Appendix F: Impact Assessment

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1 Introduction

The Department of Agriculture, Forestry and Fisheries (DAFF) aims to develop and facilitate aquaculture (the sea-based or land-based rearing of aquatic animals or the cultivation of aquatic plants for food) in South Africa to supply food, create jobs in marginalised coastal communities and contribute to national income. To facilitate investment and development of additional aquaculture in Saldanha Bay, DAFF proposes to establish and apply for Environmental Authorisation (EA) for a sea-based Aquaculture Development Zone (ADZ) in Saldanha Bay.

This appendix presents the detailed impact assessment that forms part of and is reported in the Basic Assessment Report (BAR) compiled for the project. It must be read in conjunction with the BAR, Environmental Management Programme (EMPr) and any other appendices compiled for this project as listed in the BAR.

1.1 Environmental Impacts Identified

Based on the professional experience of the EIA team, legal requirements, the nature of the proposed activity, the nature of the receiving environment and issues raised in the stakeholder engagement process, the following key environmental issues – potential negative impacts and potential benefits – were identified:

- **Marine ecology** – potential alteration of the marine ecology of the bay due to impacts on the water column and sea bed from aquaculture;
- **Socio-economic** – potential socio-economic benefits and adverse impacts to the wider community in the form of job creation, increased investment and growth and reduction in access to areas used for watersports;
- **Visual** – potential alteration of the sense of place, and visual intrusion from aquaculture structures and lighting at night; and
- **Heritage** – potential impact on heritage resources on the sea bed, notably wrecks and associated artefacts.

1.2 Impact Rating Methodology

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

The significance of potential impacts that may result from the proposed project was determined in order to assist decision-makers (typically a designated competent authority or state agency, but in some instances, the applicant).

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 criteria used to determine impact consequence are presented in the table below.

Table 1-1: Criteria used to determine the Consequence of the Impact

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. Saldanha Bay)	1
Regional	The region, e.g. South African West Coast	2
(Inter) national	South African waters and beyond	3

Rating	Definition of Rating	Score
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 timeframe over 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	3

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

Table 1-2: Method used to determine the Consequence Score

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

Once the consequence was derived, the probability of the impact occurring was considered, using the probability classifications presented in the table below.

Table 1-3: Probability Classification

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

The overall **significance** of impacts was determined by considering consequence and probability using the rating system prescribed in the table below.

Table 1-4: Impact significance ratings

		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**

Finally, the impacts were 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.

Table 1-5: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

Authorities should consider the impact significance rating in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended and impacts were rated in the prescribed way both without and with the assumed effective implementation of essential mitigation and optimisation measures. Mitigation and optimisation measures are either:

- **Essential**: best practice measures which must be implemented and are non-negotiable; and
- **Best Practice**: recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the applicant if not implemented.

Negative impacts (with mitigation) rated high or very high are shaded in red, while positive impacts (with optimisation) rated high or very high are shaded green.

For the sake of brevity, only **key** (i.e. non-standard essential) mitigation measures are presented in impact rating tables (later in this section), with a collective summary of all recommended mitigation measures presented at the end of discipline.

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2 Impact Assessment

2.1 Potential Marine Ecology Impacts

2.1.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Marine Ecology Specialist Study undertaken by Pisces (see Appendix D1). The purpose of the study was to assess the potential impacts of the Saldanha ADZ on marine ecology, indicate the environmental acceptability of the ADZ and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Describe the ecological baseline of Saldanha Bay, including different habitat types, associated fauna and flora and sensitivity and the current impact of aquaculture on Saldanha Bay;
- Identify and assess impacts on marine and coastal environments from expanded marine aquaculture production, based on the project description derived in the Project Definition Phase, including impacts associated with the construction and operation phases, using SRK's prescribed impact rating methodology;
- Indicate the acceptability of alternatives and recommend a preferred alternative;
- Identify and describe potential cumulative impacts of the proposed development in relation to proposed and existing developments in the surrounding area;
- Recommend mitigation measures to avoid and/or minimise impacts and/or optimise benefits associated with the proposed Project; and
- Recommend and draft a monitoring campaign, if applicable.

The baseline is based on the review of existing information, derived though a literature search and review of all relevant, available local and international publications and information sources on southern African West Coast communities, with specific reference to Saldanha Bay. The assessment is based on the baseline and additional extensive review of relevant literature pertaining to aquaculture operations in other regions.

2.1.2 Assessment of Impacts: Construction Phase

One potential direct construction phase impact on the marine ecology of the area was identified:

- ME1: Crushing of biota in sediments during placement of mooring infrastructure.

2.1.2.1 Potential Impact ME1: Crushing of Biota in Sediments during Placement of Mooring Infrastructure

Impacts on the marine environment during the construction phase are limited to impacts caused by the placement of mooring infrastructure on the seabed, which will crush biota directly within the footprint of mooring blocks. The subsequent movements of mooring chains and ropes may cause further disturbance of benthic communities. The impact would, however, be highly localised and of low intensity.

The impact is assessed to be of ***low*** significance without and with the implementation of mitigation (Table 2-1).

Table 2-1: Significance of crushing of biota in sediments during placement of mooring infrastructure

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
All Alternatives								
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	-ve	High
Essential mitigation measures: • Avoid potentially sensitive and valuable habitats such as conservation areas (Malgas Island, Jutten Island, Langebaan Lagoon MPAs), biogenic habitats (e.g. kelp beds) and reefs (e.g. Lynch Blinder, North Bay Blinder). • Ensure mooring systems are well designed to prevent / limit movement of anchors and chains over the sea floor.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	-ve	High

2.1.3 Assessment of Impacts: Operation Phase

A very detailed impact assessment is presented in the marine ecology specialist study (Appendix D1). For ease of presentation and understanding, the impact assessment was summarised and grouped into the main eight impact categories below:

- ME2: Modification of seabed characteristics;
- ME3: Modification of water column characteristics;
- ME4: Creation of habitat;
- ME5: Alteration of behaviour and entanglement of seabirds and marine fauna;
- ME6: Introduction of alien invasive species or spread of fouling pests;
- ME7: Transmission of diseases to wild populations;
- ME8: Risk of genetic interaction with wild populations; and
- ME9: Contamination by therapeutants and trace contaminants from finfish farming.

2.1.3.1 Potential Impact ME2: Modification of Seabed Characteristics

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
  - *Effects of suspended shellfish culture on biodeposition and associated physico-chemical changes to sediment properties;*
  - *Changes in biological communities in response to changes in sediment properties;*
  - *Modification of seabed habitat at suspended shellfish cultivation sites;*
  - *Shading of the seabed under suspended shellfish cultivation facilities;*
  - *Contamination of sediments or the water body from suspended shellfish cultivation; and*
- *Operation Phase: Finfish farming:*
  - *Effects of finfish culture on nutrient enrichment, sediment physico-chemical properties and alteration of benthic communities.*

The key impact on the seabed from **shellfish farming** arises from the deposition of shellfish faeces and pseudo-faeces[1], which leads to the enrichment of the seabed sediments beneath the farms, and associated effects on benthic communities, due to the high organic content of the particles. The intensity of impacts on the seabed depends on the degree to which biodeposits accumulate in the vicinity of a farm, which is a function of the:

- Rate of faeces and pseudo-faeces production;
- Initial dispersal, redistribution via creep, saltation and/or resuspension, influenced by:
  - Site-specific environmental characteristics (such as water depth, current speeds and directions, benthic habitat, wave climate and phytoplankton abundance); and
  - To a lesser degree, farm management practices (such as stocking densities, line orientation and harvesting techniques); and
- Rate of biodeposit decay.

Farms located in well-flushed tidal environments typically produce a favourable increase in macrofaunal biomass rather than the accumulation of pseudo-faeces, while farms located in sheltered embayments or inlet systems are expected to contribute to sediment hypoxia. Modelling of faeces and pseudo-faeces distribution at other farms have indicated that depositional footprints can exceed 250 m for farms in more energetic environments or greater water depth, while the footprint typically does not extend beyond 50 m from the farm boundaries for shallow, sheltered embayments with low flushing rates.

The increased sedimentation and accumulation of biodeposits on the seabed beneath shellfish farms can change the physico-chemical properties of sediments, including changes in sediment texture, local organic enrichment and increase in oxygen consumption, increased nitrogen release rates, sulphate reduction and lowered REDOX potential. Other possible effects are changes in shearstress at the seabed (with associated effects on flushing rates), biological changes in response to physico-chemical changes in the sediments and habitat modification.

Accumulation of organic matter and associated changes in physico-chemical properties can alter benthic micro- and macrobiota, microbial and meiofaunal community composition. Studies have indicated that changes in community structure were not always highly variable across sites and dependent on environmental conditions such as depth and average current velocity and will ultimately be related to site-specific characteristics, such as presence of species or habitats that are sensitive to deposition or of high conservation value.

Anchor blocks, mussel / oyster clumps and shell litter can potentially serve as a substrate for the formation of reef-type communities and result in an increase in predators and scavengers such as starfish, crabs and fish, thereby indirectly increasing local benthic diversity and productivity. In other situations, however, mussel clumps and shell litter can remain relatively barren of reef-type communities. Seabed community recovery rates are also assumed to be site specific and relatively rapid once farming ceases.

Farm structures can also result in shading of the seabed, with potential implications for the growth, productivity, survival and depth distribution of ecologically important primary producers such as benthic microalgae, macroalgae or seagrasses, and a range of associated ecological effects.

[1] Pseudo-faeces are particles that cannot be used as food, and which have been rejected by the animal; they are wrapped in mucus and then expelled.

However, water clarity (turbidity) in Saldanha Bay is generally poor, which reduces the potential impact of shading beneath structures in the proposed precincts of the ADZ.

The impact of shellfish farming on seabed characteristics is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low***[2] (Table 2-2). Although the reduced Big Bay South Alternative results in a lower impact, the overall impact rating is the same for both alternatives. The reduced Big Bay South Alternative is preferred from a seabed modification point of view.

Table 2-2: Significance of modification of seabed characteristics by shellfish farming

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**MEDIUM**	-ve	High
Essential mitigation measures: • Select sites favouring well-flushed, deep and productive areas (Big Bay North, Outer Bay North, Outer Bay South) and avoid potentially sensitive and valuable habitats such as conservation areas (Malgas Island, Jutten Island, Langebaan Lagoon MPAs), biogenic habitats (e.g. kelp beds) and reefs (e.g. Lynch Blinder, North Bay Blinder). (Note: raft density within each farm, production levels per farm or the number of precincts within the agreed ADZ will also influence the level of mitigation deemed appropriate). • Leave mooring anchors or blocks in place when undertaking structure maintenance or fallowing sites to avoid repetitive impacts of the same activity at each site. • Avoid high density culture (overcrowding). The recommended density is one raft of 800 droppers per ha; 11 longlines of 832 droppers per ha. • Implement recommended monitoring in seabed properties at farming sites and compile annual monitoring reports.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	-ve	High

The environmental impacts associated with shellfish farming discussed above also generally apply to **finfish farming**. A number of impacts are, however, specific to finfish farming. The addition of feed in finfish farming adds uneaten feed to depositions.

Modelling of nutrient and chemical waste dispersal from a proposed commercial-scale fish farm at Mossel Bay, assuming a very efficient Food Conversion Ratio (FCR) of 1.2, predicted a depositional footprint of 200 m around cages. At a less efficient FCR the footprint would likely be higher. However, in comparatively shallow habitats (such as Saldanha Bay), where fish cages would be close to the seabed, depositional footprints are likely to be much reduced.

The impact of finfish farming on seabed characteristics is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***medium*** (Table 2-3). As the area excluded for the reduced Big Bay South Alternative was not identified for fish farming, the impact is identical for both alternatives.

[2] The sub-impact of habitat modification through anchor blocks, mussel / oyster clumps and shell litter was rated as medium significance after mitigation, assuming the build-up of material is not actively removed. The sub-impact of sediment contamination through shellfish farming was rated as very low significance.

Table 2-3: Significance of modification of seabed characteristics by finfish farming

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td colspan="9">All alternatives</td></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>High
3</td><td>Long-term
3</td><td>High
7</td><td>Definite</td><td>HIGH</td><td>-ve</td><td>Low</td></tr>
<tr><td colspan="9">Essential mitigation measures:
Select sites avoiding potentially sensitive and valuable habitats such as conservation areas (Malgas Island, Jutten Island, Langebaan Lagoon MPAs), biogenic habitats (e.g. kelp beds, seabird breeding and foraging areas) and reefs (e.g. Lynch Blinder, North Bay Blinder).
Select suitably deep sites that allow cages to be suspended at least 5 m above the seabed.
Implement buffers and a phased-in development of finfish farms.
Ensure that finfish cages do not occupy more than 30% of the total area allocated for finfish farming at any one time, both within individual licence areas and overall within the portions of the ADZ identified for finfish culture.
Manage stocking densities at levels to ensure that environment health is maintained, as determined by the environmental sampling and monitoring programme (see EMPr).
Monitor and manage feeding regimes to minimise feed wastage and chemical usage. Use high digestibility, high energy and low phosphorus feeds, species and system-specific feeds and maximize food conversion ratios (and minimize waste).
Rotate cages within a production area to allow recovery of benthos.
Limit annual increases in finfish production to no more than 1 000 t, and only if monitoring results indicate that environment health has been maintained and impacts remain manageable, up to 5 000 tpa ungraded production.
Only exceed finfish production of 5 000 tpa (after at least 5 years) to a maximum of 10 000 tpa if a precautionary approach is applied, involving strict and intensified monitoring programmes and adherence to environmental quality standards. Should standards or precautionary limits be approached or exceeded, the sampling and monitoring plans must include a response procedure that leads to appropriate downward adjustment of fish production.
Adopt the (relevant aspects of) MOM (Modelling-Outgrowing-Monitoring) management system (or similar) to monitor infaunal and epifaunal macrobenthic communities at farming sites.
</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Medium
2</td><td>Long-term
3</td><td>Medium
6</td><td>Definite</td><td>MEDIUM</td><td>-ve</td><td>Low</td></tr>
</table>

Prior to the development of finfish culture in Saldanha Bay, analytical and numerical modelling exercises must be undertaken using detailed, site-specific current modelling data to predict the magnitude and extent of waste plumes generated, to ensure that these do not impact on sensitive habitats such as the Saldanha Bay shoreline, important reefs and MPAs. **However**, analytical and numerical modelling for finfish farming is not deemed necessary if:

- Recommended mitigation measures for siting, buffer zones and managing stocking densities are implemented; these include:
  - A 1 000 m buffer around the Malgas Island MPA and the entrance to the Langebaan Lagoon;
  - A 250 m wide buffer at Jutten Island[3]; and
  - A 100 m wide buffer around reefs and blinders; and
- A phased approach for the development of finfish cage culture in the ADZ is implemented, limiting annual increases in finfish production to 1 000 tons per annum (tpa), and only if

[3] The recommendation to implement buffer zones is aimed at mitigating a number of impacts, including modification of sea bed characteristics and disturbance of seabird colonies and associated feeding areas in MPAs. The seabird population is deemed more sensitive on Malgas Island (also see Section 2.1.3.4). As such, and taking into account both considerations, it is understood that a 250 m-wide buffer is deemed sufficient by DEA at Jutten Island, where the bird population is deemed less sensitive.

monitoring results indicate that environment health has been maintained and impacts remain manageable, up to 5 000 tpa ungraded production.

2.1.3.2 Potential Impact ME3: Modification of Water Column Characteristics

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
  - *Effects of farm structures on currents and waves;*
  - *Effects of farm structures on seawater nutrient chemistry:*
  - *Removal of seston[4] from the water column by suspended shellfish cultivation;*
  - *Preferential feeding by shellfish may alter plankton community structure;*
  - *Increased incidence of Harmful Algal Blooms (HABs) caused by suspended shellfish cultivation; and*
- *Operation Phase: Finfish farming:*
  - *Effects of finfish culture on water column chemistry.*

The water column is a highly dynamic environment that varies markedly in space and time due to complex hydrodynamics and chemical and biological processes. This complexity is further compounded by the way that the physiological processes of filter-feeding bivalves interact with the surrounding water. Therefore, not only can the physical presence of the **shellfish farming** structures influence the current and wave regime in an area, but the composition of water passing through a mussel farm can be altered in a variety of ways, both in terms of the amount and composition of particulate matter as well as dissolved nutrients.

Shellfish farms generate drag forces in their interaction with currents. The size, aspect ratio and orientation of suspended culture systems, spacing of ropes, rope diameter, stock biomass and presence of predator nets all contribute to the degree to which water flow through the farm is affected. Previous studies demonstrated a small 10% decrease in current speed within mussel rafts in Saldanha Bay; increased rope density further reduced current velocities. Rafts have, however, become longer and thinner, thereby reducing drag. Ecosystem function could be affected through increased retention and reduced flow rates (modifying deposition regimes), alteration of the wave climate shoreward of farms (which could theoretically affect ecologically important intertidal and shallow subtidal habitats) and anchor blocks (producing localized scouring).

The present density of rafts and longlines in Saldanha Bay has little impact on currents and waves, but with increased density of farming structures, potential impacts, particularly in Small Bay, may also increase. In general, the impact on hydrodynamics is likely to be small compared to impacts on other marine aspects. It is therefore considered unlikely that the proposed expansion of shellfish farming in Saldanha Bay will significantly affect bay-wide hydrodynamic characteristics. At the local farm-scale, effects on currents may have potential implications for the sustainability of individual shellfish ventures and the local ecosystem.

Filter-feeding bivalve farms effectively create a fixed biological filtration system suspended through the upper portion of the water column, and mussels have been reported to filter up to 8.6 litres per

[4] The organisms (bioseston) and non-living matter (abioseston) swimming or floating in a water body. Plankton can be regarded as bioseston.

mussel per hour, extracting seston (possibly comprising phytoplankton, zooplankton, ichtyoplankton, protozoa, bacteria, detrital organic matter and inorganic sediment). A substantial proportion of the seawater flowing through a fully stocked farm will thus be “processed” by the bivalves as it passes through the farm. This could lead to food depletion, which could affect cultured stock and other suspension-feeders in the ecosystem. The considerable variation in food depletion identified in studies and associated with environmental conditions suggests that adverse ecosystem effects over bay-wide scales are unlikely. The proposed ADZ production volume considers the ecological carrying capacity estimated by Probyn et al. (2015) for Saldanha Bay.

Studies have indicated that some bivalve species may select specific food items based on particle size and/or nutritional value, and are unable to efficiently filter out picoplankton (phytoplankton cells <2 μm). Preferential filtering may result in changes to the size structure of the plankton communities in a farmed area, particularly in areas of low flow.

The alteration of seawater nutrient chemistry around and within the proposed farms depends on the scale of operations, their effects on the hydrodynamic regime and the stocking density. Possible alterations include:

- Removal of oxygen from the water column by bivalves, associated fouling organisms and decomposing of particulate organic materials beneath farms; however, development of anoxic zones within the water column is extremely unlikely; and
- Release of dissolved nitrogen (e.g. ammonium) into the water column from the metabolic waste products of cultured filter-feeders. Microbial breakdown of mussel biodeposits can result in stimulation of further phytoplankton production and/or stimulation of algae production that could potentially enhance coastal fish production.

HABs represent a particular risk in shellfish growing waters. There is, however, no evidence from other parts of the world that localised farm-generated enrichment or alteration of phytoplankton communities have increased the incidence of HABs.

The environmental impacts associated with shellfish farming discussed above also generally apply to **finfish farming**. A number of impacts are, however, specific to finfish farming. The addition of feed in finfish farming adds uneaten feed and faeces and the release of excreted ammonia.

Modelling of nutrient and chemical waste dispersal from a proposed commercial-scale fish farm at Mossel Bay, assuming a very efficient FCR of 1.2, predicted elevated levels of dissolved nutrients up to 2 km from the fish cages, with nitrate levels expected to be above background concentrations as much as 8-12 km from the site under certain oceanographic conditions. At a less efficient FCR the footprint would likely be higher.

Expelled particulate wastes will also result in nutrient enrichment in the water column in the vicinity of finfish farms, which can stimulate phytoplankton growth (potentially leading to eutrophication and the development of algal blooms), reduce water transparency (thereby affecting the growth of macroalgae and seagrasses) and alter phytoplankton species composition. Estimates indicate that production of 5 000 tpa of finfish may introduce Nitrate (N) volumes produced by finfish farming that are equivalent to ~15% of N occurring in the Bay.

The impact is assessed to be of ***medium***[5] significance and with the implementation of mitigation is reduced to ***low***[6] (Table 2-4). Although the reduced Big Bay South Alternative results in a lower

[5] This impact rating has been aggregated across the various sub-impacts. While the effects of farm structures on currents and waves was rated as potentially High significance before mitigation if the extent is deemed regional, the specialist also notes that the proposed expansion of shellfish farming in Saldanha Bay will

impact, the overall impact rating is the same for both alternatives. The reduced Big Bay South Alternative is preferred from a marine ecology point of view.

Table 2-4: Significance of modification of water column characteristics

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
All alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** **6**	Probable	**MEDIUM**	-ve	High
Essential mitigation measures: • Select sites avoiding potentially sensitive and valuable habitats such as conservation areas (Malgas Island, Jutten Island, Langebaan Lagoon MPAs), biogenic habitats (e.g. kelp beds, seabird breeding and foraging areas) and reefs (e.g. Lynch Blinder, North Bay blinder). • Select sites favouring well-flushed, deep and productive areas (Big Bay North, Outer Bay North, Outer Bay South). • Implement buffers and a phased-in expansion of shellfish and finfish farms. • Manage stocking densities at levels to ensure that environment health is maintained, as determined by the environmental sampling and monitoring programme (see EMPr). • Undertake ongoing, detailed water quality monitoring; including baseline surveys at control and impact sites, and decrease the ADZ carrying capacity should the environmental quality indicator be exceeded outside of the accepted sacrificial footprint. • Monitor and manage feeding regimes to minimise feed wastage and chemical usage. Use high digestibility, high energy and low phosphorus feeds, species and system-specific feeds and maximize food conversion ratios (and minimize waste). • Limit annual increases in finfish production to no more than 1 000 t, and only if monitoring results indicate that environment health has been maintained and impacts remain manageable, up to 5 000 tpa ungraded production. • Only exceed finfish production of 5 000 tpa (after at least 5 years) to a maximum of 10 000 tpa if a precautionary approach is applied, involving strict and intensified monitoring programmes and adherence to environmental quality standards. Should standards or precautionary limits be approached or exceeded, the sampling and monitoring plans must include a response procedure that leads to appropriate downward adjustment of fish production. • Monitor for copper leachate from antifouling paint.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Definite	**LOW**	-ve	High

Prior to the expansion of shellfish farms in Saldanha Bay, analytical and numerical modelling must be undertaken to predict the effects of shellfish farming structures on local and bay-wide currents, stratification and wave climates (either for specific precincts or for site-specific farms). The results could additionally be used to develop alternative farm designs, and to adjust the orientation of rafts/longlines and submerged structures relative to prevailing currents so as to minimise possible localised hydrodynamic changes. **However**, analytical and numerical modelling for shellfish farming is not deemed necessary if:

- Recommended mitigation measures for siting of buffer zones are implemented; these include:
  - A 500 m-wide buffer around the Malgas Island MPA and at the entrance of the Langebaan Lagoon;

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unlikely significantly affect bay-wide hydrodynamic characteristics, and that the impact on hydrodynamics is likely to be small compared to impacts on other marine aspects.

[6] This impact rating has been aggregated across the various sub-impacts. While the effects of farm structures on currents and waves was rated as potentially Medium significance after mitigation if the extent is deemed regional, the specialist also notes that the proposed expansion of shellfish farming in Saldanha Bay will unlikely significantly affect bay-wide hydrodynamic characteristics, and that the impact on hydrodynamics is likely to be small compared to impacts on other marine aspects. The impacts on seawater chemistry and plankton community structure were both rated as Very Low after mitigation.

  - A 250 m-wide buffer around the Jutten Island MPA[7]; and
  - A 100 m-wide buffer around reefs and blinders;

- A phased approach for the expansion of shellfish farms in the ADZ is implemented, limiting annual ungraded shellfish production to 10 000 tpa for the first two years, increasing thereafter annually by 5 000 tpa only if monitoring results indicate that environment health has been maintained and impacts remain manageable to a maximum of 27 600 tpa ungraded production; and
- A phased approach for the development of finfish cage culture in the ADZ is implemented, limiting annual increases in finfish production to 1 000 tons per annum (tpa), and only if monitoring results indicate that environment health has been maintained and impacts remain manageable, up to 5 000 tpa ungraded production.

2.1.3.3 Potential Impact ME4: Creation of Habitat

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
  - *Creation of habitat by farm structures; and*
- *Operation Phase: Finfish farming:*
  - *Effects of finfish culture on habitat creation.*

Shellfish and finfish farm structures provide a three-dimensional suspended reef habitat for colonisation by fouling communities and the aggregation of wild fish or other associated biota. The structures can therefore play a role in the pelagic ecosystem through enhancement of local biodiversity and productivity. The assemblages that develop on artificial structures can be quite different to those in adjacent rocky areas.

Artificial structures also provide novel foraging habitat, detrital food sources, breeding habitat, and refuge from predators for many species. Although the functional role of the associated fouling community is not well understood, it contributes in some way to the water column and seabed effects described above.

The benefit is assessed to be of ***medium*** (positive) significance (Table 2-5). No mitigation is possible.

[7] It is understood that a 250 m-wide buffer is deemed sufficient by DEA at Jutten Island, where the bird population is deemed less sensitive.

Table 2-5: Significance of creation of habitat

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
All alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**MEDIUM**	+ve	High
Essential mitigation measures: • None.								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**MEDIUM**	+ve	High

2.1.3.4 Potential Impact ME5: Alteration of Behaviour and Entanglement of Seabirds and Marine Fauna

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
  - *Effects of suspended shellfish cultivation on fish;*
  - *Effects of suspended shellfish cultivation on seabirds;*
  - *Effects of suspended shellfish cultivation on marine mammals; and*
- *Operation Phase: Finfish farming:*
  - *Effects of finfish cage culture on seabirds, marine mammals and piscivorous predators.*

By creating conditions (such as a fouling community) that is conducive to fish, and effectively creating commercial ‘no-take’ areas, **shellfish farms** could benefit the wild fish population. Such effects could potentially be compromised if farms result in removal of eggs and larvae or create additional recreational fishing pressure. Overall, it is deemed unlikely that shellfish farming in Saldanha Bay would have significant knock-on effects on the sustainability of wild fish populations.

Saldanha Bay, Langebaan Lagoon and the associated islands provide important shelter, feeding and breeding habitat for at least 53 species of seabirds. Potential positive effects of aquaculture structures on seabirds are potentially increased foraging success on fish aggregating in the area and biofouling organisms, availability of farm structures as perching sites for look-outs or to evade shore predators and as roost sites closer to foraging areas. Potential negative impacts include reduced surface or seabed feeding area available to seabirds, increased human disturbance in offshore areas while activities take place (daily) on structures. No entanglements of seabirds in shellfish farm lines have been reported, although lost lines and plastics are a concern.

Interactions between marine mammals and aquaculture usually result from an overlap between the spatial location of the facilities and the breeding, feeding and/or migrating habitat of the marine mammal species. Impacts include range restriction, underwater noise, potential for entanglement and alterations in trophic pathways. The mammal species that are likely to occur in the ADZ occur over a wide range, and none have restricted feeding areas within the project area. The probability of interaction is species dependent. Interaction with whales and dolphins is unlikely within the bay, but possible in Outer Bay. Although no longer breeding on the Saldanha Bay islands, Cape fur seals forage widely throughout inshore waters along the southern African West Coast and over the continental shelf, being attracted to fishing vessels and harbours. Seals would be present across the extent of the ADZ area.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low***[8] (Table 2-6). Although the reduced Big Bay South Alternative results in a lower impact, the overall impact rating is the same for both alternatives. The reduced Big Bay South Alternative is preferred from a marine ecology point of view.

Table 2-6: Significance of alteration of behaviour and entanglement of seabirds and marine fauna from shellfish farming

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	-ve	High
Essential mitigation measures: • Implement buffer zones at MPAs. • Minimise the potential for litter entering the marine environment (particularly plastic wastes). • Keep a log of all cetaceans, seabirds and predators recorded in the vicinity of fish farms, including behavioural observations. These data should be periodically compiled and analysed by experts.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	-ve	High

The environmental impacts associated with shellfish farming discussed above also generally apply to **finfish farming**. Some impacts are, however, more pronounced for finfish farming.

Interaction with whales is unlikely, while interaction with smaller cetaceans is possible and interactions with seals, diving seabirds and large predatory fish (particularly sharks) is definite, requiring predator exclusion nets around cages. In particular, the area around Malgas Island has a high abundance of seals, who prey regularly on both adult and juvenile gannets that nest on the island. Attraction of seals to the island by fish farms could thus increase predation. Heavisides dolphins are also reported in Outer Bay North.

The potential for wider, more indirect ecosystem effects on seabirds and marine mammals due to finfish cage culture includes food-web interactions, biotoxin and pathogen outbreaks and antibiotic use. While these potential indirect interactions have been considered in the literature, no actual research on any indirect effect has yet been documented. The intensity of the impact is deemed high due to the high threat status of some potentially affected species.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 2-7). As the area excluded for the reduced Big Bay South Alternative was not identified for fish farming, the impact is identical for both alternatives.

[8] This impact rating has been aggregated across the various sub-impacts. The post-mitigation impact of shellfish farming on fish was rated Medium significance (positive), although the specialist notes that it is unlikely that shellfish farming in Saldanha Bay would have significant knock-on effects on the sustainability of wild fish populations. The impact of shellfish farming on marine mammals was rated as Very low.

Table 2-7: Significance of alteration of behaviour and entanglement of seabirds and marine fauna from finfish farming

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**HIGH**	-ve	High
Essential mitigation measures: • Implement buffer zones at MPAs (as discussed in Section 2.1.3.1). • Minimise the potential for litter entering the marine environment (particularly plastic wastes). • Remove any injured or dead fish from cages promptly. • Do not release any blood and/or offal (organic waste) from finfish into the bay. • Keep a log of all cetaceans, seabirds and predators recorded in the vicinity of fish farms, including behavioural observations. These data should be periodically compiled and analysed by experts. • Use predator exclusion nets as necessary. Enclose nets at the bottom to minimise entanglement, keep nets taut, use mesh sizes of < 6 cm and keep nets well maintained (e.g. repair holes). • Develop disentanglement protocols in collaboration with DAFF, DEA and the SA Whale Disentanglement Network and establish a rapid response unit to deal with entanglements.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	-ve	High

2.1.3.5 Potential Impact ME6: Introduction of Alien Invasive Species or Spread of Fouling Pests

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
    - *Introduction of alien invasive species or spread of fouling pests; and*
- *Operation Phase: Finfish farming:*
    - *Introduction of alien invasive species or spread of fouling pests.*

The development of new **shellfish farms** raises the likelihood that biosecurity risks will arise when pest organisms are spread by imported shellfish spat (e.g. oysters) into new regions. The prevalence of pests and diseases in South Africa's aquaculture industry is low at present. As mussel and oyster farming has been underway in Saldanha Bay for a number of years, expanded production is unlikely to pose a higher risk, unless increased demand for seed stock requires imports from new localities, or new mollusc species are introduced that are sourced from elsewhere. In such cases a risk analysis would need to be conducted as part of the import permit.

The development of **finfish farming** in Saldanha Bay also has the potential to exacerbate the domestic spread of pest organisms, although various management approaches can be implemented to reduce such risks.

Key components to biosecurity management are:

- Prevention of incursions, focussing on the management of high-risk pathways (including international source regions), new pathways and regional sources known to be infected by recognised high-risk pests;
- Surveillance (detection), focussing on passive surveillance (screening at airports and ports), routine surveillance (undertaken on and around marine farm structures and associated vessels and infrastructure by farm operators) or targeted surveillance of high-risk areas; and
- Control of populations and outbreaks requiring coordination with, and support from, all marine stakeholders (whose activities can spread unwanted organisms) and agencies at local, regional and national scales. Eradication measures and / or application of therapeutants

(pharmaceutical products, or 'medicines') are only advised if the risk of re-invasion can be managed and pests can be detected before they become widespread.

The impact is assessed to be of ***very high*** significance and with the implementation of mitigation is reduced to ***medium*** (Table 2-8). The impact significance is the same for both alternatives.

Table 2-8: Significance of introduction of alien invasive species or spread of fouling pests

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
All alternatives								
Without mitigation	Regional 2	High 3	Long-term 3	**Very High 8**	Probable	**VERY HIGH**	-ve	High
Essential mitigation measures: • Ensure that a high level of biosecurity management and planning is in place to limit the introduction of pests to be able to respond quickly and effectively should biosecurity risks be identified. • Undertake routine surveillance on and around marine farm structures and associated vessels and infrastructure for indications of non-native fouling species. • Maintain effective antifouling coatings and regularly inspect farm structures and farm vessels for pests. • Clean structures and hulls regularly to ensure eradication of pests before they become established. • If spat import cannot be avoided, only use spat from biosecure certified hatcheries. • Ensure that veterinarian protocols to eliminate any pests, parasites and diseases are strictly adhered to.								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	-ve	High

2.1.3.6 Potential Impact ME7: Transmission of Diseases to Wild Populations

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
    - *Transmission of diseases from cultured stock to wild populations; and*
- *Operation Phase: Finfish farming:*
    - *Transmission of diseases from cultured stock to wild populations.*

The risk of transmitting indigenous pathogens or parasites from cultured **shellfish** stock to wild populations and to other species can be considered minimal. The effects of disease on the farmed mussels themselves are of importance with regard to farm management and can be economically significant. This is a possibility only if the endemic species are susceptible and if appropriate intermediate hosts (if required) are available. The possibility that potential intermediate hosts could be part of the suite of fouling organisms should not be overlooked, both in life cycle studies and as possible control measures. There is international evidence that mytilids might harbour viruses with consequent threats to susceptible fish.

The higher frequency and prevalence of diseases in cultured **finfish** species compared to wild fish results primarily from the high density of fish within the net pen and therefore the increased likelihood that a pathogen will find a new susceptible host. Stress caused by adverse temperature and salinity levels, low oxygen or high carbon dioxide levels, poor diet, overcrowding, presence of predators, or high suspended solids will predispose fish to disease. There are many known diseases and parasites associated with finfish and the spread of parasites, viruses and bacterial infections between caged and wild fish populations is a significant concern for the fish farming industry worldwide.

The parasites and diseases infecting the endemic species being considered for cage culture in Saldanha Bay are not well studied, although kob at least are known to be infected by sea lice of the same genus (Caligus) that caused serious problems amongst salmonids. Yellowtail are regarded as nomadic, white stumpnose are migratory within Saldanha Bay, whilst silver kob within the vicinity (10-100 km) of future sea cages will also likely come into contact with farmed stock. All three of these species (and any others with nomadic or migratory movement patterns) would therefore be at an increased risk of contracting diseases and or parasites from stocked fish and spreading them through wild populations, both locally within the bay and regionally. Potential negative effects on wild stocks are particularly concerning, as all three of these species are important in the commercial and recreational line fisheries and wild kob in the area is assessed as collapsed.

Diseases and parasites can detrimentally affect both cultured and wild stocks, thereby adversely affecting production (e.g. reduced growth rates, unmarketable fish, and mass mortalities). Disease has been an issue within the Saldanha Bay salmon industry, and further issues may arise with other salmonids or endemics, depending on the location of the farms and the water quality in the area as a whole. This could lead to the use of therapeutants to manage disease risks, with associated indirect effects on ecosystem health.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 2-9) for both alternatives

Table 2-9: Significance of transmission of diseases to wild populations

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Regional 2	High 3	Long-term 3	**Very High 8**	Possible	**HIGH**	-ve	High
Essential mitigation measures: • Ensure that a high level of biosecurity management and planning is in place to limit the introduction of pests and diseases and to be able to respond quickly and effectively should biosecurity risks be identified. • If spat import cannot be avoided, only use spat from biosecure certified hatcheries and/or quarantine facilities. • Ensure that veterinarian protocols to eliminate any pests, parasites and diseases are strictly adhered to. • Discourage the use of chemicals in disease management. Use only prescribed veterinary chemicals.								
With mitigation	Local 1	High 3	Short-term 1	**Low 5**	Possible	**VERY LOW**	-ve	High

2.1.3.7 Potential Impact ME8: Risk of Genetic Interaction with Wild Populations

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Shellfish farming:*
  - *Risks of Genetic interactions with wild mussel populations – mussels;*
  - *Risks of Genetic interactions with wild oyster, scallop or abalone populations; and*
- *Operation Phase: Finfish farming:*
  - *Risks of genetic interactions of endemic culture species with wild populations.*

Aquaculture has the potential to affect genetic profiles of wild populations of the same species that is farmed. Any factor that reduces the overall genetic variability may compromise the capacity of that species to adapt to environmental change, and may even compromise the long-term survival of the species. If the genetic variation within a given population is reduced, the population will be less able to adapt to change. Inbreeding from culture-based production of seed is also possible.

With the exception of *Chromytilus meridionalis*, most of the **shellfish** culture species under consideration are non-native to the West Coast, although *Mytilus galloprovincialis* is now widespread on rocky shores along most of the southern African West Coast. Their success as an invasive alien suggests that they have adapted well genetically to their environment and hybridisation with cultured stocks is unlikely to reduce their genetic variation. The spat used by the industry is allowed to settle naturally onto the culture ropes. As such, genetic profiles are not expected to be affected by mussel culture at all.

If the oyster, abalone or scallop farming industry increases its dependence on hatchery-supplied spat, particularly with the advancements in selective breeding, this may require the development and implementation of genetic management protocols where relevant.

The impact is assessed to be of ***very low*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 2-10) for both alternatives.

Table 2-10: Significance of risk of genetic interaction with wild populations by shellfish farming

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Regional 2	Medium 2	Long-term 3	**High 7**	Possible	**MEDIUM**	-ve	High
Essential mitigation measures: • Ensure good physical and biological containment to limit the effects of escaped stocks.								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Possible	**LOW**	-ve	High

Escape from **finfish farms** is a common problem globally and can be expected with finfish farming in Saldanha Bay, given the exposed nature of the South African coast and abundance of large piscivores. Potential interactions between escapees from fish farms and wild fish populations include competition for resources, alteration of the genetic structure of wild fish populations by escapee fish and transmission of pathogens from farmed stocks to wild fish populations.

Effects from escapee salmonids are likely to be minimal given the small scale of the industry, the fact that only female fish will be farmed and the absence of salmonid species in wild populations within the grow-out region. In the case of endemic line fish species, the risk of genetic contamination is accentuated by the collapsed status of many of the stocks. Ecosystem effects from escapees or significant genetic influences on relatively small wild stocks may occur, resulting in potential further loss of genetic diversity.

DAFF has developed *Genetic Best Practice Management Guidelines for Marine Finfish Hatcheries in South Africa* that contains similar recommendations as the Marine Finfish Farmers Association of South Africa's *Environmental Impact Information Document* in this regard.

The potential genetic impacts of escapees to wild stocks will remain a threat until reproductively sterile fingerlings are available for fish cage farming in South Africa. Genetic effects are almost certainly species- and location specific. The issues regarding the genetic contribution from farms to wild population via gametes from farm fish will also only apply if the farmed fish achieve reproductively mature size before reaching harvest size. Maintaining a large effective population size and genetic homogeneity between cultured and wild stock is potentially an effective mitigation measure. In the case of salmonids, genetic interactions are improbable.

Confidence in the impact significance prediction is low, as effects will be species- and location specific, and monitoring would be required to determine any changes in genetic diversity in wild stocks due to the influence of escaped culture stock.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 2-11). As the area excluded for the reduced Big Bay South Alternative was not identified for fish farming, the impact is identical for both alternatives.

Table 2-11: Significance of risk of genetic interaction with wild populations by finfish farming

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td colspan="9">All alternatives</td></tr>
<tr><td>Without mitigation</td><td>Regional
2</td><td>High
3</td><td>Long-term
3</td><td>Very High
8</td><td>Possible</td><td>HIGH</td><td>-ve</td><td>Low</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Implement suitable management and planning measures to limit the possibility of genetic interactions.
• Implement the “Genetic Best Practice Management Guidelines for Marine Finfish Hatcheries” developed by DAFF and ensure adequate genetic monitoring of brood stock rotation.
• Implement annual genetic monitoring between wild caught and farmed fish to monitor for any significant differences.
• Use appropriate spawning regimes in the hatchery to maintain genetic diversity in the offspring.
• Use all female or triploid salmonids in the farms.
• Use robust, well-maintained containment systems.
• Maintain cage integrity through regular maintenance and replacement.
• Ensure appropriate training of staff.
• Develop and implement recovery procedures should escapes occur.</td></tr>
<tr><td>With mitigation</td><td>Regional
2</td><td>Low
1</td><td>Long-term
3</td><td>Medium
6</td><td>Improbable</td><td>LOW</td><td>-ve</td><td>Low</td></tr>
</table>

2.1.3.8 Potential Impact ME9: Contamination by Therapeutants and Trace Contaminants from Finfish Farming

This section relates to the following impacts assessed in the marine ecology study:

- *Operation Phase: Finfish farming:*
    - *Impacts of therapeutants and trace contaminants.*

Therapeutants (pharmaceutical products, or ‘medicines’), disinfectants, anti-fouling paints and feed are all potential sources of chemicals to the marine environment from **finfish farms**. Some chemical contaminants have the potential to accumulate and persist in the marine environment, resulting in deleterious effects to biota. Inappropriate use of medicines may lead to resistance in pathogenic organisms. Therapeutant treatments are typically parasite or disease-specific. In general, however, most therapeutants are water soluble and break down readily and therefore have limited environmental significance. Those administered as feed additives, however, can be deposited on the seabed or taken up by other animals feeding on the feed-waste.

Internationally, increased levels of trace metals (zinc, a nutritional supplement, and copper, from antifouling paints) have been reported in sediments beneath fish cages. Global bodies have highlighted the environmental and public health threats of chemical use on fish farms and the salmon farming industry has moved away from the use of antibiotics and organophosphates; however, numerous other potentially hazardous chemicals are still a serious concern.

The South African finfish aquaculture industry will almost certainly need to use chemicals to protect infrastructure and treat stock. The DAFF Marine Aquaculture Code of Conduct requires that all chemicals and treatments procedures must receive prior approval by the governing authorities. The MFFASA code of conduct recommends avoiding hazardous chemical use, minimizing the use of agricultural, veterinary and industrial chemicals and adherence to legal requirements when these are required. Contaminant inputs to the environment should thus be minimised to ensure contaminant loads remain within acceptable limits in the future, as if not managed, wider natural processes may be affected or altered if chemicals used in fish cage operations bio accumulate up food chains. The tendency for bioaccumulation of many of the chemicals used in fish cage culture is not well understood, and the biological availability and ecotoxicity of these contaminants in the environment would be site, species and even population specific.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 2-12). As the area excluded for the reduced Big Bay South Alternative was not identified for fish farming, the impact is identical for both alternatives.

Table 2-12: Significance of contamination by therapeutants and trace contaminants from finfish farming

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
All alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** **6**	Probable	**MEDIUM**	-ve	Medium
Essential mitigation measures: • Use only approved veterinary chemicals and antifoulants. • Reduce levels of nutritional therapeutants and trace contaminants in feed, using only the lowest effective doses. • Use the most efficient drug delivery mechanisms that minimise the concentrations of biologically active ingredients entering the environment. • Establish and adhere to guidelines around the use of anti-fouling products in the mariculture industry. • Do not apply antifoulants on site and use environmentally friendly alternatives where effective.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Probable	**LOW**	-ve	Medium

2.1.4 The No-Go Alternative

The No Go alternative entails no change to the *status quo*, in other words, aquaculture will continue in areas that are currently operational in Small Bay and in isolated areas in Outer Bay and Big Bay, and may expand into areas authorised through separate EIA processes. There is a possibility that future development will take place in Big Bay related to the Oil and Gas industry and iron ore export operations. The No-Go alternative does not result in impacts or benefits relative to the current situation.

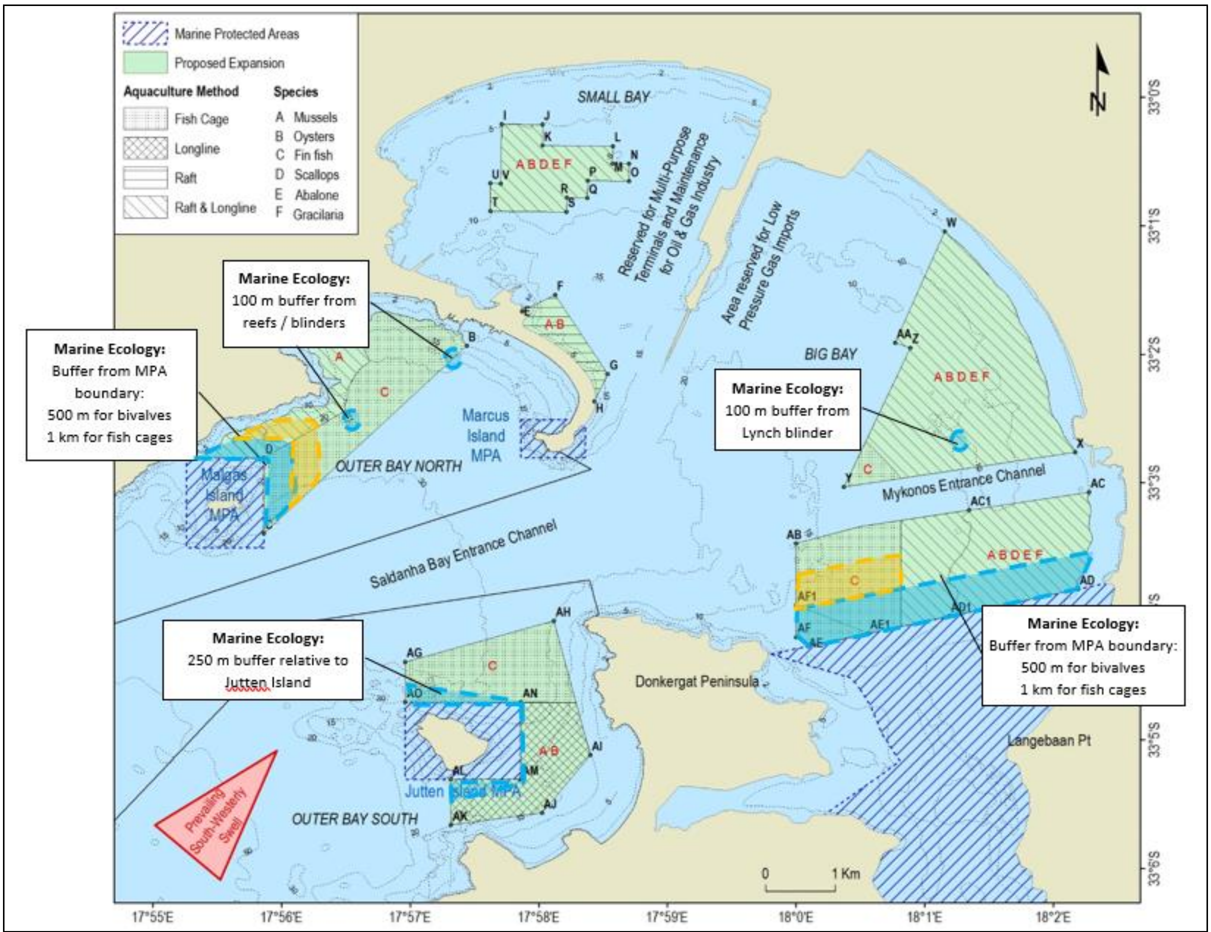
2.1.5 Mitigation Measures: Potential Aquatic Ecology Impacts

Essential marine ecology mitigation measures during **design** are as follows:

- Implement buffer zones to avoid the need for analytical and numerical modelling of aquaculture farms (Figure 2-1):
  - A 500 m buffer around the Malgas Island MPA and the entrance to the Langebaan Lagoon for shellfish farms;
  - A 1 000 m buffer around the Malgas Island MPA and the entrance to the Langebaan Lagoon for finfish farms;
  - A 250 m-wide buffer at Jutten Island; and
  - A 100 m-wide buffer around reefs and blinders; and
- Implement a phased approach for the development of **finfish** cage culture in the ADZ to avoid the need for analytical and numerical modelling of aquaculture farms, limiting annual increases in finfish production to up to 1 000 t, and only if monitoring results indicate that environment health has been maintained and impacts remain manageable, up to 5 000 tpa ungraded production.
- Only exceed finfish production of 5 000 tpa (after at least 5 years) to a maximum of 10 000 tpa if a precautionary approach is applied, involving strict and intensified monitoring

programmes and adherence to environmental quality standards. Should standards or precautionary limits be approached or exceeded, the sampling and monitoring plans must include a response procedure that leads to appropriate downward adjustment of fish production.

- Implement a phased approach for the expansion of **shellfish** farms in the ADZ, limiting annual ungraded shellfish production to 10 000 tpa for the first two years, increasing thereafter annually by 5 000 tpa only if monitoring results indicate that environment health has been maintained and impacts remain manageable, to a maximum of 27 600 tpa ungraded production.
- Select suitably deep sites that allow finfish cages to be suspended at least 5 m above the seabed.
- Develop disentanglement protocols in collaboration with DAFF, DEA and the SA Whale Disentanglement Network and establish a rapid response unit to deal with entanglements.



srk consulting	**SALDANHA ADZ** AREAS TO AVOID IN MITIGATION OF MARINE ECOLOGY IMPACTS (IN BLUE AND ORANGE)	Project No. 499020

Figure 2-1: Areas to avoid in mitigation of marine ecology impacts (in blue and orange)

Essential marine ecology mitigation measures during **construction** are as follows:

- Ensure mooring systems are well designed to prevent / limit movement of anchors and chains over the sea floor.

Essential marine ecology mitigation measures during **operations** are as follows:

- Ensure appropriate training of staff.

  - Manage stocking densities at levels to ensure that environment health is maintained, as determined by the environmental sampling and monitoring programme (see EMPr).

- Leave mooring anchors or blocks in place when undertaking cage net maintenance or fallowing sites to avoid repetitive impacts of the same activity at each site.
- Do not discard fouling organisms removed from oyster stacks, abalone barrels and finfish cages taken onshore for maintenance back into the marine environment.
- Ensure that a high level of biosecurity management and planning is in place to limit the introduction of pests and diseases and to be able to respond quickly and effectively should biosecurity risks be identified.
- Undertake routine surveillance on and around marine farm structures and associated vessels and infrastructure for indications of non-native fouling species.
- Maintain effective antifouling coatings and regularly inspect farm structures and vessels for pests; clean structures and hulls regularly to ensure eradication of pests before they become established.
- Use only approved veterinary chemicals and antifoulants.
- Establish and adhere to guidelines around the use of anti-fouling products in the mariculture industry.
- Do not apply antifoulants on site and use environmentally friendly alternatives where effective.
- Ensure that veterinarian protocols to eliminate any pests, parasites and diseases are strictly adhered to.
- Minimise the potential for litter entering the marine environment (particularly plastic wastes).
- Ensure debris and waste material does not enter the water to minimise the risk of attraction and entanglement by seabirds, marine mammals and large predators.
- Keep a log of all cetaceans, seabirds and predators recorded in the vicinity of fish farms, including behavioural observations. These data should be periodically compiled and analysed by experts.
- Implement recommended monitoring.
- When farming seaweeds, use only locally sourced *Gracilaria* for stocking the ropes.
- Shellfish-specific mitigation measures:
  - Avoid high density culture (overcrowding). The recommended density is one raft of 800 droppers per ha; 11 longlines of 832 droppers per ha; 11 longlines of 176 oyster stacks / abalone barrels per ha.
  - Reduce the discard rate of over-settlement.
  - If spat import cannot be avoided, only use spat from biosecure certified hatcheries.
- Finfish-specific mitigation measures:
  - Monitor and manage feeding regimes to minimise feed wastage and chemical usage.
  - Use high digestibility, high energy and low phosphorus feeds, species and system-specific feeds and maximize food conversion ratios (and minimize waste).

- Ensure that finfish cages do not occupy more than 30% of the total area allocated for finfish farming at any one time, both within individual licence areas and overall within the portions of the ADZ identified for finfish culture.
- Rotate cages within a production area to allow recovery of benthos.
- Remove any injured or dead fish from cages promptly.
- Ensure that minimal blood and offal enters the water during harvesting.
- Use predator exclusion nets as necessary. Enclose nets at the bottom to minimise entanglement, keep nets taut, use mesh sizes of < 6 cm and keep nets well maintained (e.g. repairing holes).
- Ensure good physical and biological containment to limit the effects of escaped stocks.
- Use robust, well-maintained containment systems.
- Maintain cage integrity through regular maintenance and replacement.
- Develop and implement recovery procedures should escapes occur.
- Use all female or triploid salmonids in the farms.
- Implement suitable management and planning measures to limit the possibility of genetic interactions.
- Implement annual genetic monitoring between wild caught and farmed fish to monitor for any significant differences.
- Use appropriate spawning regimes in the hatchery to maintain genetic diversity in the offspring.
- Implement the “Genetic Best Practice Management Guidelines for Marine Finfish Hatcheries” developed by DAFF and ensure adequate genetic monitoring of brood stock rotation.
- Take necessary action to eliminate pathogens through the use of therapeutic chemicals or improved farm management.
- Regularly inspect stock for disease and/parasites as part of a formalised stock health monitoring programme.
- Maintain comprehensive records of all pathogens and parasites detected as well as logs detailing the efficacy of treatments applied.
- Locate cages stocked with different cohorts of the same species as far apart as possible; if possible stock different species in cages successively.
- Implement good house-keeping practices in place at all times i.e. keep nets clean and allow sufficient fallowing time on sites to ensure low environmental levels of intermediates hosts and or pathogens.
- Treat adjacent finfish cages simultaneously even if infections have not yet been detected if prescribed by veterinarian.
- Discourage the use of chemicals in disease management. Use only prescribed veterinary chemicals.
- Reduce levels of nutritional therapeutants and trace contaminants in feed, using only the lowest effective doses.

  - Use the most efficient drug delivery mechanisms that minimise the concentrations of biologically active ingredients entering the environment.
  - Adopt the MOM management system (or similar) for monitoring.

Best practice marine ecology mitigation measures during **operations** are as follows:

- Use seaweeds as a co-culture species for use in Integrated Multi-Trophic Aquaculture (IMTA) rather than as monoculture.
- Monitor the immediate water column around the precincts or specific farms for:
  - Nutrient parameters (dissolved carbon, nitrogen and phosphorous); and
  - Key plankton parameters (chlorophyl a, phytoplankton abundance and species composition).
- Use only minimal non-navigational lighting at night.
- Use downward-pointing and shaded lights.
- Ensure all mooring lines and rafts are highly visible (use thick lines and bright antifouling coatings).
- Keep all lines taught through regular inspections and maintenance.
- Develop and enforce strict maintenance and operational guidelines and standards in relation to potential entanglement risks on the farm, including loose ropes, lines, buoys or floats.
- Develop disentanglement protocols in collaboration with DAFF, DEA and the SA Whale Disentanglement Network and establish a rapid response unit to deal with entanglements.
- Adopt appropriate maintenance and operational guidelines and standards for minimising noise in noise-generating equipment.
- Develop South African bivalve hatcheries to reduce the reliance on spat import, and hence the risk of non-intentional introduction of associated alien species and diseases.
- Develop technology to create sterile fry for stocking of cages.
- Restrict stocking densities to below 15-20 fish per m^3 to limit the spread of diseases and parasitic infections.
- Avoid the use of fertilizers or chemicals in the culture of seaweeds.

Additional mitigation measures and comprehensive monitoring requirements are laid out in the Environmental Management Programme (EMPr).

2.2 Potential Socio-Economic Impacts

2.2.1 Introduction, Terms of Reference and Methodology

Social impacts can be defined as “the consequences to human populations of any public or private actions (these include 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 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, gender and educational backgrounds etc. 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).

An economic impact refers to the effect that an event, policy or project has on economic factors, such as market activity, unemployment, income levels or government revenue. Economic impacts and social impacts are often interrelated.

The ToR for the study were to:

- Review literature, internet resources, previous studies and information provided by stakeholders relating to the socio-economic environment of the study area;
- Compile a baseline for the affected areas, including the potentially affected community as well as the local (municipal) and, where relevant, regional (district municipal) context;
- Analyse the information to ascertain the socio-economic conditions and characteristics of the study area;
- Identify the potential socio-economic impacts of the proposed project based on the baseline data, project description, review of other studies for similar projects and professional experience;
- Assess the significance of the socio-economic impacts using the SRK 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 announcement of the proposed Saldanha ADZ project 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.

Socio-economic impacts are likely to result from a number of project interventions and/or activities:

- Procurement and installation of equipment for new aquaculture farms;
- Change in character of the site (marine environment) caused by new aquaculture farms;
- Restriction in access to areas occupied by aquaculture farms; and
- Employment in and production at new aquaculture farms.

2.2.2 Assessment of Impacts: Construction Phase

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

- SE1: Investment in the economy; and

- SE2: Increased employment, income and skills development.

2.2.2.1 Potential Impact SE1: Investment in the Economy

It is expected that farms will be commissioned over time, in response to available funding and demand. However, this study assesses the ultimate investment scenario assuming the ADZ is fully utilised / occupied.

Table 2-13 indicates the full (pre-mitigation) extent of identified ADZ areas identified for shellfish and finfish production. It is assumed that areas identified as suitable for finfish are also suitable for bivalve cultivation, though the reverse does not necessarily apply. Table 2-14 shows the total bivalve and fish production volumes considered for the ADZ. It is deemed feasible that these volumes can also be produced in the post-mitigation scenario; they are thus realistic assuming that they are phased in gradually and ongoing monitoring shows that ecological impacts are acceptable.

Table 2-13: ADZ areas (ha)

Area	Total ADZ Area	Bivalves	Fish
Small Bay	163	163	-
Big Bay North	525	503	22
Big Bay South	521	326	195
Outer Bay North	336	112	224
Outer Bay South	327	153	174
Total	**1 872**	**1 257**	**614**

Table 2-14: Potential maximum ADZ production volumes

Product	Area (ha)	Graded production (tpa) [9]	Assumptions
Bivalves	1 871	15 203	ECC for total ADZ can be applied to smaller areas at higher densities
Fish	614	5 150	Nitrate (N) generated by finfish farming should not exceed 15% of N load in the Bay initially

Based on industry proposals for aquaculture in Saldanha Bay provided by DAFF, the capital investment for new aquaculture farms in the ADZ is estimated at R20 000 per (graded) ton of bivalve production and R30 000[10] per ton of finfish production, which implies the following potential capital investment values:

- At total ultimate production of some 15 000 (graded) tons of bivalves in the ADZ, additional[11] capital investment is estimated at R260 million (in 2016 equivalent Rand); and

[9] It is assumed that the total ADZ shellfish production volume could also be achieved in a smaller area (e.g. if no production takes place in recommended buffer areas) at higher densities, provided that environmental and shellfish growth characteristics remain acceptable.
Total ADZ finfish production volume is linked to maximum production densities per hectare and would be lower if no production takes place in recommended buffer areas.

[10] A high-level feasibility study of marine finfish aquaculture (Advance Africa, 2016) implies capex of R56 000 per ton of finfish production in cages, including hatchery in a reticulating aquaculture system, implying a total investment amount of R280 million for 5 000 tons of fish farming (including hatchery component).

[11] Excluding approximately 2 000 (graded) tons of bivalves currently produced.

- At total initial production of some 5 000 tons of finfish, capital investment is estimated at R150 million (in 2016 equivalent Rand).

It must be noted that a gradual increase of aquaculture in Saldanha Bay is recommended; as such the investment would be implemented over at least 3-5 years, possibly much longer. Capital investment values are estimates only and may differ significantly with different equipment, methods, bulk orders or over time.

Investment in the aquaculture farms will generate:

- Direct economic impacts, through the employment of staff and direct procurement from suppliers, e.g. equipment and contractors;
- Indirect economic impacts, mainly procurement by suppliers and service providers from other businesses; and
- Induced economic impacts, through increased demand from households earning an income from direct and indirect economic impacts.

The full investment value would be significant compared to the:

- Investment of some R2 billion by aquaculture companies in the Western Cape at present (WCADI, 2014);
- Saldanha Bay Municipality Regional Gross Domestic Product (GDPR) of R6.2 billion in 2014 (WCG Provincial Treasury, 2015); and
- Saldanha Bay Municipality agriculture sector GDPR, which was approximately R434 million in 2014 (WCG Provincial Treasury, 2015).

The extent of the benefit is deemed regional, as materials and expertise required during construction are likely to be available in and near Saldanha, given the existing expertise in bivalve farming in the area. Fish farming in the sea has been less explored in South Africa, and specialised equipment is likely to be sourced from further afield / abroad, which would dilute the benefit accruing locally. The intensity of the benefit is considered medium over a medium-term. Full production volumes can only be achieved if ongoing ecological monitoring of the Bay shows that impacts remain acceptable. To be conservative, the probability of the full benefit occurring has been rated as possible below. If the full investment is made, the impact significance is likely to be medium (positive).

The benefit is assessed to be of ***low*** (positive) significance without and with the implementation of mitigation (Table 2-15). As it is assumed that the total ADZ production volume can also be achieved in a smaller area, at higher densities, both alternatives have an equal benefit.

Table 2-15: Significance of investment in the economy

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
All Alternatives								
Without mitigation	Regional 2	Medium 2	Medium 2	**Medium 6**	Possible	**LOW**	+ve	Medium
Essential mitigation measures: • Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on Black Economic Empowerment (BEE) suppliers where possible.								
With mitigation	Regional 2	Medium 2	Medium 2	**Medium 6**	Possible	**LOW**	+ve	Medium

2.2.2.2 Potential Impact SE2: Increased Employment, Income and Skills Development

The number of direct employment opportunities created during the construction phase is not known, but expected to be relatively small, as the installation of aquaculture structures is relatively 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. As it is likely that individual farms will be commissioned sequentially, the overall construction phase is likely to involve short spurts of construction activity over a number of years.

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 created by the project at this stage, 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. 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 with the implementation of mitigation (Table 2-16). Assuming that the total ADZ production volume could also be achieved in a smaller area, at higher densities, both alternatives have an equal benefit.

Table 2-16: Significance of increased employment, income and skills development

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All Alternatives								
Without mitigation	Local 1	Low 1	Medium 2	**Very Low** **4**	Probable	**VERY LOW**	+ve	High
Essential mitigation measures: • Utilise local labour (Saldanha Bay Municipality) as much as possible.								
With mitigation	Local 1	Low 1	Medium 2	**Very Low** **4**	Probable	**VERY LOW**	+ve	High

2.2.3 Assessment of Impacts: Operation Phase

Five potential socio-economic impacts were identified during the operation phase:

- SE3: Contribution to the economy;
- SE4: Increased employment, income and skills development;
- SE5: Possible reduction in watersport activities and associated decline in tourism and business activities;
- SE6: Possible restrictions to military activities;
- SE7: Pressures on resources and infrastructure due to an influx of people;

2.2.3.1 Potential Impact SE3: Contribution to the Economy

Potential maximum production volumes for bivalves and fish in the ADZ are shown in Table 2-14. Based on industry proposals provided by DAFF, the average revenue for aquaculture farms in the ADZ is estimated at R20 000 per ton of bivalve production and R80 000 per ton of finfish production, which implies the following yearly revenues:

- At total ultimate production of some 15 000 (graded) tons of bivalves in the ADZ, additional[12] annual revenue is estimated at R300 million (in 2016 equivalent Rand); and
- At total initial production of some 5 000 tons of finfish, annual revenue investment is estimated at R400 million (in 2016 equivalent Rand).

It must be noted that a gradual increase of aquaculture in Saldanha Bay is recommended; as such the revenue would also gradually increase over at least 3-5 years. Ultimate fish production volumes in particular are associated with higher uncertainties and thus require monitoring and a slower ramp-up, further extending the potential timeframe over which the higher revenue is possibly achieved. Estimated revenue is likely to vary significantly over time, as the production is sensitive to environmental factors (such as algal blooms or water pollution) and pricing is sensitive to national and international competition and demand.

Revenue from aquaculture farms will generate:

- Direct economic impacts, through payment of salaries and direct procurement from suppliers, e.g. equipment and contractors;
- Indirect economic impacts, mainly procurement by suppliers and service providers from other businesses; and
- Induced economic impacts, through increased demand from households earning an income from direct and indirect economic impacts.

Multipliers for the aquaculture industry in South Africa are not yet established, and backward and forward linkages depend on inputs and downstream processing. Bivalve farming is expected to have a lower multiplier, as it requires fewer inputs (no feeds and relatively basic equipment) and less processing if mussels and oysters are sold fresh (which is often the case). More sophisticated processing of mussels / oysters, e.g. canning, is more labour-intensive. Fish farming is expected to have a higher multiplier and stronger linkages, as it requires feed, higher-tech equipment and more sophisticated processing of the fish after harvest.

The project will also contribute to local, regional and national income through payment of taxes and levies.

The extent of the benefit is deemed regional, as project and private expenditure is likely to take place in the region. The intensity of the benefit is considered medium, as revenue is likely to be volatile, over the long-term. Full production volumes can only be achieved if ongoing ecological monitoring of the Bay shows that impacts remain acceptable. To be conservative, the probability of the full benefit occurring has been rated as possible below. If full production is ecologically sustainable, the impact significance is likely to be high (positive).

The benefit is assessed to be of ***medium*** significance without and with the implementation of mitigation (Table 2-17). Assuming that the total ADZ production volume could also be achieved in a smaller area, at higher densities, both alternatives have an equal benefit.

[12] Excluding approximately 2 000 (graded) tons of bivalves currently produced.

Table 2-17: Significance of contribution to the economy

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
All alternatives								
Without mitigation	Regional 2	Medium 2	Long-term 3	**High 7**	Possible	**Medium**	+ve	Medium
Essential mitigation measures: • Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible. • Procure ancillary services for goods purchased overseas, such as installation, customisation and maintenance, from South African companies as far as possible.								
With mitigation	Regional 2	Medium 2	Long-term 3	**High 7**	Possible	**Medium**	+ve	Medium

2.2.3.2 Potential Impact SE4: Increased Employment, Income and Skills Development

Employment provides many socio-economic benefits to employees and their dependants, including:

- Improved material wealth and standard of living;
- Enhanced potential to invest and improved access to social services such as education and health services;
- Enhanced skills transferred to previously unskilled workers, facilitating employment prospects of such workers; and
- Contribution to a sense of independence, freedom and pride, which may promote a good work ethic.

The project is expected to create various types of employment.

Direct employment includes permanent project staff / contractors. The aquaculture industry in Saldanha Bay directly employed 89 people in 2013 (Olivier et al, 2013)[13]. Employment / production ratios depend on the culturing technology and harvesting method. Average ratios for mussel / oyster[14] and finfish cultivation were obtained from previous studies of the Saldanha Bay aquaculture industry as well as industry proposals for future expansion in the Bay (see Table 2-18). Bivalve production is significantly more labour intensive and generates more employment than any other aquaculture sector in South Africa (Olivier et al, 2013), and significantly more than finfish.

Table 2-18: Employment ratios in the Saldanha Bay aquaculture industry

Product	Staff per 100 tpa	Source	Comment
Mussels / oysters	7.6	Olivier et al (2013)	Average based on 2010 data for aquaculture industry in Saldanha Bay. Of these: • 75% are unskilled / semi-skilled labourers; • 97% are permanent staff; and

[13] Note that a submission by the Saldanha Bay and West Coast Shellfish Farmers Forum to SRK dated 14 November 2011 stated that eight aquaculture companies active in Saldanha Bay employed more than 150 full time personnel at the time.

[14] WCADI (2008) estimated employment at oyster farms at ~ 20 jobs per 100 tons production, while estimates of employment at mussel farms varied widely. Although no data is available for scallops and abalone, it is likely that employment levels will be similar to those at oyster farms as they use similar production technologies (WCADI, 2008).

Product	Staff per 100 tpa	Source	Comment
			• 17% are women.
	4.9	DAFF	Average based on industry proposals for aquaculture in Saldanha Bay provided by DAFF. Ratios vary widely for different companies from 0.2 to 21.3.
Fin fish	0.3	DAFF	Based on industry proposals for 2019 aquaculture in Saldanha Bay.

Assuming a production per employee ratio of ~6 staff per 100 tons of bivalves and 0.3 staff per 100 tons of fin fish, the proposed ADZ could support 855 additional direct jobs in the full operational scenario, most of which are generated by bivalve farming:

- Production of some 15 000 (graded) tons of bivalves in the ADZ could generate 780 additional[15] jobs, of which ~75% (585 staff) are likely to be unskilled / semi-skilled[16]; and
- Total initial production of 5 000 tons of finfish could generate 15 additional jobs.

Employees will support a number of dependants (Olivier et al, 2013 estimated that on average three dependants are supported by each worker, which would amount to 2 385 supported dependants for the full ADZ scenario).

Indirect employment includes off-site contractors and service providers to the project. Aquaculture creates and sustains indirect jobs in upstream sectors, e.g. equipment, stock and feed supply; downstream sectors, e.g. product processing; as well as in maintenance and other services provided by contractors, e.g. monitoring and security. The ratio of production to upstream and downstream jobs varies across aquaculture products and farming methods and is greater for methods requiring external supply of stock and feed and more intensive processing. Mussel farming is thus expected create a smaller ratio of indirect job than oyster or fish farming.

Induced employment includes employment generated by increased spending at businesses and on services by households earning an income from the project (the multiplier effect). The calculation of induced employment multipliers for this project is beyond the scope of this study, but certain to be positive.

A gradual ramp-up of aquaculture in Saldanha Bay is recommended; as such employment would also increase over at least 3-5 years. Ultimate fish production volumes in particular are associated with higher uncertainties and a slower ramp-up, further extending the potential timeframe to achieve the above employment figures. Although employment effects cannot be forecast with certainty, the project is expected to have a significant and positive employment impact.

Direct as well as many indirect jobs will be located at or near Saldanha Bay, as aquaculture often requires long working hours and swift response to changing conditions and - by implication - a workforce that lives nearby (Olivier et al, 2013). Unlike many other jobs in the agricultural and fishing sectors, employment at aquaculture farms is expected to be year-round, providing a regular income for workers[17].

Approximately 10 470 people were unemployed in 2011 in the Saldanha Bay Municipality, while the 23.4 % unemployment rate in 2011 was the highest in the West Coast District. A further 1 909 people of working age were discouraged job seekers and 22 168 were not economically active.

[15] Excluding approximately 2 000 (graded) tons of bivalves currently produced.

[16] In Saldanha Bay, 75% of the aquaculture workforce has Grade 9 or lower school education.

[17] However, Olivier et al (2013) notes that two farms in Saldanha Bay had to suspend employee salaries in the past during HAB closures of the industry.

Saldanha Bay unemployment and poverty levels have increased in recent decades due to the dwindling fishing industry in the area. Approximately 40 347 people (41% of the Saldanha Bay municipal population) reported that they earned no income in 2011 and 30 618 people (52% of income earners) earned less than R3 200 per month (Census 2011).

The creation of some 795 direct and additional indirect jobs would contribute meaningfully towards employment at the local level, and the ADZ would generate income for a large number of households. The aquaculture activity typically benefits residents with low skill levels, i.e. the people most in need of employment, income and skill development. DAFF (2012) also notes that the development of general and specific skills for aquaculture projects contributes to the socio-economic fabric of coastal communities, who may otherwise have limited opportunities to develop new and economically valuable skills that can also be applied in other sectors. In addition, aquaculture can provide more job opportunities for women and youth than fisheries traditionally do. Specialist skills also required in aquaculture include boat handling, commercial scuba diving and mechanical repairs.

Aquaculture projects may provide equity and empowerment opportunities, and some of the existing farms in Saldanha Bay have already entered into Broad-based Black Economic Empowerment (BBBEE) ventures. However, it is noted that the farms in the ADZ will be developed by a range of private developers, and their BBBEE status is not yet known.

The extent of the benefit is deemed local, as it is anticipated that workers will be sourced from communities located close to Saldanha Bay. The opportunities created by the value chain are also likely to benefit local communities most. The intensity of the benefit is considered medium, extending over the long term. Full production volumes can only be achieved if ongoing ecological monitoring of the Bay shows that impacts remain acceptable. To be conservative, the probability of the full benefit occurring has been rated as possible below. If full production is ecologically sustainable, the impact significance is likely to be high (positive).

Employment numbers are largely determined by the industry and market forces, and significant enhancement of the benefit is therefore unlikely.

The benefit is assessed to be of ***medium*** (positive) significance without and with the implementation of mitigation (Table 2-19). Assuming that the total ADZ production volume could also be achieved in a smaller area, at higher densities, both alternatives have an equal benefit.

Table 2-19: Significance of increased employment, income and skills development

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Possible	**MEDIUM**	+ve	Medium
Essential mitigation measures: • Utilise local labour (Saldanha Bay Municipality) as much as possible. Where non-local specialist staff is required, implement a training programme to upskill local labour to assume these positions over a period of 5 years. • Collect annual data on staff numbers, composition and origin and report these at least annually to the respective authorities (e.g. DAFF).								
With mitigation	Local 1	High 3	Long-term 3	**High 7**	Possible	**MEDIUM**	+ve	Medium

2.2.3.3 Potential Impact SE5: Possible Reduction in Watersport Activities and Associated Decline in Tourism and Business Activities

Saldanha Bay, together with Langebaan Lagoon, provides a wide and fairly unique range of conditions and scenic views that attract thousands of watersports enthusiasts engaging in sailing, paddling, windsurfing, kitesurfing, scuba diving, power boating and recreational fishing. Some

2 720 families are members of the three clubs affiliated to South African Sailing in Saldanha Bay (Saldanha Yacht Club, Langebaan Yacht Club and Club Mykonos) (South African Sailing, 23 August 2016), while others engage in watersports outside of club structures.

Watersports are most popular in the summer months from October to March, when on average 100 sailors and 150 kite and windsurfers use Saldanha Bay / Langebaan Lagoon system daily (South African Sailing, 23 August 2016). More than 1 000 recreational boats / small craft are launched annually in Saldanha Bay.

Some operators offer programmes to introduce youths (many from previously disadvantaged population groups) to watersports as an alternative to crime and drugs, which are common in the area.

A number of watersports competitions are held in Saldanha Bay, including:

- Local events, such as the Annual Downwind Dash (a yearly event attracting hundreds of windsurfers, kitesurfers, hobie catamarans and stand up paddlers) and other kitesurfing, windsurfing and inflatable boat racing events;
- Regional events, such as national, provincial and other sailing regattas; and
- Periodic international competitions, such as Hobie Worlds, Optimist Nationals and Lipton Cup.

The popularity of the Saldanha Bay / Langebaan Lagoon system for watersports has spawned a watersports industry and, more general, tourism industry in the Saldanha Bay region.

The watersports industry comprises watersports training facilities (including numerous schools teaching sailing, kitesurfing, windsurfing, paddling / kayaking and scuba diving), craft and equipment rentals and maintenance, guided tours and charters.

A detailed economic assessment of the tourism industry or Cost Benefit Analysis is excluded from the scope of this study. However, a high-level overview of economic indicators of the watersports industry in Saldanha Bay provided by industry stakeholders in 2016 (South African Yacht Training Association (Dove, 18 August 2016) and South African Sailing (23 August 2016)) is shown in Table 2-20 (the table does not include all watersports businesses and events in the area). The figures are approximations and were not independently verified; however, they are deemed suitable to provide an indication of the overall level of the economic contribution of the watersport industry.

Table 2-20: High-level indicators of direct economic contribution of watersports industry in Saldanha Bay

Sector	Employees	Turnover p.a.[18]	Participants p.a.	Comments
Sailing schools	~67	~R24.5 million (course fees only) *~R26 million (spending based on 2-week courses and R1 000 spend/ day/student)*	~1 850 students (in six schools), ~650 of these are international	Several schools offer internationally accredited Royal Yachting Association (RYA) training, which requires specific training conditions only available in South Africa in Saldanha Bay and Cape Town. Includes Atlantic Yachting, Ocean Sailing Academy, Sail Due South, Yacht Master Ocean Services, Two Oceans Maritime, Ocean Star

[18] Assumptions made by SRK on spending by watersports students are indicated in italics; these are based on average spend figures provided by the industry stakeholders listed above and conservative assumptions on course durations made by SRK. May include some double counting, as students or event competitors also engage in recreational watersports.

Sector	Employees	Turnover p.a.[18]	Participants p.a.	Comments
Clubs and Marinas	~50	~R4 million	~400 moorings	Full time mooring and other services Includes Club Mykonos, Yacht Port SA, Saldanha Bay Yacht Club, Langebaan Yacht Club
Kitesurfing / windsurfing	~42 in season, ~12 out of season	Course fees from ~R3 500 per week *(equivalent to ~R4.5 million for 1 300 students)* *~R6.5 million (spending based on 5-day stays and R1 000 spend /day/student)*	~1 300 students (in six schools)	Many schools also offer accommodation and catering / restaurants Includes Windtown, Kite Lab, Cape Sport Centre, Sirens, Wind Chasers, Wind Town Hotel
Annual formal competitions	n/a	~R2.7 million (spending by competitors)	~2 000 competitors	Includes SAS WC Provincial Championships, Hobie Champs Downward Dash, Hobie Champs Tiple Crown, SAKA Downwind Dash, SAKA Closing Round, WSA World, Mykonos Regatta
Informal / recreational watersports	n/a	~R45 million (incl. equipment hire, accommodation, food)	~45 000	High season from Oct - March Includes catamaran and small sailboats, kiteboards and windsurfers and keel boat cruising
Charters	n/a	~R3.6 million	n/a	
Total	**~150**	**~R116.8 million**	**~50 350[19]**	

Based on the high-level estimates presented in Table 2-20, the watersports industry is estimated to:

- Provide in excess of 150 direct jobs in the region. The number of indirect jobs in the associated tourism industry (e.g. accommodation, catering, car hire) is likely to be significantly larger; and
- Generate direct (e.g. course fees, equipment hire) and indirect (e.g. accommodation, catering, car hire) annual turnover of more than R100 million. Additional indirect turnover is generated in the associated tourism industry (e.g. accommodation, catering, car hire).

Different watersports use different areas of the Saldanha Bay / Langebaan Lagoon system and have different needs and safety requirements. While many activities take place on the more sheltered Langebaan Lagoon, stakeholder submissions indicate that the following Saldanha Bay areas are also of particular importance for watersports:

- Sailors and paddlers sail around Jutten Island (part of Outer Bay South ADZ precinct) – between the island and Donkergat Peninsula – under certain wind conditions, during sailing regattas from Cape Town, Mykonos and Saldanha Bay Yacht Club and to avoid the main port shipping channel. Scuba diving also takes place near Jutten Island; and
- The area located at the entrance of the Langebaan Lagoon and Club Mykonos (part of Big Bay South ADZ precinct) is utilised extensively by sailors, paddlers and surfers entering / exiting the Mykonos harbour and the Lagoon.

[19] May include some double counting, as students or event competitors also engage in recreational watersports.

Areas north of the entrance channel to Mykonos (part of Big Bay North ADZ precinct) and the Port of Saldanha (part of Outer Bay North ADZ precinct) are also used for watersports, though to a lesser extent. It is understood that watersports activities occasionally take place at night, e.g. as part of training or competitions. A significant amount of watersports training takes place in Saldanha Bay, resulting in a significant number of inexperienced water users that are at higher risk of accidental collisions with aquaculture structures.

Concerns with regards to the ADZ development relate to the:

- Inaccessibility of those areas for watersports; and
- Safety hazards if craft get entangled in aquaculture structures, either due to unfavourable wind conditions, poor markings of aquaculture areas in the Bay and on charts and/or drifting debris from aquaculture structures.

Extensive aquaculture, particularly in ADZ precincts Big Bay South and Outer Bay South (notably the channel between Jutten Island and Dongergat Peninsula), would render those areas unsuitable for watersports in the long-run. This is likely to affect and curtail watersports activities in the Saldanha Bay / Langebaan Lagoon system, particularly training and competitions that make use of the full extent of the system, with a knock-on effect on recreational activities that are supported by people visiting the areas for training and competitions.

It is expected that aquaculture will only gradually be established in the available / designated ADZ precincts, so that the direct effect may be felt in the medium-term; however, uncertainty related to the expansion of aquaculture and the prospect of a reduction in (critical) areas available for watersports may affect investment levels in the watersports / tourism industry at an earlier stage.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 2-21). Although the reduced Big Bay South Alternative results in a slightly lower impact, the overall impact rating is the same for both alternatives. The recommendation to avoid the Big Bay South precinct on account of its impact on watersports eliminates the difference between the alternatives.

Table 2-21: Significance of possible reduction in watersport activities and associated decline in tourism and business activities

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**HIGH**	-ve	High
Essential mitigation measures: • Avoid placing aquaculture structures in the Big Bay South precinct to allow continued access by watersports crafts. • Avoid placing aquaculture structures in the section between Jutten Island and Dongergat Peninsula in the Outer Bay South precinct to allow continued access by watersports crafts. • Invite the general public to register as stakeholders on a stakeholder database maintained by the ADZ Management Committee. Provide regular updates to all registered stakeholders on activities in the ADZ. • Provide at least 2 months' notice to registered stakeholders before installation of new farms commences. Provide detail on the proposed farm type and location. • Ensure that all active aquaculture farms are accurately marked on all navigational charts. • Ensure that the outer boundaries of all active aquaculture areas are accurately marked day and night using markers compliant with South African Marine Safety Authority (SAMSA) regulations. • Monitor markers to ensure they are always fully functional.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	-ve	High

Avoiding areas with the most significant interference with other users of Saldanha Bay from the ADZ, notably Big Bay South and portions of Outer Bay South, is expected to significantly mitigate the potential impact on watersports and related industries. While (portions of) these areas may be suitable for aquaculture, stand-alone EIAs should be undertaken for aquaculture ventures in those areas to identify cumulative impacts and devise mitigation measures that specifically address potential impacts on other activities in Saldanha Bay.

Notwithstanding the overall impact of the ADZ on watersports, mitigation measures implemented as part of the ADZ would also apply to existing operations (which will form part of a future ADZ) which would improve aspects of current management.

2.2.3.4 Potential Impact SE6: Possible Restrictions to Military Activities

A military base is located at the Donkergat Peninsula, and a military exclusion zone extends around the Peninsula. The proposed ADZ precincts are located outside the military exclusion zone.

The South African National Defence Force (SANDF) has, however, advised (Marx, 9 and 19 August 2016) that a number of military activities by the SANDF and South African Navy (night-time boating, swimming and diving as well as air delivery of boats and personnel) take place outside of the military exclusion zone and within proposed ADZ precincts, notably Outer Bay South and Big Bay South. Underwater shooting ranges and demolition training grounds are located in Salamander Bay, Boat rock area and Wildebeest Bay.

Concerns with regards to the ADZ development relate to:

- Precluding military training activities in the areas; and
- Safety hazards if crafts or personnel get entangled in aquaculture structures, particularly at night.

It is assumed that there are few alternative sites providing conditions and/or convenience similar to the areas surrounding the Donkergat Peninsula for military training activities. The military activities described above are largely in the same ADZ precincts used by watersports users of Saldanha Bay. Implementation of the mitigation measures proposed to mitigate impacts on watersports (see Section 2.2.3.3) are also expected to mitigate impacts on military training activities to a high degree.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 2-22). Although the reduced Big Bay South Alternative results in a slightly lower impact, the overall impact rating is the same for both alternatives. The recommendation to avoid the Big Bay South precinct on account of its impact on military activities eliminates the difference between the alternatives.

Table 2-22: Significance of possible restrictions to military activities

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**HIGH**	-ve	High

Essential mitigation measures:

- Avoid placing aquaculture structures in the Big Bay South precinct to allow continued access by watersports crafts.
- Avoid placing aquaculture structures in the section between Jutten Island and Donkergat Peninsula in the Outer Bay South precinct to allow continued access by watersports crafts.
- Invite the general public to register as stakeholders on a stakeholder database maintained by the ADZ Management Committee. Provide regular updates to all registered stakeholders on activities in the ADZ.
- Provide at least 2 months' notice to registered stakeholders before installation of new farms commences. Provide detail on the proposed farm type and location.
- Ensure that all active aquaculture farms are accurately marked on all navigational charts.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
• Ensure that the outside boundaries of all active aquaculture areas are accurately marked day and night using markers compliant with SAMSA regulations. • Monitor that markers are fully functional.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Probable	**LOW**	-ve	High

2.2.3.5 Potential Impact SE7: Pressures on Resources and Infrastructure due to an Influx of People

The population of the Saldanha Bay Municipality increased by 41% between 2001 and 2011, from 70 438 to 99 139, significantly above the national population increase of 15% over the same period. Population growth was particularly pronounced in Langebaan with an increase of 142% to 8 297 people, while the Saldanha population increased by 30% to 28 142 over the same period (http://www.saldanhabay.co.za/pages/maps-stats/statistics/stats.html#, Census 2011).

Prospective employment opportunities are thought to have played a significant role in the high increase in the Saldanha Bay population. Some 32 000 people actively participated in the labour market in 2001, of which 25 005 (79%) were employed and 6 853 (21%) were unemployed. In 2011, some 45 000 people actively participated in the labour market, of which 34 359 (76%) were employed and 10 470 (24%) were unemployed. While a significant number of jobs were created between 2001 and 2011, unemployment in the Saldanha Bay Municipality increased in absolute and relative terms due to the increase in population, and the 2011 unemployment rate was the highest in the West Coast District. Saldanha Bay's labour force represents 27.1% of the West Coast District labour force.

These are indications that the Saldanha area presents employment opportunities and is, therefore, attractive to job-seekers. The announcement of an ADZ could further stimulate in-migration of opportunistic jobseekers, given the job creation potential (see Section 2.2.3.2), high unemployment and poverty levels in the wider region and the low-skilled jobs required in aquaculture farms. The movement of such people is generally uncontrolled, and it is expected they will be predominantly unskilled and are likely to settle for longer periods and in poorer sections of settlements in the area, where facilities are already inadequate.

Although most people in the Saldanha Bay Municipality have access to basic services, there is some continued concern regarding the provision of water (80% of households had access to piped water inside their dwelling in 2011, up from 67% in 2001) and housing (82% of households lived in formal dwellings in 2011, down from 85% in 2001). Formal housing and service provision was nearly universal in Langebaan, while housing and service provision in Saldanha was below municipal averages in 2011.

Should a significant number of people move into the area, service provision to existing and future households may suffer if there is not sufficient capacity (financial and personnel) at the municipal level to expand and maintain the required services and infrastructure as well as facilities such as schools and clinics.

This indirect impact is common to many medium to large scale projects in South Africa. It cannot be addressed by the project alone and will require management of resources and capacities by the municipality as well, including development of additional services and infrastructure, including basic service provision, health, education and transport networks.

However, it is recommended that aquaculture farms are commissioned over time, which may reduce the number of workers initially required and reduce the "pull" of the project on workers from communities outside of the region, and population numbers may increase gradually, albeit still above historical growth rates.

The communities located on Saldanha Bay are small to medium size, and population increases may be noticeable in the local context. As such, management of influx and adequate scaling of services provided by the Saldanha Bay Municipality are critical to mitigate potentially negative impacts of influx of workers and jobseekers.

The extent of the impact is deemed local, as jobseekers are likely to move into the communities located closest to Saldanha Bay. The intensity of the impact is considered low if services and infrastructure are not scaled appropriately to supply newcomers. The duration of the impact is long-term. The probability of the impact occurring (as a result of this project) is deemed possible, as the extent of any influx cannot be forecast with certainty. Other industrial developments in the Saldanha area may well overshadow the “pull factor” of the ADZ development.

If appropriately managed, the project may result in an impact of local extent, low intensity and long-term duration. Again the probability of the benefit occurring is deemed possible, as the extent of any influx cannot be forecast with certainty and the delivery of infrastructure and services will depend on a number of factors that are outside of the control of the project team. Since the farms will be managed by individual operators, there is limited scope for a coordinated approach to recruitment.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 2-23).

Table 2-23: Significance of pressures on resources and infrastructure due to an influx of people

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Possible	**VERY LOW**	-ve	Medium
Essential mitigation measures: • Implement a local recruitment policy, to discourage an uncoordinated influx of outside workers.								
With mitigation	Local 1	Low 1	Long-term 3	**LOW** **5**	Improbable	**VERY LOW**	-ve	Medium

2.2.4 The No-Go Alternative

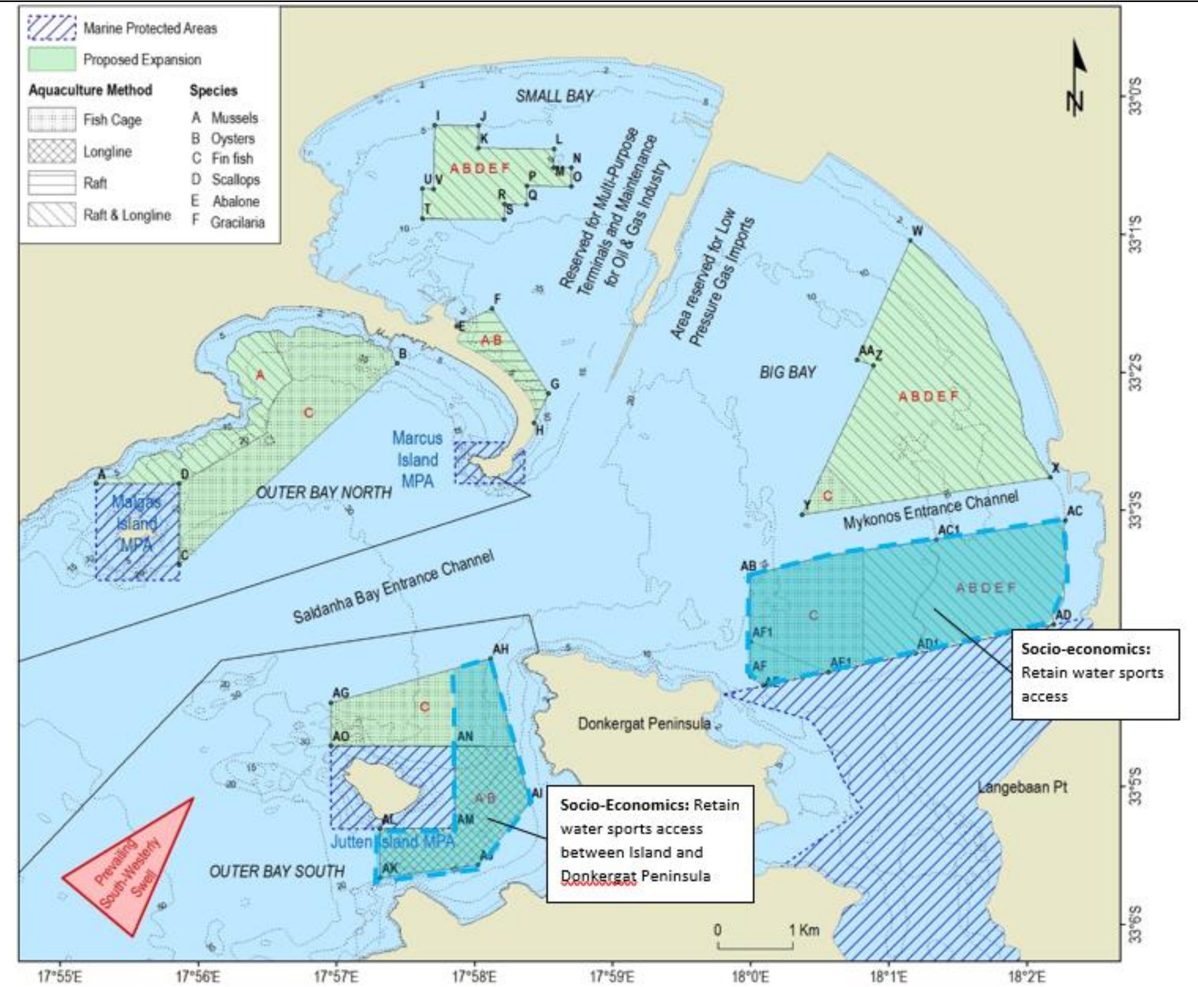
The No Go alternative entails no change to the *status quo*, in other words, aquaculture will continue in areas that are currently operational in Small Bay and in isolated areas in Outer Bay and Big Bay, and may expand into areas authorised through separate EIA processes. There is a possibility that future development will take place in Big Bay related to the Oil and Gas industry and iron ore operations. The No-Go alternative does not result in impacts or benefits relative to the current situation.

2.2.5 Mitigation Measures: Potential Socio-Economic Impacts

Essential socio-economic mitigation measures during **design** are as follows:

- Avoid placing aquaculture structures in the Big Bay South precinct to allow continued access by watersports crafts (see Figure 2-2).
- Avoid placing aquaculture structures in the section between Jutten Island and Donkergat Peninsula in the Outer Bay South precinct to allow continued access by watersports crafts (see Figure 2-2).
- Invite the general public to register as stakeholders on a stakeholder database maintained by the ADZ Management Committee (AMC). Provide regular updates to all registered stakeholders on activities in the ADZ.

- Provide at least 2 months' notice to registered stakeholders before installation of new farms commences. Provide detail on the proposed farm type and location.



srk consulting	SALDANHA ADZ AREAS TO AVOID IN MITIGATION OF SOCIO-ECONOMIC IMPACTS (IN BLUE)	Project No. 499020

Figure 2-2: Areas to avoid in mitigation of socio-economic impacts (in blue)

Essential socio-economic mitigation measures during **construction** are as follows:

- Utilise local labour (Saldanha Bay municipality) as much as possible.
- Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible.
- Procure ancillary services for goods purchased overseas, such as installation, customisation and maintenance, from South African companies as far as possible.

Essential socio-economic mitigation measures during **operations** are as follows:

- Utilise local labour (Saldanha Bay municipality) as much as possible. Where non-local specialist staff is required, implement a training programme to upskill local labour to assume these positions over a period of 5 years.
- Implement a local recruitment policy, to discourage an uncoordinated influx of outside workers.
- Collect annual data on staff numbers, composition and origin and report these to the AMC.

- Ensure that all active aquaculture farms are accurately marked on all navigational charts.
- Ensure that the outer boundaries of all active aquaculture areas are accurately marked day and night using markers compliant with SAMSA regulations.
- Monitor markers to ensure they are always fully functional.

Measures that should be implemented by the municipality are as follows:

- In cooperation with aquaculture operators and the AMC, initiate a study to identify industries or projects that could benefit from the direct and indirect opportunities generated by the ADZ, and mechanisms to promote or establish such industries or projects.
- In cooperation with aquaculture operators and the AMC, encourage projects and / or networks that provide training and support for small and medium enterprises in the Saldanha Bay Municipality to benefit from upstream or downstream opportunities generated by the ADZ. Initiate such programmes as early as possible.
- Monitor the capacity of existing services and infrastructure (e.g. provision of water, electricity, waste removal, sanitation and housing as well as health and education infrastructure) to cope with additional people moving into the area.
- Discourage land invasions.

Any additional mitigation measures and comprehensive monitoring requirements are laid out in the Environmental Management Programme (EMPr).

2.3 Potential Visual Impacts

2.3.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Visual Specialist Study undertaken by SRK (see Appendix D2). The purpose of the study was to assess the potential impacts of the Saldanha Bay ADZ on the landscape and sense of place, indicate the environmental acceptability of the ADZ and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Determine the character and sensitivity of the visual environment and identify sensitive areas;
- Identify visual resources and key viewing corridors / viewpoints;
- Determine and groundtruth the existing visual character and quality in order to understand the sensitivity of the landscape;
- Identify potential impacts of the project on the visual environment through analysis and synthesis of the following factors:
  - Visual exposure;
  - Visual absorption capacity;
  - Sensitivity of viewers (visual receptors);
  - Viewing distance and visibility; and
  - Landscape integrity.
- Assess the impacts of the project on the visual environment and sense of place using the prescribed impact assessment methodology;

- Identify and assess potential cumulative impacts resulting from the proposed development in relation to other proposed and existing developments in the surrounding area;
- Recommend practicable mitigation measures to avoid and/or minimise/reduce impacts and enhance benefits. Assess the effectiveness of proposed mitigation measures using the prescribed impact assessment methodology; and
- Recommend and draft a monitoring campaign to ensure the correct implementation and adequacy of recommenced mitigation and management measures, if applicable.

The following method was used to compile the visual baseline for the project:

1. Collect and review visual data.
2. Undertake fieldwork (05 August 2016), comprising an extensive reconnaissance of the study area, particularly the project site and key viewpoints. The objectives of the fieldwork were to:
    - Familiarise the specialist with the site and its surroundings;
    - Identify key viewpoints / corridors; and
    - Determine and groundtruth the existing visual character and quality in order to understand the sensitivity of the landscape.

    Visual 'sampling' using photography was undertaken to illustrate the likely zone of influence and visibility. The location of the viewpoints was recorded with a GPS.
3. Undertake a mapping exercise to define the visual character of the study area and identify sensitive areas, opportunities and constraints.

The following method was used to assess the visual impact of the project:

1. Make field observations at key viewpoints to determine the likely distance at which visual impacts will become indistinguishable.
2. Rate impacts (direct, indirect, and cumulative) on the visual environment and sense of place based on a professional opinion and the prescribed impact rating methodology.
3. Recommend mitigation measures to reduce the significance of negative impacts.
4. Provide environmental management measures to be included in the Environmental Management Programme (EMPr).

2.3.2 Magnitude of the Visual Impact

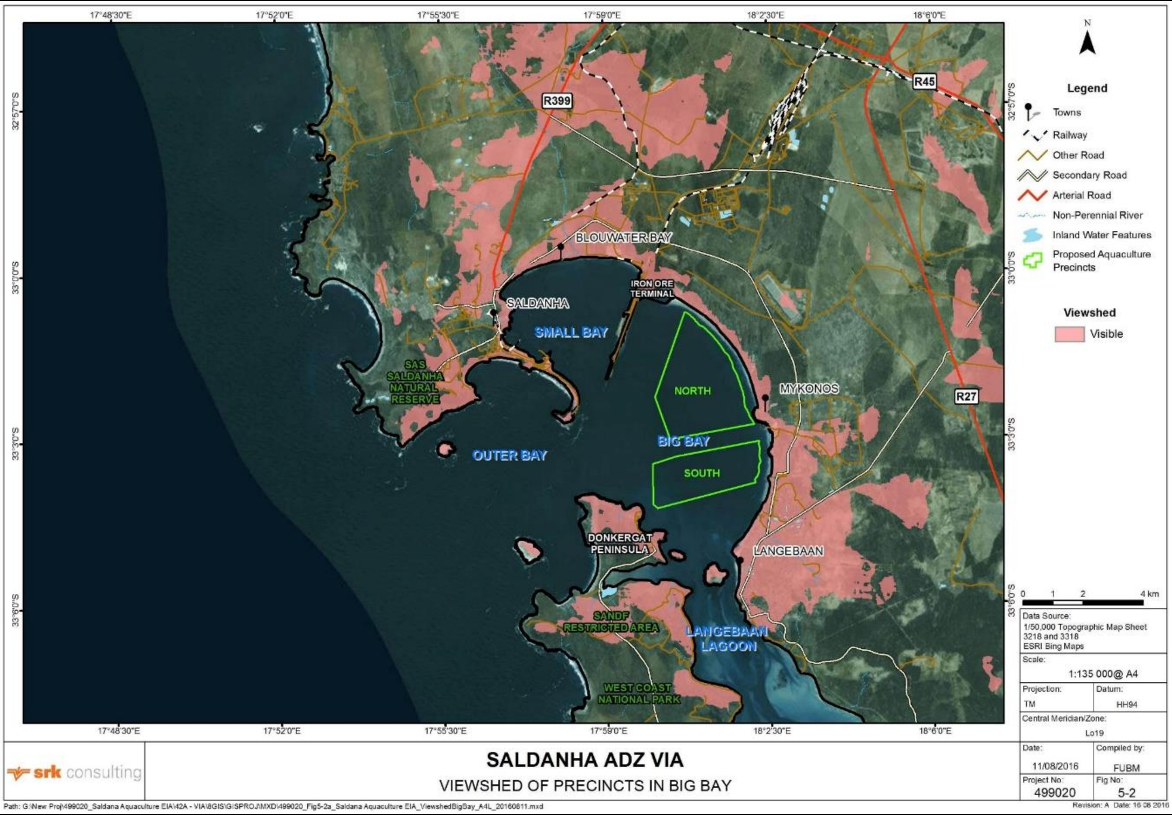
A viewshed was compiled for each proposed new ADZ precinct to determine the visibility of the marine aquaculture structures. Analysis of the viewsheds leads to the following observations:

- The viewsheds of the ADZs are limited to the coastline and elevated areas inland of Saldanha Bay;
- The viewsheds of the two Big Bay[20] precincts (see Figure 2-3) are identical. The Big Bay precincts are visible to receptors in Saldanha and Langebaan and in limited areas of the West Coast National Park (WCNP); and

[20] Note that the western boundary of Big Bay North was amended slightly after the viewsheds were generated, reducing the ADZ precinct. This is not expected to materially impact the viewsheds (the viewsheds show the worst-case scenario).

- The two Outer Bay precincts (see Figure 2-4) are visible to receptors in Langebaan (although more than 8 km away) but are not visible to the majority of receptors in Saldanha. The precincts are visible at the publicly accessible SAS Saldanha Nature Reserve to the north. Visual exposure to the south is limited to the SANDF Restricted Area on the Donkergat Peninsula.

Overall, the visual exposure of the ADZs will be moderate since the (combined) viewshed is limited to an area adjacent to the coast, but the project will be visible to a large number of receptors. Note though that the viewsheds do not take into account the screening provided by local variations in topography, the built fabric along the coastline and, notably, the Iron Ore Terminal jetty and the Marcus Island Causeway.



srk consulting	**SALDANHA ADZ** VIEWSHED BIG BAY PRECINCTS	Project No. 499020

Figure 2-3: Viewshed Big Bay precincts

Source: SRK

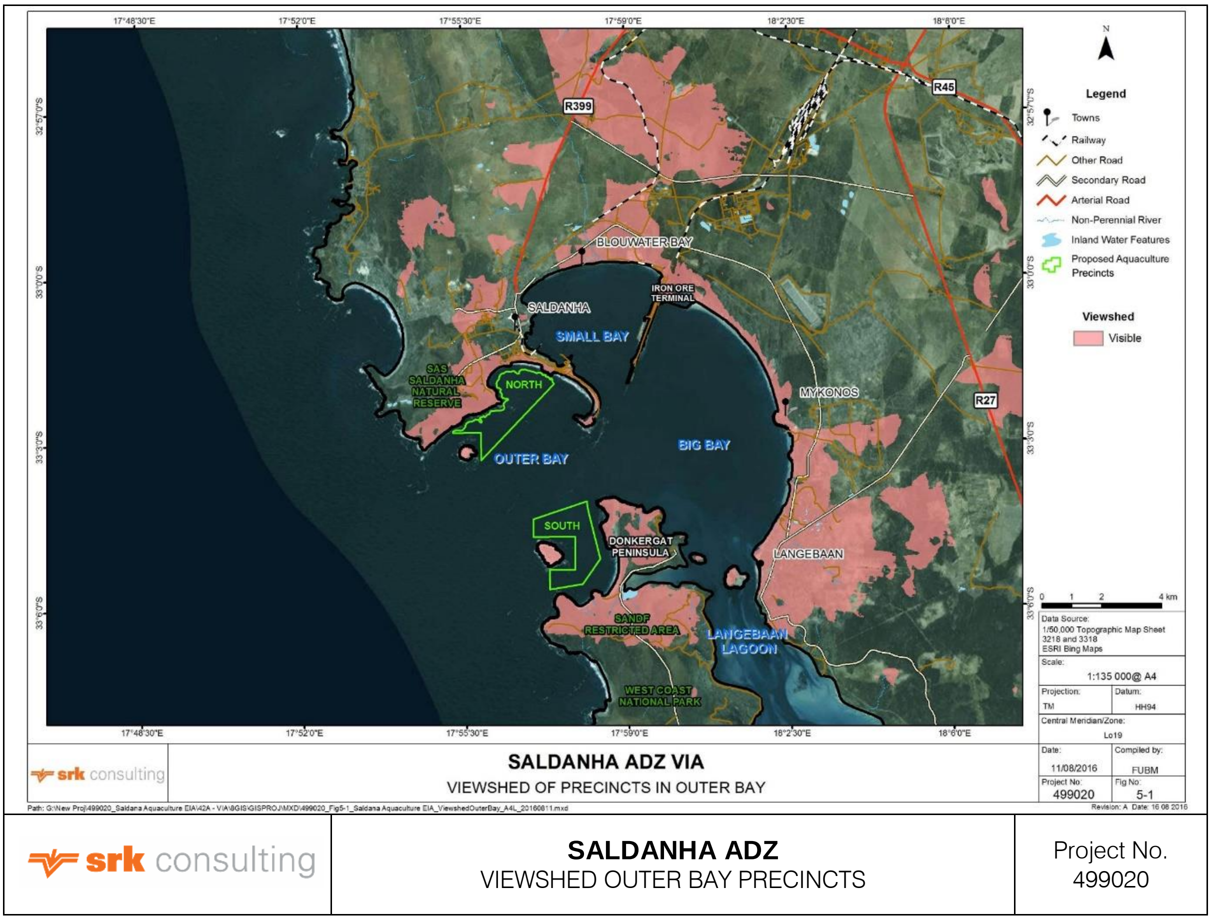


Figure 2-4: Viewshed Outer Bay precincts

Source: SRK

The Visual Absorption Capacity (VAC) of the area (its potential to conceal the project) is considered low to moderate mainly due to local topographical variations in the landscape that screen the project infrastructure beyond the immediate coastline. However, many of the residences along the eastern shoreline of the Bay are positioned on slopes overlooking the visually exposed (and "flat") Big Bay. The precincts in Outer Bay are located in visually sheltered bays and have a higher VAC.

Key visual receptors in the area, including residents and holiday-makers along the eastern shoreline and, to a lesser extent, visitors to the SAS Saldanha Nature Reserve and the Postberg Section of the WCNP (open for two months a year) are deemed to have moderate sensitivity.

Although the aquaculture structures are predominantly low (average height of less than 1 m above sea level), the scale and texture of the structures is different to the existing nature of the sites, i.e. open seascape. Overall, the project is considered to have low landscape / seascape integrity. However, as aquaculture is an acknowledged marine activity, residents and visitors to the area may consider the project to be congruent with the marine environment and perceived use of Saldanha Bay (also considering the existing aquaculture operations within the Bay).

Based on the above criteria, the expected magnitude or intensity of the overall visual impact of the project is rated as moderate to high.

2.3.3 Assessment of Impacts: Construction Phase

The project is not deemed to have significant visual impacts during the construction phase, as activities related to the installation of aquaculture structures is temporary and largely congruent with other marine activities associated with the Port and harbours in Saldanha Bay.

2.3.4 Assessment of Impacts: Operation Phase

Two potential direct visual impacts were identified during the operation phase:

- V1: Altered sense of place and visual intrusion from the proposed development; and
- V2: Altered sense of place and visual quality caused by light pollution at night.

2.3.4.1 Potential Impact V1: Altered Sense of Place and Visual Intrusion from the Proposed Development

The project will change the character of the sites (i.e. the aquaculture development precincts) from flat predominantly open water to “flat, built” sites. The precincts will be of a scale, texture and colour very different to the current nature of the sites.

The Outer Bay precinct is well screened by topography and will only visible to a limited number of sensitive receptors; as such this precinct will have a lower visual impact than the Big Bay precinct. The Big Bay precinct will be highly visible to residents and visitors along the eastern shoreline of Saldanha Bay. Many of these receptors (e.g. residents of Calypso and Club Mykonos) are positioned to overlook the visually exposed (and “flat”) Big Bay.

It must be noted that the existing aquaculture precincts in Small Bay are visually unappealing, particularly on still days when the surface of the water is calm. The variety of shapes and colours of the buoys, inconsistent spacing and the dilapidated infrastructure lend an unkempt character to these areas. Damaged ropes, buoys, etc. washed ashore and this litter along the beach is visually intrusive.

If the mitigation measures are implemented, residents and visitors to the area may consider the project to be congruent with the marine environment and perceived use of Saldanha Bay as a marine development zone (also considering the existing aquaculture operations within the Bay).

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***medium*** for both alternatives (Table 2-24). Although the reduced Big Bay South Alternative will not reduce the overall impact rating, the implementation of this alternative layout will reduce the visual impact of this particular precinct and is preferred.

Table 2-24: Significance of altered sense of place and visual intrusion – all alternatives

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	High 3	Long-term 3	High 7	Probable	**HIGH**	-ve	High
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. • Incorporate a 1 km buffer from residents along the eastern shoreline in the design of the Big Bay North precinct.								
With mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Probable	**MEDIUM**	-ve	High

Notwithstanding the overall visual impact of the ADZ, mitigation measures would, over time, also apply to existing operations (which will form part of a future ADZ) and improve / formalise certain aspects of current management.

Figure 2-5 shows the 1 km buffer proposed to mitigate the visual impact. As aquaculture was generally deemed feasible in these areas from a technical point of view, individual projects may be viable if their impacts are assessed in more detailed stand-alone EIA processes and deemed acceptable.

2.3.4.2 Potential Impact V2: Altered Sense of Place and Visual Quality caused by Light Pollution at Night

The Ports Authority (Transnet) is likely to require safety / warning lights demarcating the precincts at night. The existing ambient light level in the area is high because of light from industrial and port facilities and residential areas. Although the lights would not create a large visual impact or large amount of light, they would contribute to the change in the character of the seascape at night.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 2-25).

Table 2-25: Significance of altered sense of place and visual quality caused by light pollution at night

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All alternatives								
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Probable	**LOW**	-ve	High
Essential mitigation measures: • Restrict operations at night. • Utilise the minimum number of safety/warning lights as far as possible. Only locate lights on the corner points of each precinct and the minimum interval distance along the precinct boundary to meet Ports Authority (Transnet) safety requirements. • Confirm with key stakeholders (notably Port Captain, representatives of water users in the area and the South African Navy) whether certain boundaries of the ADZ located away from night-time traffic require lighting. • If the Ports Authority requires flashing lights, ensure the lights flash simultaneously.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Possible	**VERY LOW**	-ve	High

2.3.5 The No-Go Alternative

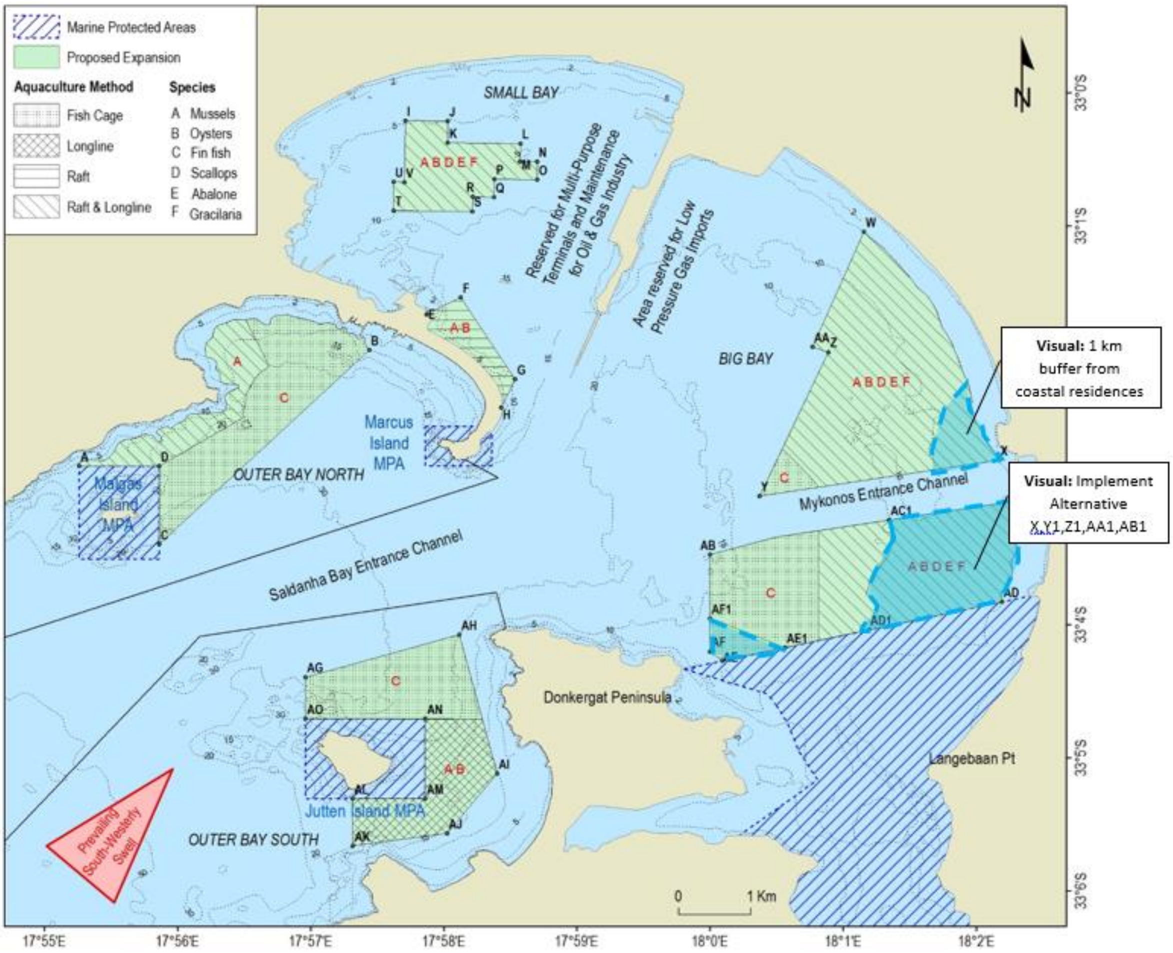
The No Go alternative entails no change to the *status quo*, in other words, the precincts identified for aquaculture are likely to remain as “unbuilt”, open water areas. Aquaculture will continue to take place in Small Bay and in isolated areas in Outer Bay and Big Bay. There is a possibility that future development will take place in Big Bay related to the Oil and Gas industry and iron ore operations.

2.3.6 Mitigation Measures: Potential Visual Impacts

Essential visual mitigation measures during **design** are as follows:

- Implement the reduced Big Bay South alternative (see Figure 2-5).
- Incorporate a 1 km buffer from residents along the eastern shoreline in the design of the Big Bay North precinct (see Figure 2-5).
- 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, scale and have a consistent spacing between them 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.
- Implement the same measures for existing operations over time as infrastructure gets upgraded / replaced.



srk consulting	**SALDANHA ADZ** AREAS TO AVOID IN MITIGATION OF VISUAL IMPACTS (IN BLUE)	Project No. 499020

Figure 2-5: Areas to avoid in mitigation of visual impacts (in blue)

Essential visual mitigation measures during **operations** are as follows:

- Maintain all project infrastructure in good working order.
- Restrict operations at night.
- Confirm with key stakeholders (notably Port Captain, representatives of water users in the area and the South African Navy) whether certain boundaries of the ADZ located away from night-time traffic require lighting.
- If the Ports Authority requires flashing lights, ensure the lights flash simultaneously.

Any additional mitigation measures and comprehensive monitoring requirements are laid out in the Environmental Management Programme (EMPr).

2.4 Potential Heritage Impacts

2.4.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Heritage Specialist Study undertaken by the African Centre for Heritage Activities (see Appendix D3). The purpose of the study was to assess the potential impacts of the ADZ on heritage resources in Saldanha Bay, assess the significance of these impacts, and recommend practicable mitigation measures to minimise potential impacts.

The ToR for the study were to:

- Undertake a field assessment and desktop research of the bay and coastal area, as required;
- Identify and map archaeological heritage resources;
- Assess and grade the significance of archaeological heritage;
- Identify potential impacts on heritage resources;
- Recommend mitigation action; and
- Compile and submit a notification of intent to develop to the relevant heritage authority.

The assessment is based on desktop research of maritime cultural resources known or likely to occur in Saldanha Bay.

2.4.2 Assessment of Impacts: Construction Phase

One potential direct construction phase impact on the heritage resources of Saldanha Bay was identified:

- H1: Destruction, damage or alteration of heritage material or sites.

2.4.2.1 Potential Impact H1: Destruction, damage or alteration of heritage material or sites

The key heritage resources potentially impacted by the project are shipwrecks older than and 60 years. Four such wrecks are potentially located in proposed ADZ precincts. The heritage significance and probability of an impact as a result of the ADZ establishment are summarised for each wreck in Table 2-26.

Table 2-26: Wrecks potentially affected by the ADZ

Wreck	Year sunk	Location	Heritage significance	Likelihood of impact
Dauphin	1830	Big Bay North	Low	Low
Luna	1880	Big Bay South	Low	Possible
Hamlet	1927	Outer Bay South	Low	Possible
Merestein	1702	Outer Bay South	Medium	Possible

Concrete moorings / anchors for aquaculture infrastructure and placed on the seabed could damage exposed portions of wrecks and their debris. However, anchors / moorings will not affect buried shipwreck material and are relatively small; as such, scour around concrete blocks that could affect shipwrecks is not expected to be significant.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation reduces to ***very low*** (Table 2-1).

Table 2-27: Significance of destruction, damage, or alteration of heritage material or sites

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
All Alternatives								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** **6**	Possible	**LOW**	-ve	High
Essential mitigation measures: • Do not place mooring blocks within 200 m of the Merestein site (33.087355º S, 17.955044º E). • Undertake diver surveys prior to placing anchors / moorings, and do not place mooring blocks on visible shipwreck features (above the seabed). • Contact an archaeologist should shipwreck material be identified to agree on any interventions required. • Provide the location and nature of any identified maritime and underwater cultural heritage resources to a maritime archaeologist and SAHRA for inclusion on their shipwreck database. • If a shipwreck site or part thereof has been disturbed, obtain a permit from SAHRA prior to continuing with activities.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Improbable	**VERY LOW**	-ve	High

2.4.3 Assessment of Impacts: Operation Phase

No potential heritage impacts during the operation phase were identified.

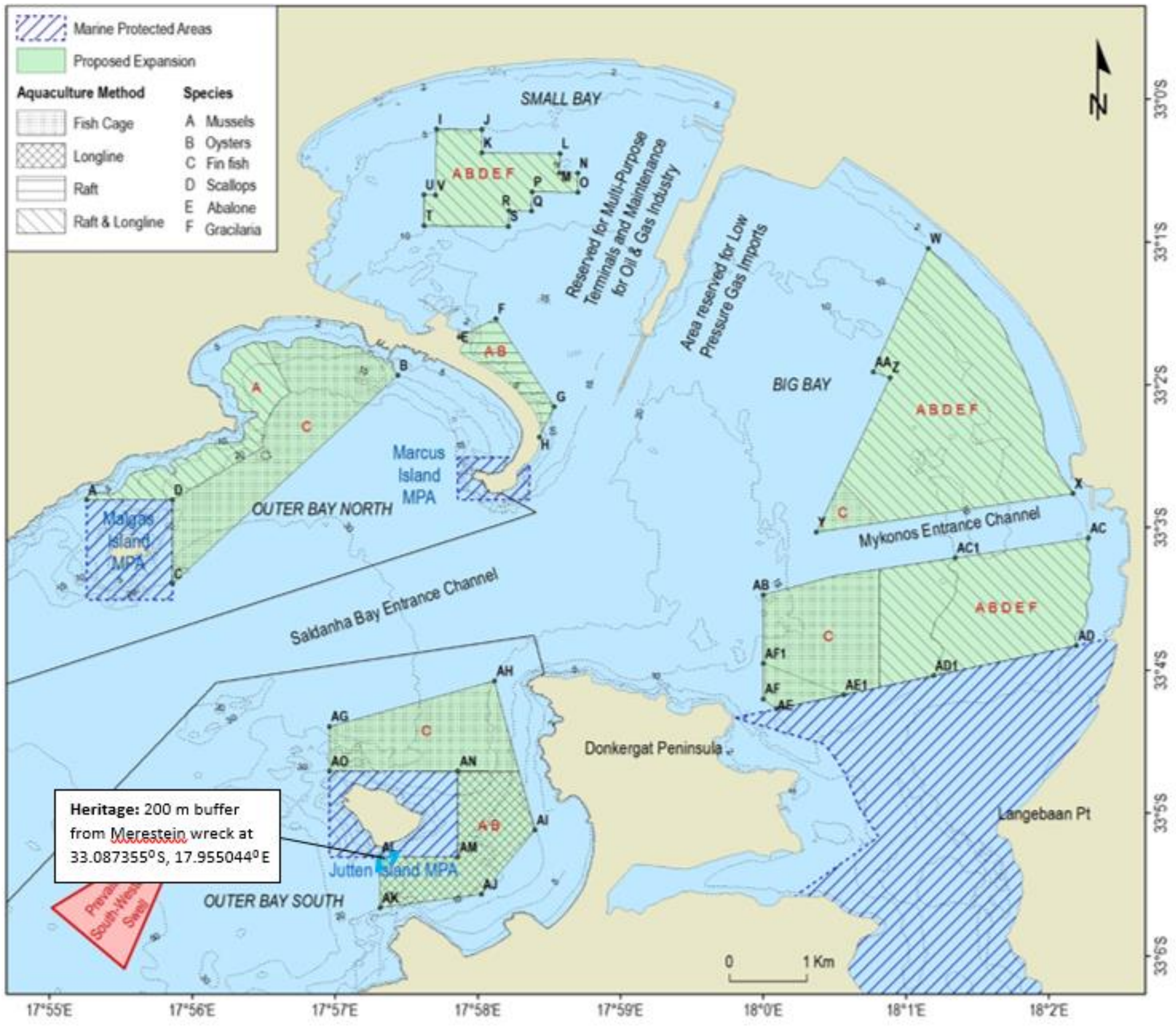
2.4.4 The No-Go Alternative

The No-Go alternative entails no change to the *status quo*. No shipwreck sites will be destroyed, damaged or altered, and the location of shipwrecks within Saldanha Bay will remain unknown.

2.4.5 Mitigation Measures: Potential Maritime Heritage Impacts

Essential heritage mitigation measures during **design** are as follows:

- Do not place new mooring blocks within 200 m of the Merestein site (33.087355º S, 17.955044º E) (see Figure 2-6).



srk consulting	**SALDANHA ADZ** AREAS TO AVOID IN MITIGATION OF HERITAGE IMPACTS (IN BLUE)	Project No. 499020

Figure 2-6: Areas to avoid in mitigation of heritage impacts (in blue)

Essential heritage mitigation measures during **construction** are as follows:

- Undertake diver surveys during the activities required for setting anchor arrays, and do not place mooring blocks on visible shipwreck features.
- Contact an archaeologist should shipwreck material be identified.
- Provide the location and nature of any identified maritime and underwater cultural heritage resources to a maritime archaeologist and to SAHRA for inclusion on their shipwreck database.
- Obtain a permit from SAHRA prior to continuing with activities which have disturbed a wreck site or part thereof, including objects or artefacts.

Best practice heritage mitigation measures during **construction** are as follows:

- Submit a detailed anchor distribution plan to the Maritime and Underwater Cultural Heritage Unit at SAHRA.

Any additional mitigation measures and comprehensive monitoring requirements are laid out in the Environmental Management Programme (EMPr).

3 Cumulative Impacts

3.1 Introduction

Anthropogenic activities can result in numerous and complex effects on the natural and social environment. While many of these are direct and immediate, the environmental effects of individual activities (or projects) can combine and interact with other activities in time and space to cause incremental or aggregate effects. Effects from disparate activities may accumulate or interact to cause **additional** effects that may not be apparent when assessing the individual activities one at a time (Canadian Environmental Protection Agency, no date). Cumulative effects can also be defined as the total impact that a series of developments, either present, past or future, will have on the environment within a specific region over a particular period of time (DEAT IEM Guideline 7, Cumulative effects assessment, 2004).

The International Finance Corporation (IFC) states that environmental assessment should include consideration of *"… cumulative impacts of existing projects, the proposed project and anticipated future projects."* For the purposes of this report, cumulative impacts are defined as 'direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors'.

Cumulative impacts can be distinguished as follows:

- **Cumulative Impacts of Existing Activities:** It is reasonably straightforward to identify significant past and present projects and activities that may interact with the project to produce cumulative impacts, and in many respects, these are taken into account in the descriptions of the biophysical and socio-economic baseline; and
- **Potential Cumulative Impacts of Future Activities:** Relevant future projects that will be included in the assessment are defined as those that are 'reasonably foreseeable', i.e. those that have a high probability of implementation in the foreseeable future; speculation is not sufficient reason for inclusion. Such projects may include those for which EAs have already been granted, that are currently subject to EA applications or that have been identified in an IDP of the relevant local municipality.

To define the level of cumulative impact, it is critical to look beyond the geographical boundaries and environmental impacts of a single development on the environment and consider the area of influence of the specific project as well as other developments currently in or proposed in the area and their understood impacts and area of influence. It may be that impacts experienced as a result of a single development are not considered to be significant, but when considered as part of a cumulative impact assessment, these require mitigation.

The assessment methodology proposed in this section of the report seeks to provide a practical means of assessing cumulative impacts as part of the environmental impact assessment and minimises deviations from the methodology proposed for the project specific impact assessment. Key considerations for the application of this methodology are:

- The cumulative impact assessment will need to be undertaken with consideration given to developments that may have contributed to cumulative effects in the past, may be contributing or are anticipated to contribute in the foreseeable future. This needs to be relevant to the timeframe within which impacts are to be experienced as a result of the project itself (i.e. all phases for which the project specific impact assessment is being undertaken - this will need to include post closure activities and monitoring). Given that the baseline environment will already be impacted on by the historical and current contributors to the cumulative impact, it is only necessary when undertaking the cumulative impact assessment to place an emphasis on an identified future cumulative baseline environment;

- Cumulative impacts may not be applicable to all specialist disciplines. Specialists will advise and justify where they believe the project related impacts will be confined to the project area and not subject to or contributing to impacts in the broader area of influence as a whole. For example, if the project area is confined to a water catchment which is not anticipated to be impacted on by other developments (past, present or foreseeable future) then a cumulative impact assessment need not be considered for this environmental aspect;
- A cumulative impact assessment will need to be undertaken for a specific area of influence which will be determined by the impact itself and the baseline environment in which it is proposed. This will vary across specialist disciplines and therefore a single area of influence for the cumulative impact assessment cannot be set and will be advised by the specialist concerned;
- The baseline environment for the project will differ from the baseline that is considered for a cumulative impact assessment where a number of projects may be implemented within a region in the future and all contributing to a cumulative baseline; and
- The cumulative impact assessment can only be undertaken where information is readily available to do so and as such will only be an initial assessment of the likely cumulative impact in terms of knowledge available at the time of the assessment.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due to mainly lack of data availability and accuracy. This is particularly true of cumulative effects arising from potential or future projects, the design or details of which may not be finalised or available and the impacts of which have not yet been assessed. Given the limited detail available regarding such future developments, the analysis will be of a more generic nature and focus on key issues and sensitivities for the project and how these might be influenced by cumulative impacts with other activities.

3.2 Cumulative Impacts of Existing Activities

It is reasonably straightforward to identify significant past and present projects and activities that may interact with the project to produce cumulative impacts, and in many respects, these are taken into account in the biophysical and socio-economic impact assessments.

The cumulative impact of different farms within the ADZ is assessed as the project impact, and thus does not constitute a cumulative impact in the sense of this assessment.

The main potential (negative) impacts of the proposed project, which could thus be subject to further cumulative impacts, are on marine ecology, watersport uses and visual quality of Saldanha Bay. These are briefly discussed below.

3.2.1 Cumulative Impacts on Marine Ecology of Saldanha Bay

Existing activities that currently affect marine ecology in Saldanha Bay through discharges into and physical use of the bay, and which therefore determine the cumulative impact of all activities on the bay, include:

- Iron ore, oil and multi-purpose port terminals and associated shipping activities;
- Urban development and associated erosion and release of stormwater and effluent into the bay;
- Discharges from the Wastewater Treatment Works and other industrial / processing facilities;

- Discharges from fish processing plants;
- Recreational activities such as fishing and angling; and
- Existing mariculture.

Many of these activities (and their effects) present at different spatial and temporal scales. Cumulative effects from existing activities are largely implicitly assessed in the impact assessment for the ADZ in Section 2.1, but some key impacts are briefly laid out below:

- Construction of the iron ore jetty has already reduced the flushing rates in Small Bay, leading to the accumulation of organic muds in isolated areas. Depending on the extent of the ADZ, these effects may also manifest as a result of aquaculture structures in Big Bay, with potential knock-on effects on Langebaan Lagoon;
- Changes in the extraction of plankton by shellfish farms from, and nutrient emissions into, the water column and seabed, together with point source discharges, e.g. from land-based outfalls, can have cumulative effects on nutrient conditions and primary production; and
- A mix of shellfish, finfish and seaweed aquaculture may alter, and potentially mitigate, some of the cumulative impacts. Consideration should be given to the development of Integrated Multi-Trophic Aquaculture (IMTA), which combines, in appropriate proportions, the cultivation of organic extractive aquaculture species (e.g. shellfish) and inorganic extractive aquaculture species (e.g. seaweeds) in close proximity to fed aquaculture species (e.g. finfish).

3.2.2 Cumulative Impacts on Watersports Uses of Saldanha Bay

Existing activities that currently affect watersports uses in Saldanha Bay, and which therefore determine the cumulative impact of all activities on the bay, include:

- Iron ore, oil and multi-purpose port terminals and associated shipping activity;
- Existing mariculture; and
- SANDF exclusion zones.

While existing activities restrict the area available for watersports in Saldanha Bay to some extent, watersports are an important activity in Saldanha Bay. The proposed ADZ has already taken into account Port and SANDF exclusion zones. As such, the impact assessment presented in Section 2.2.3.3 adequately addresses the cumulative impact of existing activities.

3.2.3 Cumulative Impacts on Visual Quality of Saldanha Bay

Existing activities that currently affect the visual quality in Saldanha Bay, and which therefore determine the cumulative impact of all activities on the bay, include:

- Iron ore, oil and multi-purpose port terminals and associated shipping activities;
- Industrial facilities located near the shoreline;
- Urban development along sections of the shoreline; and
- Existing mariculture.

The proposed ADZ activities are all located offshore; as such the project will not contribute to any cumulative onshore visual impacts. Existing activities, notably the Iron Ore Terminal at the Port of Saldanha, also result in notable offshore visual impacts. The proposed ADZ is likely to dominate the offshore visual impacts in the remainder of the bay. The cumulative impact of Port structures and expanded aquaculture will increase the sense of transformation in Saldanha Bay.

3.3 Potential Cumulative Impacts of Future Activities

There is a general trend towards more industrialisation in the Saldanha area. The most significant potential cumulative impacts from these proposed developments are likely to be:

- Additional air pollution from industrial processes, resulting in nuisance and, possibly, health concerns;
- Additional transformation of land, some of which is likely to support sensitive indigenous vegetation;
- Additional deterioration of water quality in Saldanha Bay due to:
  - Higher numbers of vessels entering the bay, releasing ballast water and, potentially, other pollutants and effluent;
  - Brine discharge at outfall points if additional freshwater demand leads to an increase in desalination plants / capacity due to the general water shortage in the area;
  - Effluent discharge and stormwater runoff from industrial and urban areas;
- Increasingly limited navigational space for vessels and recreational and Navy users of the bay due to larger mariculture areas and, in conjunction with more vessels entering the bay, greater risk of vessel collisions and resulting pollution events;
- Additional alteration of the visual character of portions of the area towards a transformed / industrial landscape; and
- Creation of significant employment and income opportunities in the area. These will benefit the local population by increasing wealth and job opportunities.

The proposed ADZ activities are all located offshore and the project will not contribute to any cumulative onshore impacts. The ADZ has a potential to contribute to cumulative impacts related to water quality and marine ecology, accessibility of the bay to a range of users, visual character and employment and income opportunities.

3.3.1 Cumulative Impacts on Marine Ecology of Saldanha Bay

Effluent released from industrial sources is likely be of a different nature than waste emanating from aquaculture, and a cumulative impact (i.e. additional release of similar pollutants with similar effects) is less likely. Where effluent does, however, increase the nutrient content of the bay (such as runoff from agricultural areas or wastewater treatment works), these effects could be cumulative / synergistic with some of the wastes from aquaculture (e.g. waste fish feed).

Additional release of pollutants into Saldanha Bay could, however, present a risk to aquaculture, which is dependent on good water quality to produce marketable seafood. At the same time, the presence of aquaculture in the bay could impose more stringent conditions on industrial and urban discharges, and mandatory water quality monitoring undertaken for aquaculture could highlight any pollution concerns.

The coastal marine environment is dynamic and varies in response to topography, weather and climate-related processes. Climate change will therefore also contribute to long-term environmental change and could influence the extent to which human activities cumulatively impact on the marine environment.

3.3.2 Cumulative Impacts on Watersports Uses of Saldanha Bay

Most of the anticipated future developments around Saldanha Bay, other than the ADZ, are land-based, and they will only impact on access to Saldanha Bay for recreational and military users insofar as they increase shipping traffic in the bay. Additional shipping traffic will restrict access to various areas, notably shipping channels to the ports and harbours / marinas in the bay. However, recreational users are already trying to avoid these channels as much as possible, and mitigation measures recommended for the ADZ have specifically been designed to ensure the continued accessibility of alternative routes for recreational and military users outside of main shipping channels, e.g. to the south-east of Jutten Island and at the at the mouth of the Langebaan Lagoon.

3.3.3 Cumulative Impacts on Visual Quality of Saldanha Bay

Most of the anticipated future developments around Saldanha Bay, other than the ADZ, are land-based, and they will impact on the visual quality of the bay shore. The proposed ADZ activities are all located offshore and will not contribute to any cumulative onshore visual impacts, but will result in a cumulative impact in that the bay itself will also take on an increasingly transformed / modified visual character. However, additional onshore activities are likely to be located in close proximity to existing activities (e.g. within the Industrial Development Zone and existing urban / residential areas), and the general impact assessment presented in Section 2.3.4 and discussion presented in Section 3.2.3 is expected to adequately address the cumulative visual impact of future activities.

3.3.4 Cumulative Impacts on Employment in the Saldanha Bay Region

Generation of employment and income opportunities largely represent a benefit and cumulative impacts would contribute to this. The cumulative scale of employment generation could result in limited in-migration to the area and will require management of resources and capacities by the municipality, including development of additional services and infrastructure, including basic service provision, health, education and transport networks.

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Note: The marine ecology specialist study uses numerous references that are not all reflected in this Appendix.