Aquaculture is the fastest growing form of food production in the world and a significant source of protein for people in many countries. The demand for fish products is expected to continue rising in the coming decades, with an additional 27 million tonnes of production being needed in 2030 to maintain the present level of per capita consumption (United Nations 2010). The development of new fish farms will therefore contribute towards the growing demand.

The development of additional aquaculture facilities has the potential to contribute towards the establishment of a viable mariculture subsector in South Africa and the positive impact would be equal for bivalve and finfish culture and are not specific to the precincts. The impact has therefore been assessed for all sites and both culture types in one impact table (Table 28).

Most of the current mariculture activities to date were isolated pilot-scale studies, with a great need for an integrated industry that could work together to ensure that the full potential thereof is realised in future. Through the development of specialized aquaculture technology, farming process can be improved to ensure the production of high quality products in a cost-effective manner. The positive impact on existing mariculture activities was rated as **medium**. A cooperative approach linked to the fish farms would ensure that other existing mariculture projects are not considering the proposed fish farms as a threat, but rather an opportunity to support their own endeavours.

Table 28 **OP-SE5 – Positive impacts on existing mariculture activities without and with mitigation measures by Algoa Bay Aquaculture Development Zone precincts 1, 6 and 7. The potential benefit affects all precincts and culture types equally and is therefore considered the same for all precincts.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Low (1)	Long-term (3)	Medium (6)	Probable	**MEDIUM**	+ ve	Medium
Benefit enhancing measures: • None identified								

Cumulative impacts

If well managed, fish farms will contribute to critical mass and economies of scale in support of mariculture activities in the area, in particular skills development, feed production, processing and storage facilities and other related infrastructure.

9.5.2.6 Potential impact OP-SE6: Potential impact on local fish industries

Fish farms could support the local fishing industry in meeting the growing demand and the development of new markets, but could also threaten existing fish industries if it competes only in the local market.

The nature and scope of fish farms should be carefully defined to minimise the impact on existing fishing grounds and business opportunities, in particular for squid, recreational and commercial fisheries. Fishermen in the Algoa Bay area are already suffering from the dwindling supply, limited resources, recently approved Addo MPA, and will not be able to endure further restrictions. There is also a concern that the supply of cheaper fish could force out competition from the traditional boat-based fishing companies. However, the owners of fishing companies and some fishermen do not foresee an impact on other fishing industries as there is enough fish to supply in the demand (Marius van Heerden, Arno Rabe, Diederick Nel, Dino Moodley & Anton Viljoen). The sustainability of the fish farms is an important consideration, as a complete disregard for the environmental impact of the finfish cage farming will have a disastrous effect on the local fishing industry. An example for this would be the transmission of disease to wild fish stock, which is especially important when farming indigenous species or when feeding fish with frozen fish (see section 8.5.2.2 for more information). The impact of disease transmission to wild stock has been assessed in the marine ecological specialist assessment and will not be repeated here. It is assumed that the significance of impact on the fishery would be directly proportional to the impact observed on wild stock.

As indicated by some interviewees, it would be more cost-effective to produce fish in the cages than catching fish in the wild (Diederick Nel and Arno Rabe), which could leave traditional fishermen without an essential income. More protein exports can address the current shortage of protein, but the first priority is to supply protein to the South African market, which is currently under-supplied (Diederick Nel and Arno Rabe). There is a general perception that fish protein is too expensive for the average consumer. This is ascribed to the trend of larger supermarkets that source fresh fish in bulk from fishing companies at reduced prices, but then sell at inflated price levels that are outside the reach of most citizens. Although the proposed fish farms can ensure a higher supply of protein to the PE market, it could also result in more competition that can lower the retail prices.

The proposed marine fish farms could have a positive impact on existing fishing operations if it improves accessibility to and opportunities for the development of new and/or improved markets for marine products sourced via traditional methods or aquaculture technology. Together with abalone and oysters produced in aquaculture systems, it could contribute to the development of niche/boutique markets for South African mariculture products. Other positive impacts on the existing industry include the following:

- Increase employment opportunities, especially in the traditional off-season periods.
- A larger protein supply for non-human consumption, which is currently needed in South Africa.
- More competition since there is a higher supply of fresh fish via the retail market to public, which in turn will ensure lower prices for consumers.
- Harbour facilities will be better utilised.

Stakeholders expressed concern regarding the southern part of Algoa 1, which overlaps with the squid breeding area frequented by current fishermen. As breeding areas provide for the best catches, the establishment of a fish farm in the same area will most likely have a significant impact on the local squid industry. The most effective mitigation measure is to reduce the size of the site and limit finfish farming to the northern section. With mitigation measures, the impact on local fisheries is considered to be **medium.** Algoa 7 overlaps with fishing grounds of all fisheries considered in this impact assessment and the impact has been rated as **medium.** Algoa 6 is located within a productive traditional linefish area, however, due to its close proximity to the shore, it is unlikely that fishing boats utilise this site to the extent indicated in Figure 28 (0.5% of total annual catch in South Africa).

Note that bivalve and finfish culture equally impact access to fishing sites and the impact rating has therefore been only separated by precincts.

Table 29 **OP-SE6 – Negative impact on local fisheries by Algoa Bay Aquaculture Development Zone precincts 1, 6 and 7 without and with mitigation measures.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1	Local (1)	High (3)	Long-term (3)	High (7)	Probable	**HIGH**	- ve	Medium
Algoa 7	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Probable	**MEDIUM**		
Algoa 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Probable	**LOW**		
Optional mitigation measure: • Algoa 1: Limit finfish farming to Option 1 to avoid squid breeding grounds (note that this mitigation measure is in conflict with those recommended for visual impacts) • No mitigation measures for the other precincts are available								
Algoa 1	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Probable	**MEDIUM**	- ve	Medium
Algoa 7	Medium (2)	Medium (2)	Long-term (3)	Medium (6)	Probable	**MEDIUM**		
Algoa 6	Medium (2)	Low (1)	Long-term (3)	Low (5)	Probable	**LOW**		

Cumulative Impact

The development of more primary industries will contribute to economic growth in the NMB area. A number of mariculture or other fishing-related industries could create economies of scale for other businesses that can provide goods and services to the growing industry, which in turn will result in more employment opportunities, etc. (i.e. an indirect impact). Conversely, a larger number of marine fish farms that compete in the local market will increase the intensity of the impact for existing fishing industries. Finally, other uses, such as the proclamation of the MPA, also contribute toward the reduction of fishing grounds for various fisheries. However, considering the small size of the proposed ADZ and considering that the inshore Algoa 6 site is not intensively utilised by any fishery, the overall contribution to reducing available fishing grounds is probably negligible. It must be noted that not reducing Algoa 1 and potentially removing access to the squid breeding site would significantly contribute towards a higher cumulative impact on the squid fisheries.

9.5.2.7 Potential impact OP-SE7: Pressure on existing land-based infrastructure to support the proposed development

The establishment and operation of the proposed fish farms will require specialised land-based infrastructure, including docking, maintenance, handling, processing and cold storage facilities.

New infrastructure businesses linked to mariculture activities may include manufacturing, boat building, service equipment manufacturers, insurance companies and trade associations (Burbridge *et al.,* 2001). Interested and Affected Parties also indicated a need for better coordination of roads, harbour, fishing factories etc., as well as strategic planning between different stakeholders (Anchor Environmental 2011).

Stakeholders indicated in the previous EIA process that Port Elizabeth harbour is not currently operating at full capacity and increased usage as a result of Algoa 1 and/or 6 could contribute to the cost-effective functioning of existing resources and the potential development of new resources.

The COEGA SEZ is currently being developed, which includes a land-based Aquaculture Development Zone, which could provide infrastructure support to Algoa 7. The negative impact on infrastructure is considered to be **medium** and **low** without and with mitigation measures respectively.

Note that the impact was found to be the same across precincts as well as for finfish and bivalve culture and has therefore not been assessed separately (Table 30).

Table 30 **OP-SE7 – Negative impact on land-based infrastructure without and with mitigation measures by Algoa Bay Aquaculture Development Zone precincts 1, 6 and 7. All precincts and culture types (i.e. finfish vs bivalve) are considered to have the same effect and were assessed collectively.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Definite	**MEDIUM**	- ve	Medium
Mitigation measures: • Any additional infrastructure required for the implementation and operation of the fish farms should be provided by the developers. • A partnership with Transnet could be considered to create fish production capacity that would also benefit the existing fishing industry.								
With mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Definite	**LOW**	- ve	Medium

Cumulative Impact

Multiple fish farms or farming activities could have a cumulative impact if the harbour facilities have to provide processing and storage facilities, as well as on-shore operational activities. If no additional infrastructure is provided by the fish farms, it could put a significant burden on the infrastructure that could impact other harbour-related activities. However, a number of fish farms could also create economies of scale for new infrastructure development that could also benefit the harbour's capacity and/or efficacy in future.

9.5.2.8 Potential impact OP-SE8: Impact on coastal real estate due to aesthetic nature of views and sense of place

Values of real estate are driven by various factors, among others supply and demand, interest rates, the contraction or expansion of the local economy, population growth rates and changes in disposable income to debt ratios. In addition, relative property values are based on the abundance of precincts that are either valued or avoided by consumers. As these underlying characteristics and resulting relative advantages change, so too do relative prices, as these advantages are capitalised into land values.

The proposed fish farms will have a visual impact that could negatively impact the view – and thus the sense of place - from residential properties, which in turn could impact the perceived value of seafront and sea-view properties. The Visual Impact Assessment shows that floating structures and maintenance vessels, as well as lights at night, would have a high visibility during the operational phase.

Algoa 1 is located very close to Summerstrand, a popular residential and recreational area. The infrastructure will be visible in the middle-ground area from the tourist receptors along the beach front of the Marine Drive area. Visibility of the project will extend several square kilometres and is defined as High (negative impact). Mitigation would involve the exclusion of the northern portion of Algoa 1 to create a three kilometre exclusion zone buffer from the beach front and a one kilometre

buffer exclusion zone buffer around Bell Buoy (Bell SQ) (see Section 2.5.1). With mitigation, the impact would be rated as **medium**.

Where the views of ships and other industrial and traffic activities are seen within the context of a harbour environment, the sense of place is unlikely to be impacted by the proposed aquaculture development. This is applicable to Algoa 6 and 7, which are situated within the harbour environment of the Ports of Elizabeth and Ngqura respectively. These precincts are therefore not considered to be situated in visually sensitive areas. Furthermore, Bluewater Bay constitutes the closest real estate receptor for Algoa 7, but lies outside the high exposure area (northeast) and has therefore not been considered in this impact assessment.

Although the visual impact of finfish versus bivalve culture at Algoa 1 was rated low and very low respectively, real estate value is unlikely to be impacted differently for these two culture types. The impact was therefore not assessed separately.

The negative impact of Algoa 1 on real estate value with and without mitigation measures was rated as **high** and **medium** respectively. Algoa 6 in contrast is expected to have a very low impact with and without mitigation measures. The confidence of the rating is considered to be low due to the lack of quantitative data on potential devaluation.

Table 31 OP-SE8 – Impact on coastal real estate due to aesthetic nature of views and sense of place without and with mitigation measures by Algoa Bay Aquaculture Development Zone precincts 1 and 6.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1	Local (1)	High (3)	Long-term (3)	High (7)	Probable	**HIGH**	- ve	Low
Algoa 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**		
Mitigation measures: • Algoa 1: Exclusion of the northern portion of Algoa 1 to create a three kilometre exclusion zone buffer from the beach front and a one kilometre buffer exclusion zone buffer around Bell Buoy (Bell SQ) • Implement other mitigation measures as detailed in the VIA.								
Algoa 1	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Possible	**MEDIUM**	- ve	Low
Algoa 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**		

Cumulative Impact

It is likely that real estate values in the area may decrease if there are multiple mariculture farms or similar developments that negatively impact on the sense of place. The contribution to cumulative impacts by Algoa 1 is likely to be considerably higher than Algoa 6.

9.5.2.9 Potential impact OP-SE9: Local community development

The fish farms have the potential to contribute to the development and upliftment of communities in the Algoa Bay area.

Initiatives supported by the mariculture farms in the ADZ could provide the impetus required to encourage small business development and enhance the training and capacity building for entrepreneurs and small business operators within the community. The assistance provided to communities should be used to entrench and expand the skills base. The core competencies and needs of the community should be determined to ensure that jobs that originate from the fish farms are offered to the local population. At full production (assuming that the development proves to be feasible and scalable), the impact on local community development has been rated as low without and medium with benefit enhancing measures. Sea-based aquaculture has not yet established in South Africa and therefore this impact could not be rated based on previous experience in the sector. Against the backdrop of the socio-economic challenges faced by South African previously disadvantaged communities, it would be inappropriate to compare the impact to a developed country such as that of Norway. The confidence of this impact rating is therefore considered to be medium.

The impact is likely to be the same for all precincts and culture types are likely to have the same impact and were therefore assessed as one (Table 32).

Table 32 **OP-SE9 – Positive impact on local community development by the Algoa Bay Aquaculture Development Zone. All precincts are considered to have the same effect and were assessed collectively. Note that when assessing this impact, the scoring of the extent is reversed, as it is more favourable to ensure that the impact occurs locally.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Low (1)	Long-term (3)	Medium (6)	Possible	**LOW**	+ ve	Medium
Benefit enhancing measures: • Develop a strategy to achieve local community development. • Ensure Corporate Social Responsibility of larger companies investing in the ADZ								
With mitigation	Local (3)	Low (1)	Long-term (3)	High (7)	Possible	**MEDIUM**	+ ve	Medium

Cumulative impacts

A number of fish farms (or any other associated industrial development for that matter) that contribute towards community development will benefit socio-economic development of the whole region. The contribution of the ADZ to cumulative positive impacts would be low during the pilot phase and increase if the project proves feasible and scalable.

9.5.2.10 Potential impact OP-SE10: Provision of goods and services by local businesses (leakages)

The maximum benefit to local businesses will depend on their ability to supply goods and services. Income leakage could have negative consequences for the economic development of the area. The more developed the economy, the greater the potential that the demand for goods and services can be met from internal supply, rather than depend on imports that cause an outflow of funds in the form of taxation and other transfer payments to suppliers. Regional and local multipliers tend to be lower than national multipliers due to the greater potential for leakages. Consequently, a higher propensity to import exists in smaller economies, which in turn usually have high leakage factors and lower multipliers.

The propensity to import is related to the nature and scope as well as the size of the NMB economy. The Bloom (2012, 2013) assessment of the current macro-economic status of the NMB economy relative to the Eastern Cape Province and the national economy indicates likelihood for the importation of certain goods and services predominantly during the establishment phase. These could typically include fish processing, nets and maintenance, transportation, packaging, containers, diving services, machinery and equipment. Sea cage farmers will also need a reliable source of disease-free fry to stock sea cages. These may be supplied from established hatcheries or companies may decide to initiate their own hatcheries. We believe that import propensities could be approximately 20% during the establishment and operational phases.

Payments related to the operations of the fish farms would be disbursed to registered suppliers of goods and services in the NMB area and other locations throughout South Africa. Ownership other than ownership from individuals/consortia based in the NMB area will result in revenue transfers in the form of dividend/profit repatriation.

Sea-based bivalve culture is more established in South Africa when compared to finfish culture and is likely to experience less leakages to the local economy. The impact has therefore been assessed separately for the culture types (Table 33) (note however that the precincts themselves are not a determining factor and have therefore not been assessed separately).

The intensity of leakages from the local economy as a result of finfish farming is likely to be higher than for bivalve culture, resulting in high and medium significance of this impact before mitigation measures respectively. The procurement of a substantial portion of the goods and services from the local area will mitigate against the potential for substantial leakage. A business enhancement and capacity building initiative would contribute to the mitigation of the envisaged leakage. With mitigation measures, the impact of leakages from the local economy have been rated as **medium** and **low** for the finfish and bivalve operations respectively.

At this stage, it is not possible to quantify the size of the dividends/profits that may flow out of the NMB economy due to potential “Non-NMB ownership”. Once the structures of the legal entities are established and the management contracts have been finalised, it would be possible to estimate the outflow of dividends/profits (if applicable). It follows that the confidence in the significance rating is medium.

Table 33 **OP-SE10 – Negative impact on income leakage *finfish and bivalve culture* at the Algoa Bay Aquaculture Development Zone on local economic development of the area.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Finfish (Algoa 1 & 7)	Local (1)	High (3)	Long-term (3)	High (7)	Probable	**HIGH**	-ve	Medium
Bivalve (Algoa 1 & 6)	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Probable	**MEDIUM**		
Mitigation measures: • The procurement of a substantial portion of the goods and services from the local area • Business enhancement and capacity building initiative								
Finfish (Algoa 1 & 7)	Local (1)	Medium (2)	Long-term (3)	Medium (6)	Probable	**MEDIUM**	-ve	Medium
Bivalve (Algoa 1 & 6)	Local (1)	Low (1)	Long-term (3)	Low (5)	Probable	**LOW**		

9.5.2.11 Potential impact OP-SE11: Small business, individual and informal sector development

Fish farms could create new opportunities that could support small business development. The development of small enterprises associated with the fish farms should fundamentally focus on two aspects, i.e.

- A commitment to procure services from small businesses within the Algoa Bay area or from other areas within the NMB Municipal area or the Eastern Cape; and
- The establishment of mechanisms that would enable the creation of small business opportunities linked to the establishment and operational components of the fish farms.

The need for developing small businesses in the mariculture industry is re-affirmed by the necessity to form alliances with business organisations, which would ensure that the Government's development objectives for mariculture development coincide with those of the community and the private sector.

During establishment and after the completion of the fish farms, the procurement of goods and services should provide additional opportunities for local suppliers to register as vendors. The use of local expertise for the development of small businesses is essential. Examples of small business opportunities emanating from the backward linkages provided by the fish farms include maintenance and various support services.

The benefit could be maximised with the introduction of a strategy to engage local businesses and communities (intensity of the impact is increased from low to medium). A pro-active approach is required to ensure that residents of the NMB area with the required skills, or that may acquire the necessary skills, together with existing businesses are placed in a position to contribute to and benefit from the development of the fish farms during both the establishment and operational phases. The significance of the impact is the same for all sites and for both culture types and has been rated as **low** without and **medium** with benefit enhancing measures.

Table 34 **OP-SE11 – Positive impact on small businesses, individual and informal sector development as a result of the Algoa Bay Aquaculture Development Zone. All precincts and both culture methods are considered to have the same effect and were assessed collectively.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional (2)	Low (1)	Long-term (3)	Medium (6)	Possible	**LOW**	+ ve	Medium
Benefit enhancing measures: • Develop a strategy to engage local businesses and communities.								
With mitigation	Regional (2)	Medium (2)	Long-term (3)	High (7)	Possible	**MEDIUM**	+ ve	Medium

Cumulative impacts

Sustainable economic growth requires that most of the human and other resources be met from internal supply. This type of approach contributes to the retention of income within the economy, leads to further induced investment and multiplied increases in income from the spending on wages and salaries of persons from the NMB area associated with the fish farms. More mariculture projects will increase the demand for goods and services, which will support the development of local businesses and ensure acceptable levels of sustainability.

9.5.2.12 Potential impact OP-SE12: Increased risk of bird strikes affecting aircrafts landing at and departing from the Port Elizabeth International Airport

According to the Airports Company South Africa (ACSA) Port Elizabeth the proposed Aquaculture Development Zone overlaps with the flight path of aircrafts landing at and departing from the Port Elizabeth International Airport. ACSA is concerned that aquaculture farms may attract birds and their aggregation would increase the risk of birds colliding with aircrafts, posing a hazard to navigation.

Bird strikes can damage aircrafts, which are expensive to repair and the damage inflicted on aircraft control surfaces or engines can lead to disaster. The likelihood of a disaster occurring is related to the density of a bird flock occurring on any given flightpath. Indeed, collision with large flocks has resulted in human casualties in the past (Scott 2009). However, these collisions are usually caused by migratory birds such as ducks, geese, starlings etc., which complete their routes at great heights posing a risk to aircrafts.

Algoa Bay and the associated protected islands provide shelter, feeding and breeding habitats for numerous sea bird species (non-migratory mainly). Piscivorous, *low-flying* sea birds could be attracted to large concentrations of fish and food in sea cages at Algoa 1 and 7 and include sea gulls, gannets, cormorants and terns. There are two groups of three islands each, within Algoa Bay that support large colonies of birds (refer to the marine specialist study in Appendix D of this BAR for more information on birds in Algoa Bay).

Johnston *et al*. 2014 modelled flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. They found that sea birds for all 25 seabird species investigated the majority of flights were within 20 m of the sea surface. The risk of collision with seabirds is therefore improbable even without mitigation measures.

The impact of the proposed ADZ on sea birds has been assessed in the marine specialist assessment of this BAR (Appendix D). The study provides a number of mitigation measures to prevent birds from accessing the finfish cages successfully. The most effective and common mitigation measure is to install predator nets on the cages which prevents seabirds from gaining access from the air. In addition, visual deterrents (e.g. tori line type deterrents for birds) can also be installed. Feed must always be stored in closed containers on the maintenance vessels. It is in the interest of farmers to ensure that their stock or feed is not predated on by birds.

Furthermore, ACSA expressed concern regarding the processing of fish or grading and initial cleaning of bivalve on board of maintenance vessels. Discarding biological waste could potentially attract large flocks of birds. Discarding biological waste (i.e. processing waste, mortalities etc.) at sea is not permitted for biosecurity reasons and this requirement is included in the Environmental Management Programme (Appendix F of this BAR). Fish will be processed exclusively at land-based facilities.

It must be recognised that Algoa Bay has existing large sea bird colonies which perform daily migrations to and from the roosting sites and these flocks are likely currently passing Algoa 1 and 7 sites on a daily basis. The additional risk posed by the finfish cages is considered to be relatively small as the cages are unlikely to alter flight path height of the bird flocks.

In addition, with the implementation of mitigation measures, birds will quickly learn that the cages do not constitute an easy food source, thereby reducing the duration of the impact to short-term. The probability of the finfish cages in Algoa 1 and 7 attracting large flocks of birds will be very low, which in turn means that the collision risk is low without and insignificant with the implementation of mitigation measures. The confidence of the impact rating is, however, considered medium as no detailed information on bird flight paths (i.e. route and height) for the bird species that roost and forage in large flocks (i.e. cormorants, terns and gannets) specifically in Algoa Bay have been considered. However, given the scientific evidence regarding flight height of 25 sea bird species in the North Sea (Johnston *et al*. 2014), a detailed assessment should not be required for this Basic Assessment. Furthermore, mitigation measures are well established in the aquaculture industry and are highly effective and should minimise any risk associated with sea birds in Algoa Bay.

Table 35 **OP-SE12 – Increased risk of bird strikes affecting aircrafts landing at and departing from the Port Elizabeth International Airport. All precincts and both culture methods are considered to have the same effect and were assessed collectively.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Improbable	**VERY LOW**	- ve	Medium
Essential mitigation measures: • Install predator nets (top) to prevent access by seabirds from the air • Install visual deterrents (e.g. tori line type deterrents for birds) • Store feed so piscivores cannot access it • During harvesting of stock, ensure that minimal blood or offal enters the water • Develop a protocol for dealing with problem piscivores in conjunction with experts and officials (DAFF, DEA etc) • Maintain a record of all interactions with piscivores as per recommended EMPr • Fish processing is to take place at land-based facilities only • No biological waste is to be discarded at sea								
With mitigation	Local (1)	Low (1)	Short-term (1)	Very low (3)	Improbable	**INSIGNIFICANT**	- ve	Medium

9.5.3 Impact significance of alternative options

DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore three combinations of precincts have been considered as alternatives in the Basic Assessment process. These three options allow for varying degrees of farming intensities by excluding finfish farming at Algoa 1 (Option B) or excluding Algoa 1 as a whole (Option C).

After benefit enhancing measures Option A and B have the same number of high, medium and low positive impacts on the socio-economic environment (Table 36). Option C excludes Algoa 1 which means that less area will be available for mariculture and therefore the benefits will be lower when compared to option A and B.

After mitigation measures are implemented, none of the alternative options have high negative impacts on the socio-economic environment. Option A has the highest number of negative impacts of medium significance when compared to the other options (Table 37). Option C excludes Algoa 1 the lowest negative impact on the socio-economic environment.

The Status Quo Alternative (or No-go option D) proposes that the development of fish farms in Algoa Bay do not go ahead. Given that the Eastern Cape coast is one of the few areas considered suitable for marine based aquaculture in South Africa, the 'No-go/Status Quo' option will limit the potential benefits linked to this industry. Not establishing ADZ will limit the potential to supply in the growing demand for seafood products, but will also eliminate the potential socio-economic concerns associated with finfish and bivalve culture. These include impact on the local economy reliant on specialised tourism, recreation (diving, swimming, and surfing) as well as the vessel collision potential.

Table 36 **Comparison of the sum of positive impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone on the socio-economic environment (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the best case scenario was considered.**

Impact significance after mitigation	**A**	**B**	**C**	**No-go**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	3	3	2	0
Medium	12	12	8	0
Low	0	0	0	0
Very low	0	0	0	0
Insignificant	0	0	0	0

Table 37 **Comparison of the sum of negative impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone on the socio-economic environment (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the worst case scenario (i.e. finfish) was considered.**

Impact significance after mitigation	**A**	**B**	**C**	**No-go**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	0	0	0	0
Medium	9	7	5	0
Low	9	10	8	0
Very low	7	7	6	0
Insignificant	3	3	2	0

9.6 Heritage resources

As the proposed development is undergoing an Environmental Authorisation (EA) application process in terms of NEMA, it is incumbent on the developer to establish whether a Heritage Impact Assessment (HIA) needs to be completed as per section 38(3) and 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA). If required such an HIA would include an underwater maritime study and any other applicable heritage components. The HIA would be conducted as part of the EA Application in terms of NEMA and the 2017 NEMA EIA Regulations.

The proposed project will affect the surface environment of the ocean more so than the sea bottom. The disturbance on the seabed will be associated with mooring/anchoring mechanism for the cages. Anchor appointed ACO Associates cc to conduct a desktop Maritime and Underwater Cultural Heritage Study as the Maritime and Underwater Cultural Heritage (MUCH) Unit at SAHRA indicated that such a study would likely to be requested. A summary of the HIA has been included in this BAR and the specialist study has been included as a standalone document in Appendix D.

South Africa has a rich and diverse underwater cultural heritage. Strategically located on the historical trade route between Europe and the East, South Africa's rugged and dangerous coastline has witnessed more than its fair share of shipwrecks and maritime dramas in the last 500 years. At least 2400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s. This doesn't include the as yet unproven potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions along the South African east coast.

In addition to historical shipwrecks, the record of South Africa's long association with the sea is much broader and extends far back into prehistory. This element of our maritime and underwater cultural heritage is represented around the South African coast by thousands of pre-colonial shell middens and large numbers of tidal fish traps, which reflect prehistoric human exploitation of marine resources since the Middle Stone Age, more than 150,000 years ago. Another, until recently, largely unacknowledged and unexplored aspect of our maritime and underwater cultural heritage are pre-colonial terrestrial archaeological sites and palaeolandscapes which are now inundated by the sea.

This assessment considers maritime and underwater cultural heritage resources in the Algoa 1, 6 and 7, namely submerged prehistoric resources and historical shipwrecks.

9.6.1 Impact Assessment for Algoa 1, 6 and 7

Aquaculture infrastructure consists of cages for finfish, long-lines for oysters and mussel rafts deployed in the water column and moored on the seafloor to prevent drifting. The only physical disturbance of the seabed related to aquaculture is the footprint mooring or anchoring points for the cages, long-lines and rafts, which can be either placed on the seabed or driven into it.

This is the only identifiable impact for maritime and underwater cultural heritage resource arising out of the development of aquaculture in Algoa Bay with heritage sites at risk as a result of the placement of anchors or from the physical penetration of the seabed to install mooring points.

On the basis of the heritage resources review in Section 8.4 (and in more detail in the study by Gribble 2019 in Appendix D of this BAR), the heritage receptors defined for this impact assessment are:

- Submerged prehistoric archaeological resources within all three proposed aquaculture areas;
- Maritime archaeological resources in Area 1;
- Maritime archaeological resources in Area 6; and
- Maritime archaeological resources in Area 7.

The assessment of impact on each of these receptors provided in the following sections is based on the methodology set out in Appendix 7 below.

9.6.1.1 Potential impact CP-UMH 1: Submerged prehistory – All Areas

Although no geophysical data for the Algoa Bay as a whole or for the three proposed aquaculture areas were available for this assessment, the rivers that presently debouch into the bay are likely to have done so at times of lower sea levels and will have palaeo-channels which extend offshore across the present seabed. Where archaeological material and palaeoenvironmental evidence have survived post-glacial marine transgressions, there is the potential for this material to be within or associated with now submerged palaeo-channels.

The small footprint of the seabed intervention that will result from the installation of mooring points for the aquaculture infrastructure make the potential for any interaction with or impact on submerged prehistoric archaeological material in Areas 1, 6 and 7 unlikely.

Were impacts to occur, they will be negative because the finite and non-renewable nature of heritage resources means that they cannot recover if disturbed, damaged or destroyed.

The potential impacts of the development of aquaculture in the three proposed areas on submerged prehistoric archaeological resources were found to be of local extent, low intensity but irreversible. The significance rating was **very low** and no mitigation measures are required for this impact (Table 38).

Table 38 **CP-UMH1 – Negative impact on submerged prehistoric resources as a result of the Algoa Bay Aquaculture Development Zone. All precincts and both culture methods are considered to have the same effect and were assessed collectively.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local (1)	Low (1)	Long-term (3)	Low (5)	Improbable	**VERY LOW**	- ve	Low
Essential mitigation measures: No mitigation required.								

9.6.1.2 Potential impact CP-UMH 2: Maritime archaeology

Based on the discussion of maritime heritage resources in **Algoa 1** in Section 8.4.2 (and in more detail in the study by Gribble 2019 in Appendix D of this BAR), there is a very low possibility that shipwreck material will be present in the aquaculture area. However, two wrecks have been identified as possibly being in the area and some of those listed only as "Algoa Bay" or "Port Elizabeth" may also be present. The probability of any interaction with or impact on maritime heritage resources in Area 1 is thus possible.

Algoa 6 is the most sensitive of the three proposed aquaculture areas with respect to maritime heritage resources and it is almost certain that historical shipwreck material is present in the development area.

Although only a handful of recorded wrecks are in the vicinity of **Algoa 7,** the presence of 147 wrecks with no specific recorded locations of loss in the bay and the location of Algoa 7 on Algoa Bay's lee shore in a south-easterly gale suggests that it is possible that shipwreck material will be present in the aquaculture area.

Geophysical data collection and/or dive surveys to inform the placement of moorings outside of an exclusionary buffer zone around any identified maritime archaeological resources is, due to the small disturbance footprint, a very effective mitigation measure. At all three sites, the impact is considered insignificant, primarily due to the fact that the impact can either be prevented or artefacts can be recovered, which reduces the duration of the impact (short-term). Algoa 6 constitutes the most sensitive site and implementation of mitigation measures are crucial to prevent impacts on the rich maritime archaeological heritage of the area.

Were impacts to occur, they will be negative because the finite and non-renewable nature of heritage resources means that they cannot recover if disturbed, damaged or destroyed.

Table 39 **CP-UMH2 – Negative impact on submerged prehistoric resources as a result of the Algoa Bay Aquaculture Development Zone. All precincts and both culture methods are considered to have the same effect and were assessed collectively.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Algoa 1&7	Local (1)	Low (1)	Long-term (3)	Low (5)	Possible	**VERY LOW**	- ve	Low
Algoa 6	Local (1)	Low (1)	Long-term (3)	Low (5)	Probable	**LOW**	-ve	Low
Essential mitigation measures: • Any geophysical data generated to support to development of aquaculture in this area must be archaeologically reviewed for the presence of historical shipwrecks or related material and to ground truth proposed mooring locations; • If geophysical data are not collected, the proposed positions of all moorings must be ground truthed by suitably qualified divers; • Should any archaeological material, be accidentally encountered during the course of developing aquaculture operations in any of the proposed areas, work must cease in that area until the project archaeologist and SAHRA have been notified, the find has been assessed by the archaeologist, and agreement has been reached on how to deal with it.								
Algoa 1, 6&7	Local (1)	Low (1)	Short-term (1)	Very low (3)	Improbable	**INSIGNIFICANT**	- ve	Low

9.6.2 Impact significance of alternative options

DAFF is seeking to promote farming of both bivalves and finfish in Algoa Bay and therefore three combinations of precincts have been considered as alternatives in the Basic Assessment process (Table 40). These three options allow for varying degrees of farming intensities by excluding finfish farming at Algoa 1 (Option B) or excluding Algoa 1 as a whole (Option C). Overall, the impacts of Option C are the lowest, solely due to the exclusion of Algoa 1 as a whole. All impacts are, however, rated either very low or insignificant for all options after mitigation.

Table 40 **Comparison of the sum of negative impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone on heritage resources (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the best case scenario was considered.**

Impact significance after mitigation	**A**	**B**	**C**	**D (No-go)**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	0	0	0	0
Medium	0	0	0	0
Low	0	0	0	0
Very low	3	3	2	0
Insignificant	3	3	2	0

9.6.3 Recommendations

The assessment of the maritime heritage resources of Algoa Bay suggests that although there is the potential for the presence of submerged prehistoric archaeological material in the bay, the minor seabed interventions associated with the installation of aquaculture infrastructure in the three proposed areas is very unlikely to impact on this resource. No mitigation is proposed in respect of submerged prehistoric archaeological resources.

With regard to historical shipwrecks, Algoa 1 and 7 have a low potential for impacts arising out of the development of aquaculture in these areas. Algoa 6, however, is located in that area of Algoa Bay with the highest concentration of recorded historical shipwrecks. Current information from local diving charters indicates that quantities of shipwreck material are visible in and on the seabed in the area proposed for Algoa 6, and the potential for interactions between these sites and the mooring points required for aquaculture development is high if not mitigated.

The following recommendations are made in respect of mitigation measures to be applied particularly to Algoa 6, but also to Algoa 1 and 7:

- Any geophysical data generated to support to development of aquaculture in this area must be archaeologically reviewed for the presence of historical shipwrecks or related material and to ground truth proposed mooring locations. Datasets that are particularly useful in this regard are magnetometer, side scan sonar and multibeam bathymetric data. It is recommended that the archaeologist is consulted before data are collected to ensure that the survey specifications and data outputs are suitable for archaeological review;
- Any video footage collected support to development of aquaculture in the three areas should ideally also be reviewed by the archaeologist for evidence of shipwreck material on the seabed;
- If geophysical data are not collected, the proposed positions of all moorings must be ground truthed by suitably qualified divers;
- Should the reviews and ground truthing set out above identify wreck material at or near the location of any proposed mooring, micro-siting of the mooring and the possible implementation of an exclusion zone around the archaeological feature should be sufficient to mitigate the risks to the site.
- Should any archaeological material, be accidentally encountered during the course of developing aquaculture operations in any of the proposed areas, work must cease in that area until the project archaeologist and SAHRA have been notified, the find has been assessed by the archaeologist, and agreement has been reached on how to deal with it.

Although these impacts are predominantly applicable to the construction phase of the development, mooring blocks and anchors may require maintenance, during which unexpected archaeological resources could be discovered. It is therefore important that in such an incident, work must cease in that area until the project archaeologist and SAHRA have been notified, the find has been assessed by the archaeologist, and agreement has been reached on how to deal with it (see last bullet point above). This mitigation measure is to be included in the operational phase of the EMPr of this BAR (Apendix F).

ACO Associates cc concluded in their impact assessment report (Gribble 2019) that the proposed development of aquaculture in Algoa 1, 6 and 7 is unlikely to have any impact on known or unknown maritime and underwater cultural heritage resources provided that the above recommendations are implemented and that the development is considered archaeologically acceptable.

10 ENVIRONMENTAL IMPACT STATEMENT

DAFF is mandated to enable aquaculture development in South Africa, and as such intends to declare an Aquaculture Development Zone (ADZ) comprising up to three separate precincts within Algoa Bay where bivalves and finfish can be farmed. This **BAR** describes and assesses potential environmental impacts associated with each of the three precincts (Algoa 1, 6, and 7) individually first, and subsequently in combination in the form of alternate options as they have been configured for this EIA process (i.e. Option A, B and C) together with the No-Go option (Alternative D) (Table 41).

Table 41 Alternative precinct combinations involving Algoa 1, 6 and 7 considered in the Basic Assessment process for the proposed sea-based Algoa Bay Aquaculture Development Zone.

Option	Algoa 1	Algoa 6	Algoa 7
A	Finfish & Bivalve	Bivalve	Finfish
B	Bivalve	Bivalve	Finfish
C	X	Bivalve	Finfish
D	X	X	X

Positive and negative impacts can be rated as insignificant, very low, low, medium, high and very high before and after benefit enhancing or mitigation measures are implemented. A summary of the environmental impacts assessed for each precinct (Algoa 1, 6 and 7) are shown for the construction (CP) (Table 42) and the operation (OP) (Table 43 to Table 46) phases of the proposed development. Potential impacts are denoted by first listing the phase of the development (i.e. CP = Construction Phase; OP = Operational phase) followed by the impact category. Impacts are numbered consecutively and separately for the construction and operational phases:

- ME = Marine Ecology
- VA = Visual and aesthetic
- SE = Socio-economic
- UMH = Underwater and Maritime Heritage Resources

Table 42 **Summary of potential impacts for the *construction* of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. CP stands for Construction Phase. The following codes are used for the various impact types: ME = Marine Ecology, SE = Socio-economic.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
CP-ME 1	Disturbance of subtidal habitat	Low	Definite	**LOW**	-ve	High
	With mitigation	Very Low	Definite	**VERY LOW**	-ve	High
CP-SE 1	Investment in the local, regional and national economy for Algoa Bay (all precincts)	Medium (5)	Possible	**LOW**	+ve	Medium
	With benefit enhancing measures	Medium (5)	Possible	**LOW**	+ve	Medium
CP -SE 2	Increased employment, income and skills development (all precincts)	Low (5)	Possible	**VER LOW**	+ve	Low
	With benefit enhancing measures	Medium (6)	Possible	**LOW**	+ve	Low
UMH 1	Impacts on Submerged Prehistoric Heritage Resources: All Precincts	Low (5)	Improbable	**VERY LOW**	-ve	Low
	No mitigation required	N/A	N/A	**N/A**	N/A	N/A
UMH 2a	Impacts on Maritime Archaeological Resources: Algoa 1 & 7	Low (5)	Possible	**VERY LOW**	-ve	Low
	With mitigation	Very Low (3)	Improbable	**INSIGNIFICANT**	-ve	Low
UMH 2b	Impacts on Maritime Archaeological Resources: Algoa 6	Low (5)	Probable	**LOW**	-ve	Low
	With mitigation	Very Low (3)	Improbable	**INSIGNIFICANT**	-ve	Low

Table 43 **Summary of potential impacts of finfish culture on marine ecology (denoted ME) for the operation of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. OP stands for Operation Phase.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 1	Disease and parasite transmission to wild fish stocks (ongoing, may be reversible).	Very High	Definite	**VERY HIGH**	-ve	High
	With mitigation	High	Probable	**HIGH**	-ve	Medium
OP-ME 2	Organic waste discharge impacting on the water column and benthic environment arising from mariculture operations (ongoing but reversible).	High	Definite	**HIGH**	-ve	High
	With mitigation	Medium	Definite	**MEDIUM**	-ve	Medium

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 3	Genetic contamination of wild stocks with escapees from finfish cage culture at Algoa 1 & 7 (ongoing and irreversible).	Very High	Possible	**HIGH**	-ve	Low
	With mitigation	Medium	Improbable	**LOW**	-ve	Low
OP-ME 4	Use of chemical therapeutants and antifoulants in finfish cage culture at Algoa 1 (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
	Use of chemical therapeutants and antifoulants in finfish cage culture at Algoa 7 (ongoing but reversible).	High	Probable	**HIGH**	-ve	Medium
	With mitigation	Low	Probable	**MEDIUM**	-ve	Low
OP-ME 5a	Accidental entanglement of cetaceans in mariculture infrastructure (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Low
OP-ME 5b	Possible impacts on cetaceans resulting from alterations in habitat use or migration patterns (ongoing but reversible).	Low	Probable	**LOW**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
OP-ME6	Piscivorous marine animals interfering with finfish cage culture operations at Algoa 1 (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low
	Piscivorous marine animals interfering with finfish cage culture operations at Algoa 7 (ongoing but reversible).	High	Probable	**HIGH**	-ve	Medium
	With mitigation	Medium	Probable	**MEDIUM**	-ve	Low
OP-ME7	Possible impacts on the proposed Addo Elephant MPA, Algoa 7 (irreversible).	Medium	Definite	**MEDIUM**	-ve	High

Table 44 **Summary of potential impacts of *bivalve culture* on marine ecology (denoted ME) for the *operation* of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. OP stands for Operation Phase.**

Impact identified		Consequence	Probability	Significance	Status	Confidence
OP-ME 8a	Introduction of alien bivalve species (Mediterranean mussel *Mytilus galloprovincialis*) to the wild.	Low	Improbable	**VERY LOW**	-ve	Medium
	No mitigation required	N/A	N/A	N/A	N/A	N/A
OP-ME 8b	Introduction of alien bivalve species (Pacific oyster *Crassostrea gigas*) to the wild	High	Possible	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 9	Introduction of alien fouling species to the wild and provision of habitat to alien fouling species	Medium	Definite	**MEDIUM**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Medium
OP-ME 10	Disease and parasite transmission to wild bivalve stocks (ongoing, may be reversible).	Very High	Definite	**HIGH**	-ve	High
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 11	Organic pollution and habitat modification (ongoing but reversible).	High	Possible	**MEDIUM**	-ve	High
	With mitigation	Medium	Possible	**LOW**	-ve	Medium
OP-ME 12	Genetic contamination of wild stocks from bivalve mariculture at Algoa 1 and 6 (ongoing and irreversible).	Low	Improbable	**VERY LOW**	-ve	Medium
OP-ME 13a	Accidental entanglement of cetaceans in bivalve mariculture infrastructure (ongoing but reversible).	Medium	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium	Possible	**LOW**	-ve	Low
OP-ME 13b	Possible impacts on cetaceans resulting from alterations in habitat use or migration patterns (ongoing but reversible).	Low	Probable	**LOW**	-ve	Medium
	With mitigation	Low	Probable	**LOW**	-ve	Low

Table 45 **Summary of potential impacts of *finfish and bivalve culture* on the seascape character (denoted VA) for the *operation* of the proposed Aquaculture Development Zone in Algoa Bay without and with mitigation. OP stands for Operation Phase.**

Impact identified (VE finfish)		Consequence	Probability	Significance	Status	Confidence
OP-VA 1a	Negative impact on seascape character by Algoa 1 by *finfish culture*	High (7)	Definite	**HIGH**	-ve	Low
	With mitigation	Medium (2)	Definite	**MEDIUM**	-ve	Low
	Negative impact on seascape character by Algoa 1 by *bivalve culture*	High (7)	Definite	**HIGH**	-ve	Low
	With mitigation	Medium (2)	Possible	**LOW**	-ve	Low
OP-VE 1b	Negative impact on seascape character by Algoa 6 *bivalve culture*	Low (5)	Definite	**LOW**	-ve	Medium
	With mitigation	Low (5)	Possible	**VERY LOW**	-ve	Medium
OP-VE 1c	Negative impact on seascape character by Algoa 7 *finfish culture*	Low (5)	Definite	**LOW**	-ve	Medium
	With mitigation	Low (5)	Possible	**VERY LOW**	-ve	Medium

Table 46 **Summary of potential impacts by finfish and bivalve culture on the socio-economic environment (denoted SE) for the operation of the proposed Aquaculture Development Zone in Algoa Bay without and with benefit enhancing measures/mitigation. OP stands for Operation Phase.**

Impact identified (SE finfish & bivalve)		Consequence	Probability	Significance	Status	Confidence
OP -SE 1	Investment in the local, regional and national economy (All precincts)	High (7)	Possible	**MEDIUM**	+ve	High
	With benefit enhancing measures	High (7)	Possible	**MEDIUM**	+ve	High
OP-SE 2	Increased employment, income and skills development for Algoa Bay. (All precincts)	Medium (6)	Possible	**LOW**	+ve	High
	With benefit enhancing measures	High (7)	Probable	**HIGH**	+ve	High
OP-SE3	Negative economic impact on specialist tourism and recreational businesses by *finfish* culture at Algoa 1	High (7)	Definite	**HIGH**	-ve	Medium
	With mitigation measures	Medium (6)	Definite	**MEDIUM**	-ve	Medium
	Negative economic impact on specialist tourism and recreational businesses by *finfish* culture at Algoa 7	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	With mitigation measures	Low (5)	Probable	**LOW**	-ve	Medium

Impact identified (SE finfish & bivalve)		Consequence	Probability	Significance	Status	Confidence
	Negative economic impact on specialist tourism and recreational businesses by *bivalve* culture at Algoa 1	Medium (6)	Definite	**MEDIUM**	-ve	Medium
	With mitigation measures	Low (5)	Definite	**LOW**	-ve	Medium
	Negative economic impact on specialist tourism and recreational businesses by *bivalve* culture at Algoa 6	Low	Improbable	**VERY LOW**	-ve	Medium
	With mitigation measures	Low	Improbable	**VERY LOW**	-ve	Medium
OPSE3a	Negative impacts on water sport recreational activities by *finfish* culture at Algoa 1 & 7	Medium (6)	Possible	**LOW**	- ve	Low
	With mitigation measures	Medium (6)	Possible	**LOW**	- ve	Low
	Negative impacts on water sport recreational activities by *bivalve* culture at Algoa 1 & 6	Low (5)	Possible	**VERY LOW**	- ve	Low
	With mitigation measures	Low (5)	Possible	**VERY LOW**	- ve	Low
OP-SE3b	Negative impacts on SCUBA diving activities for Algoa 1	Medium (6)	Possible	**LOW**	-ve	Medium
	With mitigation	Low (5)	Possible	**VERY LOW**	-ve	Medium
	Negative impacts on SCUBA diving activities for Algoa 7	Low (5)	Possible	**VERY LOW**	-ve	Medium
	With mitigation	Low (5)	Possible	**VERY LOW**	-ve	Medium
	Assessment of negative impacts on SCUBA diving activities for Algoa 6	Low (5)	Improbable	**VERY LOW**	-ve	Medium
	With mitigation	Low (5)	Improbable	**VERY LOW**	-ve	Medium
OP-SE 4a	Risk of collision between vessels and aquaculture farms as a result of drifting ships from the anchorage area for Algoa 6	Medium (6)	Possible	**LOW**	-ve	High
	With mitigation	Low (5)	Improbable	**VERY LOW**	-ve	High
	Risk of collision between vessels and aquaculture farms as a result of drifting ships from the anchorage area for Algoa 7	High (7)	Probable	**HIGH**	-ve	High
	With mitigation	Medium (6)	Possible	**LOW**	-ve	High
OP-SE 4b	Negative impact on vessel navigation routes for Algoa 1, 6 and 7	High (7)	Possible	**MEDIUM**	-ve	High

Impact identified (SE finfish & bivalve)		Consequence	Probability	Significance	Status	Confidence
	With mitigation	High (7)	Improbable	**MEDIUM**	-ve	High
OP-SE 5	Positive impacts on existing mariculture activities for Algoa 1, 6 and 7	Medium (6)	Probable	**MEDIUM**	+ve	Medium
	No benefit enhancing measures identified	N/A	N/A	**N/A**	N/A	N/A
OP-SE 6	Negative impact on local fisheries for Algoa 1	High (7)	Probable	**HIGH**	-ve	Medium
	With mitigation	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	Negative impact on local fisheries for Algoa 7	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	Negative impact on local fisheries for Algoa 6	Low (5)	Probable	**LOW**	-ve	Medium
	With mitigation	Low (5)	Probable	**LOW**	-ve	Medium
OP-SE7	Negative impact on land-based infrastructure (all precincts)	Medium (6)	Definite	**MEDIUM**	-ve	Medium
	With mitigation	Low (5)	Definite	**LOW**	-ve	Medium
OP SE8	Impact on coastal real estate due to aesthetic nature of views and sense of place for Algoa 1	High (7)	Probable	**HIGH**	-ve	Low
	With mitigation	Medium (5)	Possible	**MEDIUM**	-ve	Low
	Impact on coastal real estate due to aesthetic nature of views and sense of place for Algoa 6	Low (5)	Possible	**VERY LOW**	-ve	Low
	With mitigation	Low (5)	Possible	**VERY LOW**	-ve	Low
OP SE9	Positive impact on local community development (all precincts)	Medium (6)	Possible	**LOW**	+ve	Medium
	With benefit enhancing measures	High (7)	Possible	**MEDIUM**	+ve	Medium
OP-SE 10	Negative impact of income leakage on local economic development of the area for Algoa 1& 7 by *finfish farming*	High (7)	Probable	**HIGH**	-ve	Medium
	With mitigation	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	Negative impact of income leakage on local economic development of the area for Algoa 1 & 6 by *bivalve farming*	Medium (6)	Probable	**MEDIUM**	-ve	Medium
	With mitigation	Low (5)	Probable	**LOW**	-ve	Medium

Impact identified (SE finfish & bivalve)		Consequence	Probability	Significance	Status	Confidence
OP SE11	Positive impact on small businesses, individual and informal sector development (all precincts)	Medium (6)	Possible	**LOW**	+ve	Medium
	With benefit enhancing measures	High (7)	Possible	**MEDIUM**	+ve	Medium
OP SE12	Increased risk of bird strikes affecting aircrafts landing at and departing from the Port Elizabeth International Airport by *finfish and bivalve culture*	Low (5)	Improbable	**VERY LOW**	- ve	Medium
	With mitigation	Very low (3)	Improbable	**INSIGNIFICANT**	- ve	Medium

The outcomes of the impact assessments for Algoa 1, 6 and 7 as well as for finfish and bivalve culture (as shown in the summary tables above) were summed for each alternative option (after mitigation). Positive impacts (or benefits) cannot cancel out negative impacts and therefore have to be assessed separately (Table 47 and Table 48 respectively). Positive impacts are limited to socio-economic benefits arising from increased employment, business opportunity and skills development in the aquaculture sector.

Furthermore, note that in Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the best/worst case scenario was considered for positive and negative impacts respectively.

After benefit enhancing measures Option A and B have the same number of high, medium and low positive impacts on the socio-economic environment (Table 47). Option C excludes Algoa 1 which means that less area will be available for mariculture and therefore the benefits will be lower when compared to option A and B. The number of negative socio-economic impacts for options A and B are however substantially higher than option C (Table 48).

Table 47 **Comparison of the sum of positive (i.e. socio-economic) impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the best case scenario (i.e. finfish only) was considered.**

Impact significance after mitigation	**A**	**B**	**C**	**No-go**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	3	3	2	0
Medium	12	12	8	0
Low	0	0	0	0
Very low	0	0	0	0
Insignificant	0	0	0	0
Total	**15**	**15**	**10**	**0**

Table 48 **Comparison of the sum of negative impact significance of alternative options A, B, C and D for the proposed sea-based Algoa Bay Aquaculture Development Zone (after mitigation). In Option A, both finfish and bivalve culture are proposed for Algoa 1, however, these impacts are not additive and therefore the impact scoring for the worst case scenario (i.e. finfish only) was considered.**

Impact significance after mitigation	**Alternative Option A**	**Alternative Option B**	**Alternative Option C**	**Alternative Option D (No-go)**
Activities	**Algoa 1: finfish and bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 1: bivalves Algoa 6: bivalves Algoa 7: finfish**	**Algoa 6: bivalves Algoa 7: finfish**	**No Go**
High	2	1	1	0
Medium	16	12	10	0
Low	32	28	18	0
Very low	12	12	10	0
Insignificant	6	6	4	0
Total	**66**	**59**	**43**	**0**

Option C would involve bivalve farming at Algoa 6 and finfish farming at Algoa 7, excluding Algoa 1 altogether and is the most favourable option from an environmental impact perspective. This Alternative option has a total of 43 negative impact ratings, of which most are considered very low after mitigation measures have been implemented. A moderate number of low and medium impact ratings and only one high impact rating makes Option C the most environmentally acceptable option aside from the No-go option (Option D). The comparatively low environmental impact is mostly attributable to reduced socio-economic impacts associated with the exclusion of Algoa 1.

Option A and B have 66 and 59 negative impact ratings respectively as both options include Algoa 1 as a precinct, although Option B only allowing bivalve culture at this precinct. The exclusion of finfish at Algoa 1 makes Option B generally more environmentally favourable with fewer medium and more very low and low ratings than Option A. This difference can be ascribed to fact that bivalve culture is less likely to attract sharks, has a lower visual impact and contributes less to water quality deterioration. Option A is the most farming intensive alternative option, where both finfish and bivalve can be farmed at Algoa 1, bivalve at Algoa 6, and finfish at Algoa 7.

Option A is the most farming intensive alternative option, where both finfish and bivalve can be farmed at Algoa 1, bivalve at Algoa 6, and finfish at Algoa 7. The feasibility study for dusky kob and Atlantic salmon prepared by Advance Africa Management Services (DAFF 2017b) provided compelling evidence that demonstrated the need for social and political support to ensure that an aquaculture project is successfully implemented. It can be assumed that the public perception regarding the socio-economic impacts associated with finfish farming at Algoa 1 have not changed since the original EIA process. Beyond public support, DAFF would require the support from the local and district municipalities (that currently focus on tourism as a significant source of income), as well as from the Provincial Department of Environmental Affairs to ensure successful implementation of this project should Environmental Authorisation be granted.

Furthermore, it must be noted that recommended measures to mitigate impacts on the seascape and the squid fishing sector are directly opposed to each other. The former suggests a visual buffer that excludes a substantial part of northern Algoa 1. In contrast, the latter suggests that the squid fishing grounds in the southern part should be avoided, for if these became inaccessible, would constitute a quantifiable loss to the squid fishing industry. Finally, the review of the 28 appeals, and public perception survey (Hosking, 2016) confirmed that the socio-economic cost to the tourism and recreation sectors of developing the Algoa 1 ADZ constitutes a real, but unquantified concern.

Algoa 7 is included in all Alternative Options (with exception to the No-go alternative D). This site overlaps with the recently approved Addo Marine Protected Area (MPA), but the Department of Environmental Affairs Branch Oceans and Coasts has indicated that the affected portion of this site could potentially be excised should Environmental Authorisation be granted for this precinct. The predicted medium and high significance impacts on marine vertebrates, particularly on sea birds, seals, sharks and cetaceans associated with the St Croix and Bird islands, as well as the position on the border of a proposed MPA (thus contrary to conservation objectives) requires that a risk adverse, precautionary and adaptive management approach be adopted for finfish farming at this site.

The proposed development has the potential to create job opportunities, increase skill development and contribute towards the local and national economy. However, the impact assessment has shown that there are a relatively high number of negative impacts rated moderately significant after mitigation (mainly socio-economic and marine ecology) and at least one high rating for each alternative option. The decision making authority (DEA) will need to take cognisance of these impact ratings when making a decision on environmental authorisation.

A comprehensive Environmental Management Programme (EMPr), which includes the conditions of the overarching ADZ EMPr, would have to be developed and implemented for each aquaculture farm within the ADZ. This EMPr would have to require independent monitoring of sufficient indicators in order to detect and quantify any of the environmental impacts described in this Basic Assessment Report, and would have to specify thresholds of concern which require remedial action. The development of the ADZ should be phased in so that cumulative impacts can be detected as they arise, and adaptive management implemented. It is recommended that no more than three fin fish operators should be approved for an initial pilot phase, with a total annual production for the ADZ not exceeding 1 000 tonnes in the first year. Should monitoring reveal acceptable impacts as defined by the environmental quality objectives, indicators and performance measures, the individual operators would be permitted to increase production to full commercial scale (carrying capacity at each site for *Seriola lalandi* and *Argyrosomus sp.* as recommended in Wright *et al*. (2019) over at least a three year period, provided resource quality objectives are maintained.

The implementation of a phased approach, where expansion to maximum carrying capacity scale is only pursued if environmental impacts are acceptable, would be overseen by the ADZ Management Committee (AMC) (see EMPr in Appendix F for more details on the proposed management approach). This management structure has been set up for the Saldanha Bay Aquaculture Development Zone and has thus far been successful in implementing the adaptive management approach.

The AMC committee should at least comprise of DAFF, DEA (Oceans and Coasts / Biodiversity Branches), DEDEAT (Eastern Cape Provincial Department of Economic Development, Environmental Affairs and Tourism), the Nelson Mandela Bay Municipality and the Transnet National Port Authority. The AMC would play a coordinating and supervising role and ensure compliance with the EMPr throughout all phases of aquaculture farming in the ADZ. Furthermore, a Consultative Forum (CF) that includes the aquaculture operator, other relevant government departments, authorities and relevant local/public interest organisations must also be set-up to review environmental monitoring data and advise on management and recommend measures.

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