

*AMENDMENT OF AN ENVIRONMENTAL MANAGEMENT PROGRAMME AND ENVIRONMENTAL
IMPACT ASSESSMENT IN RESPECT OF THE ENVIRONMENTAL AUTHORISATION APPLICATION IN
SUPPORT OF A MINING RIGHT HELD BY WEST COAST RESOURCES (PTY) LTD OVER THE
KOINGNAAS AND SAMSONS BAK COMPLEXES*

AQUACULTURE STUDY

Prepared for the Environmental Assessment Practitioner:
Myezo Environmental Management Services

On behalf of the Applicant:
West Coast Resources (Pty) Ltd

Prepared by:



D.W. Japp and S. Wilkinson
Cape Town

31 July 2016
Revised (minor edits) 28/10/2016

Contents

- Expertise and Declaration of Independence 1
- 1. Terms of Reference 2
- 2.0 Assumptions, Uncertainties and Gaps in Knowledge 2
- 3.0 Introduction 2
- 4.0 Project Description 3
- 5.0 Description of Baseline Environment: Abalone Ranching 6
 - 5.1 Distribution of abalone 6
 - 5.2 Habitat preference and growth rates 6
 - 5.3 Abalone production in South Africa 6
 - 5.4 Stages in abalone ranching 9
 - 5.5 Oceanography along the west coast 10
 - 5.6 Socio-economic benefits of abalone ranching on the West Coast 11
 - 5.7 Access arrangements 11
 - 5.8 Land-based Access 11
 - 5.9 Sea-based Access 12
 - 5.10 Cost of alternatives (boat-based vs land-based seeding) 12
- 6.0 Review of Applicable Legislation 13
 - 6.1 Abalone ranching 13
 - 6.2 Mining right 14
 - 6.3 Conflicting Rights 15
- 7.0 Methodology 15
- 8.0 Description of Impacts 18
 - 8.1 Overview 18
 - 8.2 Ecological Impacts 19
 - 8.3 Operational Impacts 21
 - 8.4 Opportunities and risks posed on local economy 21
- 9.0 Impact Assessment Results 22
 - 9.1 Impact of loss of habitat for abalone seed 22
 - 9.2 Impact of suspended sediment plumes and elevated turbidity 22
 - 9.3 Restrictions on access to identified abalone seed areas 24
 - 9.4 Cumulative impact of the proposed mining on abalone ranching 25
- 10.0 Management and Mitigation Measures 26
- 11.0 Discussion and Conclusions 27
- 12.0 Consultation Process 28
- 13.0 References 29
- Appendix 1: Minutes of meeting held with Department of Agriculture Forestry and Fisheries on 25/07/2016 32
- Appendix 2: Summary of meeting held between CapMarine and Diamond Coast Abalone 33
- Appendix 3a: General permits conditions related to Abalone ranching 34

Appendix 3b: Abalone ranching catch statistic form (ref: DAFF)	44
Annexure 3c. Abalone Ranching Permit Conditions: Harvesting of Ranched Abalone (Annexure R4) 2016	45
Appendix 3d. Abalone Ranching Permit Conditions: Seeding of Abalone for Ranching - NC (Annexure R2) 2016	46
Appendix 4: Financial Analysis of the DCA Abalone Ranching Venture – June 2015	48

TABLE OF FIGURES

Figure 1: Detailed location map of Concessions 6a and 7a, indicating the Samson’s Bak Complex (purple), Koingnaas Complex (pink) and their associated portions. The type and length of shoreline in the concessions is also indicated.....	4
Figure 2: Proposed phased rock berm construction at Koingnaas 68/69, Somnaas and Langklip Central (Source: WSP 2015).....	5
Figure 3: Map showing abalone ranching concession areas in the Northern Cape Province (Areas labelled 1 – 4). Diamond Coast Abalone (Pty) Ltd obtained the rights for Zone 4.	7
Figure 4: Map showing 16 potential seeding sites within abalone ranching zone 4. Number of spat seeded (2015) and number of spat proposed to be seeded (2016) at each site is annotated in pie graphs.	10

TABLE OF TABLES

Table 4.1: Estimated rock volumes required for the various construction phases.....	5
Table 5.1: The boundary co-ordinates of potential seeding sites in Zone 4.	9
Table 5.2: Travel distances from Hondeklip Bay (mobilisation base) to each of the seeding sites.	12
Table 7.1: Ranking criteria for environmental impacts.....	16
Table 7.2: Determining the consequence.	16
Table 7.3: Determining the significance rating.	16
Table 7.4: The interpretation of the impact significance.	16
Table 7.5: The interpretation of the status of the impact.	17
Table 7.6: Definition of confidence ratings.....	17
Table 7.7: Definition of reversibility ratings.....	17
Table 7.8: Definition of loss of resources.....	17
Table 7.9: Degree to which impact can be mitigated.	18
Table 9.1: Impact ratings for the loss of abalone habitat due to the proposed mining activities	22
Table 9.2: Impact ratings for the increased suspended sediment plumes and elevated turbidity on abalone seed due to the proposed mining activities	23
Table 9.3: Impact ratings for the restriction of access to seeding sites.....	25
Table 9.4: Impact ratings for the the cumulative impact of the proposed mining activities on abalone ranching.	26

ACRONYMS AND ABBREVIATIONS

DAFF	Department of Agriculture Forestry and Fisheries
DCA	Diamond Coast Abalone (Pty) Ltd
DME	Department of Minerals and Energy
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
MCM	Marine and Coastal Management
MLRA	Marine Living Resources Act (1998)
MPA	Marine Protected Area
MPRDA	Minerals and Petroleum Resources Development Act
NCP	Northern Cape Province
NEMA	National Environmental Management Act, Act No. 107 of 1998
NWA	National Water Act (1998)
SFRI	Sea Fisheries Research Institute
TOR	Terms of Reference
UCT	University of Cape Town
WCR	West Coast Resources (Pty) Ltd

EXECUTIVE SUMMARY

West Coast Resources (Pty) Ltd is a mining company planning to re-establish diamond mining operations in coastal areas previously owned by De Beers on the Namaqualand coast. The new operations are however intended to extend seawards for several hundred meters. These operations conflict with abalone ranching in the area, both in terms of the location of mining operations as well as in terms of possible ecological impacts. This report reviews relevant literature on abalone ranching and intertidal mining to create an understanding of the impacts mining could have on the abalone industry in the area.

Mining and abalone ranching are in direct conflict in terms of geographic space usage. Embayments in areas such as Noup, Visbeen, Koingnaas, Somnaas Langklip and Langklip Central, which are target areas for intertidal mining, are also pristine seeding sites proposed for abalone ranching. Furthermore, the ripple effects mining will have on reducing or eliminating local habitats will further limit options for abalone seeding. The impact on kelp, the availability of which plays a key role in the expansion of the abalone sector also cannot be ignored.

The immediate impact of both beach accretion and berm construction would be the physical loss of potential seeding area in and immediately adjacent to the mining target areas. The proposed mining areas would however target bays and sandy areas that are not expected to be primary seeding areas. Impacts are likely to be of high intensity and to persist over the medium to long term and are thus considered to be of **HIGH** significance. There are no mitigation practicable measures proposed. The construction of berms and general disturbance of the intertidal area would be expected to result in the generation of localised suspended sediment plumes, which may affect primary productivity, thereby reducing the availability and suitability of food for abalone. Due to the transient nature of such plumes, the potential impacts are considered to be of low intensity and are thus considered to be of **MEDIUM to LOW** significance. No mitigation measures are possible. The impact of restricted access to seeding sites is considered to be of high intensity in the medium-term of overall **MEDIUM** significance. The impact could be reduced to low significance if access to the specific locations could be expedited within a short time frame (24 hours) in order to allow windows of opportunity to be utilised.

Whereas abalone production and spin-off industries present numerous and plentiful opportunities for sustainable income creation, using local human and ecological asset bases, mining is an extractive industry and therefore has a lifespan. Regardless of employment opportunities that mining may afford, cognisance must be taken of the negative impacts the closing down of this sector will have on local economies. Aquaculture in general, and abalone in particular presents a viable option, both in terms of ecological sustainability as well as in terms of contribution to local economies in a culturally relevant way. Lack of mitigation assumes complete closure of abalone ranching operations without mitigation. The local to regional impacts of loss of seeded abalone due to mining is considered to be of high intensity in and adjacent to the mining target areas. Impacts are considered to be of **HIGH** significance.

EXPERTISE AND DECLARATION OF INDEPENDENCE

CAPRICORN MARINE ENVIRONMENTAL (PTY) LTD

Reg. No. 2004 / 004844 / 07

P.O. Box 50035, Waterfront, Cape Town, South Africa, 8002

Unit 15 Foregate Square, Table Bay Boulevard, Cape Town

Tel: +27 21 425 2161 Fax: 425 1994 (www.capfish.co.za)

This report was prepared by Dave Japp and Sarah Wilkinson of Capricorn Marine Environmental (Pty) Ltd. Dave Japp has a BSc in Zoology, University of Cape Town (UCT) and a MSc degree in Fisheries Science from Rhodes University. Sarah Wilkinson has a BSc (Hons) degree in Botany from UCT.

Both have considerable experience in undertaking specialist environmental impact assessments relating to fishing and fish stocks. Dave Japp has worked in the field of Fisheries Science and resource assessment since 1987. His work has included environmental economic assessments and the evaluation of the environmental impacts on fishing. Sarah Wilkinson has worked on marine resource assessments, specialising in spatial and temporal analysis (GIS), as well as the economic impacts of fisheries exploitation.

This specialist report was compiled on behalf of Myezo Environmental Management Services for their use in compiling an amended Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) on behalf of West Coast Resources (Pty) Ltd. We do hereby declare that we are financially and otherwise independent of the applicant and Myezo Environmental Management Services.



Dave Japp



Sarah Wilkinson

1. TERMS OF REFERENCE

Specialist studies are required to investigate the anticipated preliminary scoped issues, to determine the actual impacts for which management measures will be developed. Socio economic assessment, as part of the EIA for the Koingnaas and Samsons Bak mining projects will be undertaken. In order to undertake the study, input from a marine biologist who has an understanding of abalone biology and aquaculture (inclusive of ranching) will be required. In this regard, the following points are required to be addressed:

- i. Impact of mining activities on the habitat required for abalone ranching and the likelihood that seeded abalone could be destroyed;
- ii. Potential impact of water quality deterioration, especially turbidity on the abalone ranching activities;
- iii. Legal review of applicable legislation, with a specific focus on user and access rights;
- iv. Review of suggested access arrangements;
- v. Cost comparison of seeding abalone from land vs boat-based seeding;
- vi. Identification of mitigation measures to alleviate or reduce the determined impacts;
- vii. Estimate of cost of the proposed mitigation measures to address the above impacts;
- viii. Assessment of and professional opinion on the broader potential opportunities and risks posed by the mining project on the local economy of the area, and not just on the abalone sector.

2.0 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The study is based on the project description made available to the specialist at the time of the commencement of the study. The assessment is limited to a “desktop” approach and thus relies on existing information only; no new data were collected as part of the study.

3.0 INTRODUCTION

West Coast Resources (Pty) Ltd (WCR) is a mining company planning to re-establish diamond mining operations in areas previously owned by De Beers on the Namaqualand coast. The area falls under the existing mining rights of July 2012, i.e. Koingnaas Mining Right (522MRC) and Samsons Bak Mining Right (525MRC). As part of their operations, WCR intend to mine deposits that are located on the beach and extend seaward, potentially for several hundred metres. WCR wants to continue with mining on the areas covered by these rights i.e. areas within the existing mining rights authorization, with immediate target being the Langklip and Koingnaas mining areas. The target areas are those that will not trigger new listed activities in terms of the National Environmental Management Act, Act No. 107 of 1998 (NEMA).

The planned continuation of mining activities will be undertaken under these existing mining rights. The triggered listed activities in terms of NEMA, NEM: WA, and NWA, which are not covered in the EMPs require a separate environmental authorization application, which will be undertaken, while the authorized activities are being implemented on site during mining.

There are various listed activities which will require environmental authorisation in terms of the NEMA. The proposed mining operations conflict with abalone ranching¹ in the area, both in terms of the location of mining operations as well as in terms of possible ecological impacts. This report reviews relevant literature on abalone ranching and intertidal mining to create an understanding of the impacts mining could have on the abalone ranching industry in the area.

¹ Abalone ranching is “where hatchery-produced seed are stocked into kelp beds outside the natural distribution” (Troell *et al.*, 2006); or Bannister (1991) defines marine ranching (reseeded) as “*Identifiable stock released with the intention of being harvested by the releasing agency*”; Also see: Government Gazette Gazette, 20 August 2010 No. 729. Marine Living Resources Act Policy on Abalone Ranching: “*when a new species is translocated into an area outside its natural range*”.

4.0 PROJECT DESCRIPTION

WCR holds existing mining and prospecting rights for a number of properties north and south of Hondeklipbaai on the west coast of the Northern Cape Province, South Africa. The Mining/Prospecting Rights, and their portions comprise:

1. Koingnaas – reference number SNC 522 MRC
 - Portion of remaining extent of the farm Somnaas No 474
 - Portion of the farm Koingnaas No 475
 - Portion of the farm Zwart Lintjies River No 484
 - Adjacent Sea Strips now described as unalienated state land, Portion of the Farm Langklip No 489
 - Portion of the farm Mitchels Bay No 495 and adjacent Sea strips now described as state land.
2. Samson's bak - reference number SNC 525 MRC
 - Portion of the farm Elandsklip 333
 - Portion of the Farm Koingnaas 475
 - Portion of the farm Noup 473
 - Portion of the farm Samson's bak 330
 - Portion of the farm Schulpfontein 472
 - Portion of the Remaining Extent and Portion 1 of the farm Somnaas 474
3. The Namaqualand Prospecting Right (NPR) - reference number SNC 672 PRC - incorporating farms:
 - Michell's Bay 495
 - Langklip 489
 - Farm No. 496 (known as Kliphuis)
 - Zwart Lintjes Rivier 484
 - Samson's Bak 330
 - Elands Klip 333
 - Zwart Duinen 332
 - Schulp Fontein 472
 - Somnaas 474
 - Koingnaas 475
4. Concession 8a - reference number NCS 30/5/1/2/2/555 MR
5. Concession 9a - reference number NCS 30/5/1/2/2/556 MR
6. Concession 8b - reference number 8bNCS 30/5/1/1/2/699 PR

Concession 6a is located north of Hondeklipbaai, in the Samson's Bak Complex, while Concession 7a spans the Koingnaas Complex and Hondeklipbaai. Concession 8a extends from Mitchell's Bay in the north to Skuit Bay, about 10 km south of the mouth of the Bitter River, whereas 9a extends from Skuit Bay to a position about 15 km south of Strandfontein Point. Each concession is approximately 30 km long (N-S), and extends from a line 31.49 m below the low water mark to a coast parallel line one kilometre seaward from the high water mark. Concession 8b lies seawards and adjacent to Concession 8a and extends from a coast-parallel line one kilometre seaward to about 5 km seaward of the high water mark. These concessions were formerly held by Namagroen Prospecting and Investments (Pty) Ltd.

For the purpose of this study, the project area thus encompasses a ~135 km stretch of the coastal and shallow marine habitats from approximately Swartklip in the north to south of Strandfontein Point (Figure 1). WCR would commence with mining activities that are currently authorised under the existing mining right. Surf zone, beach and offshore channel mining activities would only commence once authorisation has been received as part of the Environmental Impact Assessment (EIA), which this marine specialist assessment forms part of. All marine mining operations would be conducted both by contractors and WCR.

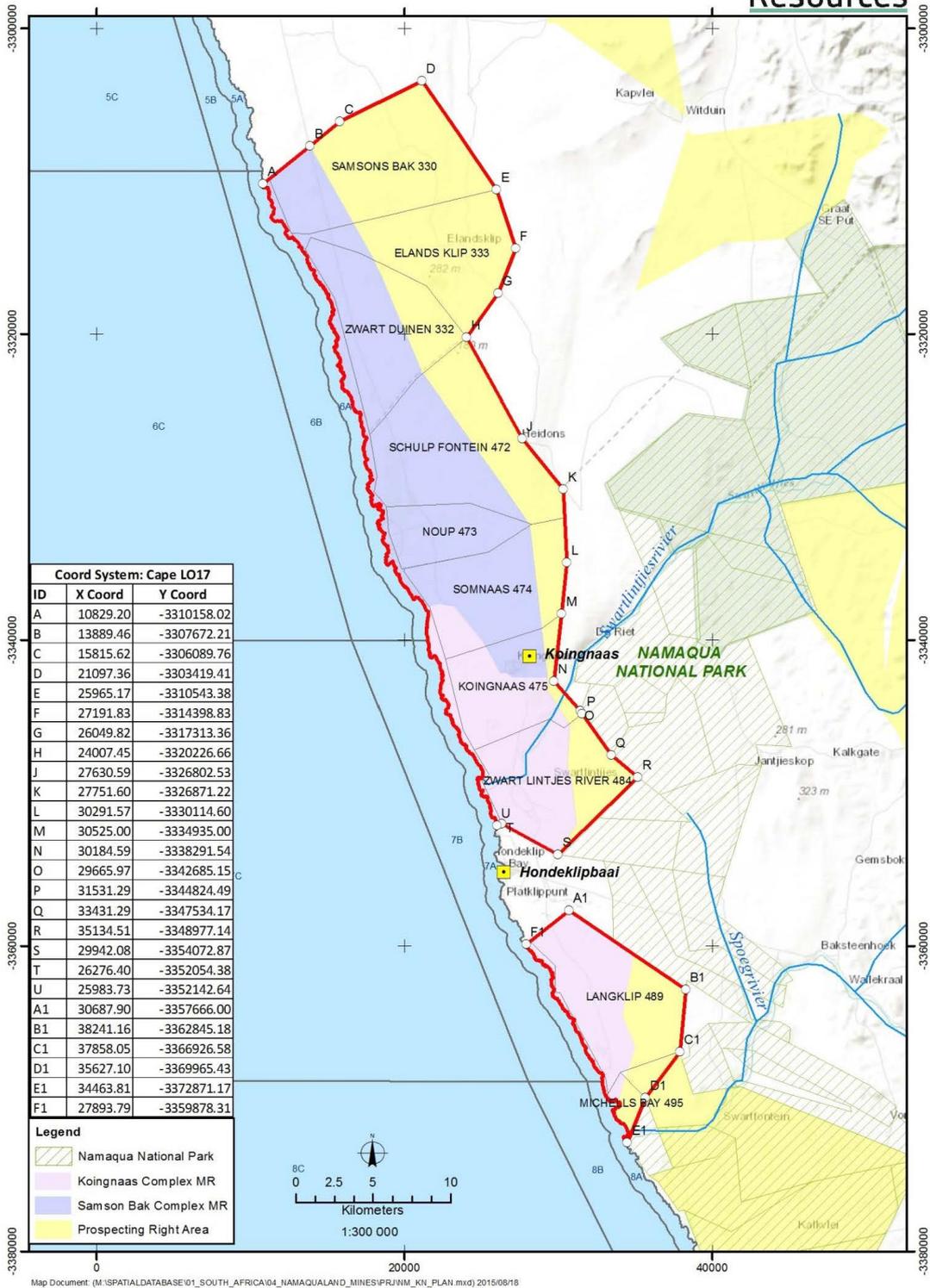


Figure 1: Detailed location map of Concessions 6a and 7a, indicating the Samson’s Bak Complex (purple), Koingnaas Complex (pink) and their associated portions. The type and length of shoreline in the concessions is also indicated.

Two approaches are proposed to access diamond resources seaward of the low water mark. One is the accretion of the beach, the other is construction of rock berms or coffer dams. Accretion involves the stepwise movement seawards at 150 m per stage using overburden material from the beach or from adjacent mining sites to reclaim sheltered bays. Berm construction involves the walling-off of a cove, or sections thereof, by tipping quarry material from trucks perpendicular to incoming waves and the shoreline (Figure 2). Material becomes courser towards the outside of the berm wall, with the outermost layer consisting of non-native rock from a stockpile in Koingnaas. After an area is mined out, the berm is then extended further seawards to enclose the next mining block. A maximum seaward extension of 300 m is possible. This approach is planned for bays in Noup, Visbeen, Koingnaas, Somnaas Langklip and Langklip Central (Pulfrich, 2016).

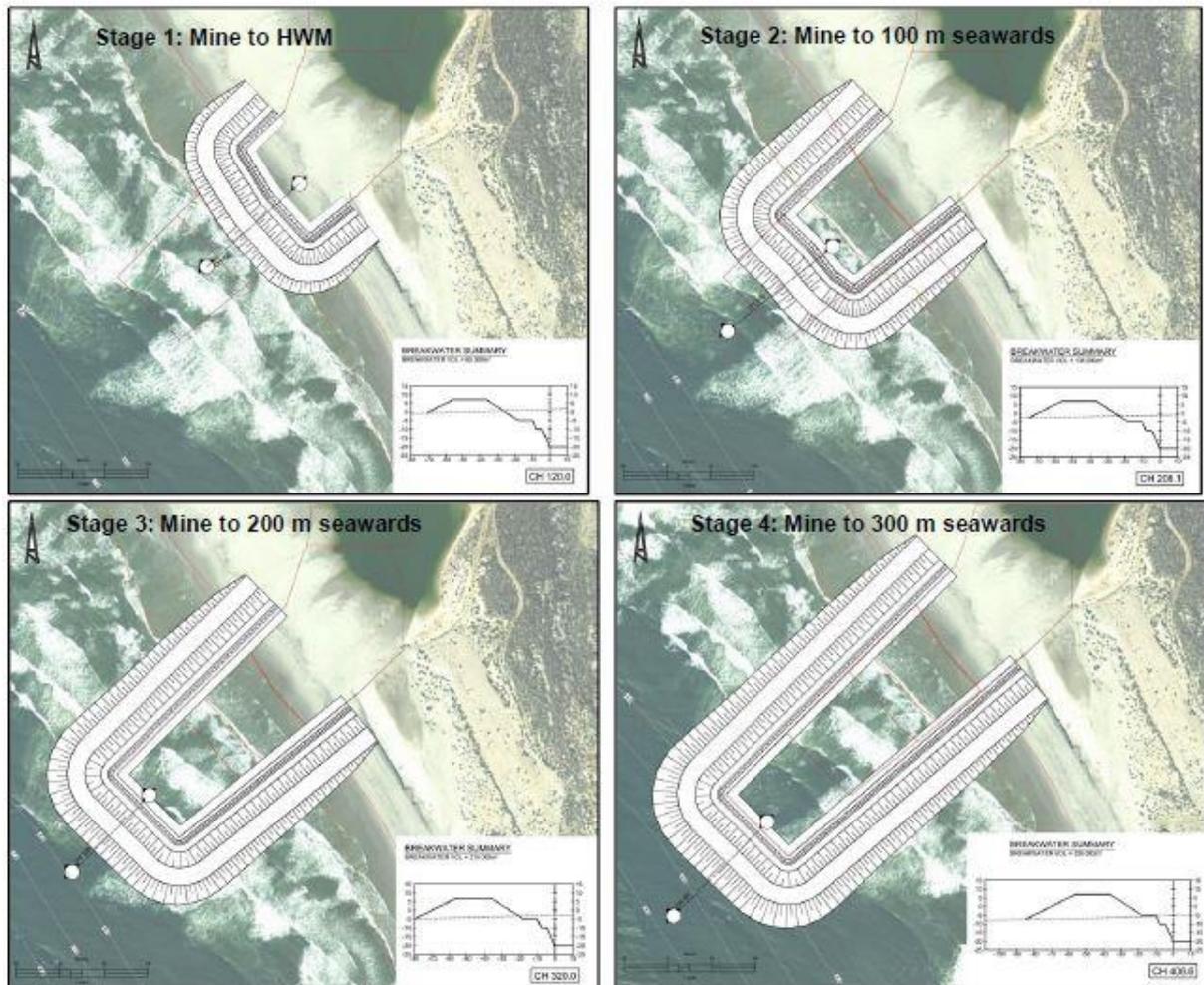


Figure 2: Proposed phased rock berm construction at Koingnaas 68/69, Somnaas and Langklip Central (Source: WSP 2015).

Despite the comparatively high volumes of material required for berm construction (Table 1), the design-life of such berms is typically one to two years and they can thus be considered temporary structures.

Table 4.1: Estimated rock volumes required for the various construction phases.

Construction Phase	Material requirements (m ³)
Stage 1	65,000
Stage 2	135,000
Stage 3	216,000
Stage 4	356,000

5.0 DESCRIPTION OF BASELINE ENVIRONMENT: ABALONE RANCHING

5.1 Distribution of abalone

The Abalone *Haliotis midae*, is endemic to South Africa. The natural population extends along 1500 km of coastline east from St Helena Bay in the Western Cape to Port St Johns on the east coast (Branch *et al.* 2010; Troell *et al.* 2006). Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat specifically for seeding of abalone in designated areas (ranching) (Anchor Environmental, 2012). The potential to increase this to seeded area to 175 km has been made possible through the issuing of “Abalone Ranching Rights” (Government Gazette, 20 August 2010 No. 729) in four concession zones (Figure 3) for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016).

5.2 Habitat preference and growth rates

H. midae inhabits intertidal and subtidal rocky reefs, with the highest densities found in kelp forests (Branch *et al.*, 2010). Kelp forests are a key habitat for abalone, as they provide a key food source for abalone as well as an ideal ecosystem for abalone’s life cycle (Branch *et al.*, 2010). Light is a limiting factor for kelp beds, which are therefore limited to depths of 10m on the Namaqualand coast (Anchor Environmental, 2012).

Habitat preferences change as abalone develop. Larvae settle on encrusted coralline substrate and feed on benthic diatoms and bacteria (Shepherd and Turner, 1985). Juveniles of 3-10 mm are almost entirely dependent on sea urchins for their survival, beneath which they conceal themselves from predators such as the West Coast rock lobster (Sweijid, 2008; Tarr *et al.*, 1996). Juveniles may remain under sea urchins until they reach 21-35 mm in size, after which they move to rocky crevices in the reef. Adult abalone remain concealed in crevices, emerging nocturnally to feed on kelp fronds and red algae (Branch *et al.*, 2010). In the wild, abalone may take 30 years to reach full size of 200 mm, but farmed abalone attain 100 mm in only 5 years, which is the maximum harvest size (Sales & Britz, 2001).

5.3 Abalone production in South Africa

South Africa is the largest producer of abalone outside of Asia (Troell *et al.*, 2006). For example, in 2001, 12 abalone farms existed, generating US\$12 million at volumes of 500-800 tons per annum (Sales & Britz, 2001). By 2006, this number had almost doubled, with 22 permits granted and 5 more being scheduled for development (Troell *et al.*, 2006). Until recently, abalone cultivation has been primarily onshore, but abalone ranching provides more cost effective opportunities for production (Anchor Environmental, 2012).

Abalone ranching is “where hatchery-produced seed are stocked into kelp beds outside the natural distribution” (Troell *et al.*, 2006). Abalone ranching was pioneered by Port Nolloth Sea Farms who were experimentally seeding kelp beds in Port Nolloth by 2000. Abalone ranching expanded in the area in 2013 when DAFF issued rights for each of four Concession Area Zones (see Figure 3).

One of seven rights² was issued to Diamond Coast Abalone (Pty) Ltd (DCA) to engage in an abalone ranching pilot project in Concession Area Zone 4 in the Northern Cape Province in 2012. The area stretches from Skulpfontein (30°6’08.15” S; 17°11’08.03” E) southwards for ± 40 km to two small rocky outcrops located 200 m offshore (30°25’56.26” S; 17°20’05.43” E). There is a 7 km buffer zone between Zone 4 and Zone 3. The right allocates 40 km of coastline for 15 years³, placing no limit on production (Diamond Coast Abalone, 2016). DCA has identified 16 suitable seeding sites in Zone 4 (see Table 5.1) and commenced their pilot project in 2014 by seeding 156 000 of a possible 600 000 spat in five locations near Hondeklipbaai (Figure 4). We note however that the Abalone Ranching

² See Appendix 2 – DCA have a share in the rights of Zone 1

³ Some discrepancy not verified – Policy states 10 years. Also the policy states that the first 10 years are a “pilot study” and that long-term rights could result in renewal for 20 years

Policy (DAFF, 2010) states that the first 10 years are a “pilot study” and that long-term rights could result in renewal for 20 years

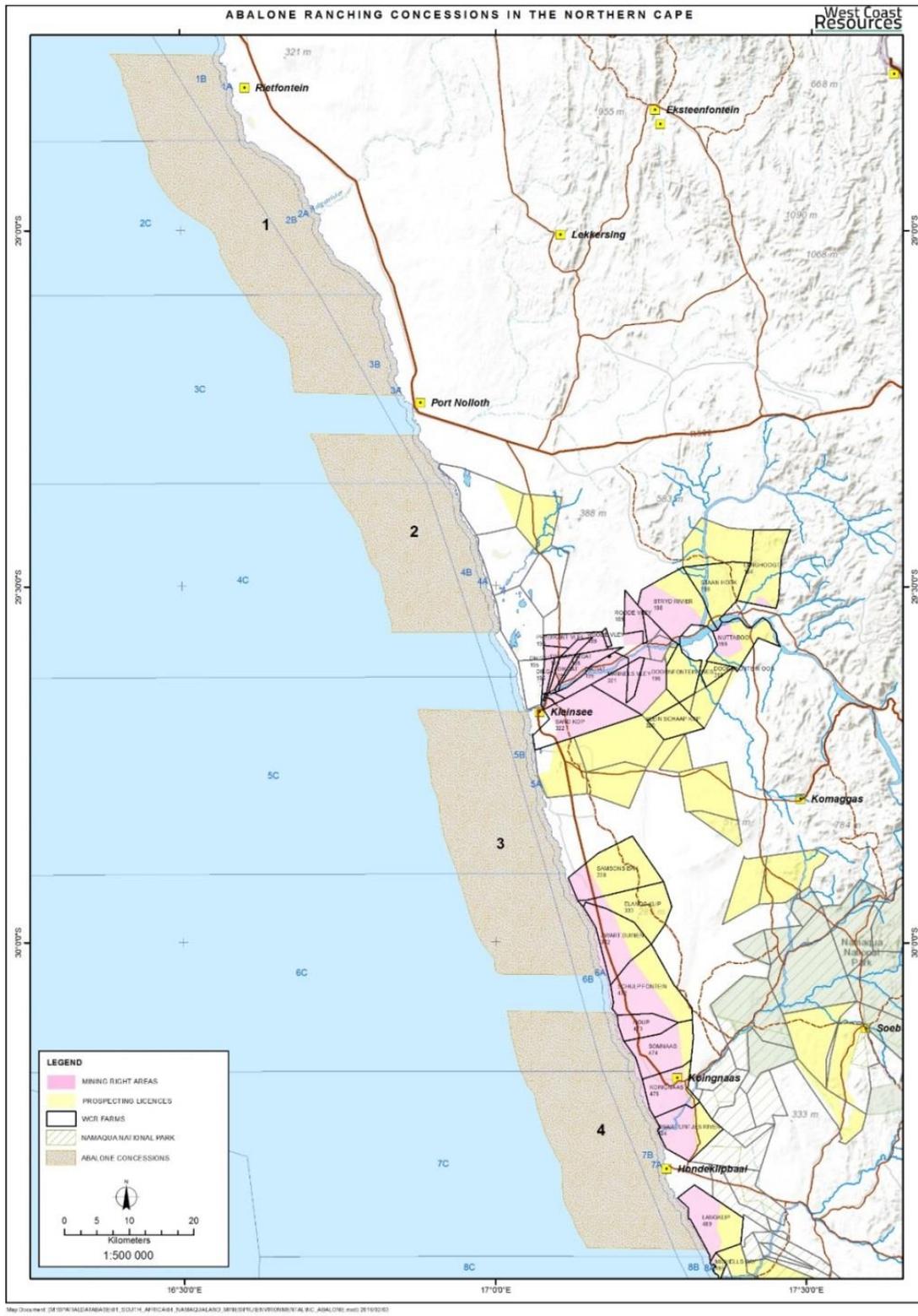


Figure 3: Map showing abalone ranching concession areas in the Northern Cape Province (Areas labelled 1 – 4). Diamond Coast Abalone (Pty) Ltd obtained the rights for Zone 4.

Abalone ranching in South Africa is guided by the “General Guidelines for Marine Ranching and Stock Enhancement in South Africa” (see government gazette of 20 August 2010 published as part of the the Marine living Resources Act, 1998 (Act No. 18 of 19880). In addition to the guidelines, and as part of the requirements for the “Rights” application, DCA commissioned the following independent specialist studies in order to inform and support its proposal:

- An environmental risk assessment undertaken by Ecosense Environmental Consultants;
- A marine specialist report on the potential biological impacts associated with abalone ranching along the Northern Cape coast;
- A disease risk assessment of the proposed abalone ranching operation in Hondeklip Bay prepared by Amanzi Biosecurity;
- A social impact assessment of abalone ranching in Concession Area 4 in the Northern Cape Province conducted by Liezel de Waal; and
- An environmental management programme drafted by Ecosense Environmental Consultants.

The policy also stated that *“the pilot phase shall not exceed 10 years. This is considered to be long enough to allow assessment of the enhancement techniques employed and critical ecological processes and effects”*

Some the key points noted in the policy pertinent to this assessment include:

- Risks: User group conflicts (e.g. with "conventional" fishing and recreational activities, etc.);
- Access and resource sharing issues;
- Proposals must address distribution of benefits and how other users in the area will be affected by the proposed initiative;
- Right of access to the area and the need for large areas of water to be allocated for these activities. All these issues must be addressed prior to embarking on a stock enhancement or ranching initiative;
- In order to encourage investment in ranching, which is capital intensive, exclusive ranching rights would be given as an incentive. The decision to grant exclusive ranching rights would have to be balanced with the interests of the broader public and other user groups;
- The sea bed area in which sedentary stock, such as abalone, are seeded will not be owned by the right holder, and the rights of other users of the area (e.g. swimmers, vessels, fishing right holders) will still be valid, unless they are restricted by the Minister in terms of the Marine Living Resources Act.;
- The applicant (for an abalone ranching right) should identify potential social/user conflicts arising from the project and make recommendations on how to mitigate/ manage them;
- The size of the area to be allocated will be based on kelp bed area (which is the main source of food for abalone), survival estimates and on available economic model projections; and
- Where different rights (concession areas) are allocated adjacent to one another, buffer zones (approximately 1 - 10 km) will separate adjacent ventures. Buffer zones will also be used to separate ranching areas and areas that are set aside to protect viable populations, including closed areas and Marine Protected Areas (MPAs).

Table 5.1: The boundary co-ordinates of potential seeding sites in Zone 4.

Table 1: Boundary co-ordinates of the Zone 4 seeding sites			
Site	Name	Northern Boundary	Southern Boundary
1	Voëlklip	S30°06'15.48", E17°11'20.30"	S30°06'43.17", E17°11'21.38"
2	Noupbaai	S30°06'44.32", E17°11'20.87"	S30°07'26.10", E17°11'26.04"
3	Kommagappunt	S30°07'33.62", E17°11'38.34"	S30°08'13.26", E17°11'39.49"
4	Stilbaai	S30°08'09.65", E17°11'56.34"	S30°08'50.36", E17°12'13.55"
5	Somnaasbaai	S30°09'01.08", E17°12'24.46"	S30°09'24.68", E17°12'50.11"
6	Geelklip tot Visbeenbaai	S30°11'20.17", E17°13'25.50"	S30°12'59.71", E17°13'55.44"
7	Noord van Swartlintjes	S30°14'11.54", E17°14'39.51"	S30°14'56.92", E17°15'07.38"
8	Dokter se baai	S30°15'48.49", E17°15'24.47"	S30°16'39.35", E17°15'48.61"
9	De Beers North Boundary	S30°17'04.51", E17°15'15.19"	S30°17'45.21", E17°16'06.06"
10	Moordenaarsbaai	S30°17'51.01", E17°16'06.42"	S30°18'30.35", E17°16'05.87"
11	Hondeklip Bay	S30°18'44.28", E17°16'10.90"	S30°19'09.49", E17°16'15.85"
12	Platklippunt tot Aristea	S30°19'56.28", E17°16'20.43"	S30°20'49.27", E17°16'57.24"
13	De Beers South Boundary	S30°21'19.05", E17°17'14.89"	S30°21'52.22", E17°17'34.22"
14	Langklipbaai	S30°22'10.68", E17°17'43.88"	S30°23'02.33", E17°18'26.39"
15	Enkelduinbaai	S30°24'19.22", E17°19'21.55"	S30°24'26.42", E17°19'16.96"
16	NC4b Border	S30°25'38.79", E17°19'55.31"	S30°25'56.26", E17°20'05.43"

5.4 Stages in abalone ranching

Abalone ranching includes the spawning, larval development, seeding and harvest. An onshore hatchery supports the ranching in the adjacent sea (Anchor Environmental, 2012). Two hatcheries exist in Port Nolloth producing up to 250 000 spat, but spat may also come from an alternative hatchery e.g. Hermanus on the east coast (Anchor Environmental 2012). Juveniles of 15 mm are obtained from the hatchery, and are then further developed at a land-based holding facility in Hondeklipbaai⁴. For the Port Nolloth operation, Anchor Environmental (2012) report that the holding facility uses circulated seawater solar heated slightly above ambient temperature to grow spat to a size of 25-30 mm over 6-8 months. They are then seeded at approximately 15 months old⁵. Approximately 600 000 spat are acquired per annum for ranching, with a mortality rate of 2% during the land-based rearing phase. Thus, approximately 588 000 animals are seeded (Anchor Environmental, 2012).

Abalone mortality increases sharply after seeding, but plateaus over time. Abalone remain *in situ* subsisting on local seaweed, reaching a harvestable size of 400-600 g after 5-7 years. Mortality due to stress and predation for ranched abalone is approximately 70%, thus divers may harvest 176 400 animals after 5-7 years from a batch of 600 000 spat. The west coast supports a ranching density of approximately 3 harvestable abalone per m² (Anchor Environmental, 2012). It is estimated that ranching could produce 1000 t of abalone per annum (Britz *et al.*, 2000).

⁴ Spat are grown out to 30 mm before being used in seeding (pers comm., Gert Le Roux)

⁵ These characteristics are consistent (but not exact) with the intent in Zone 4 (pers comm., Gert Le Roux)

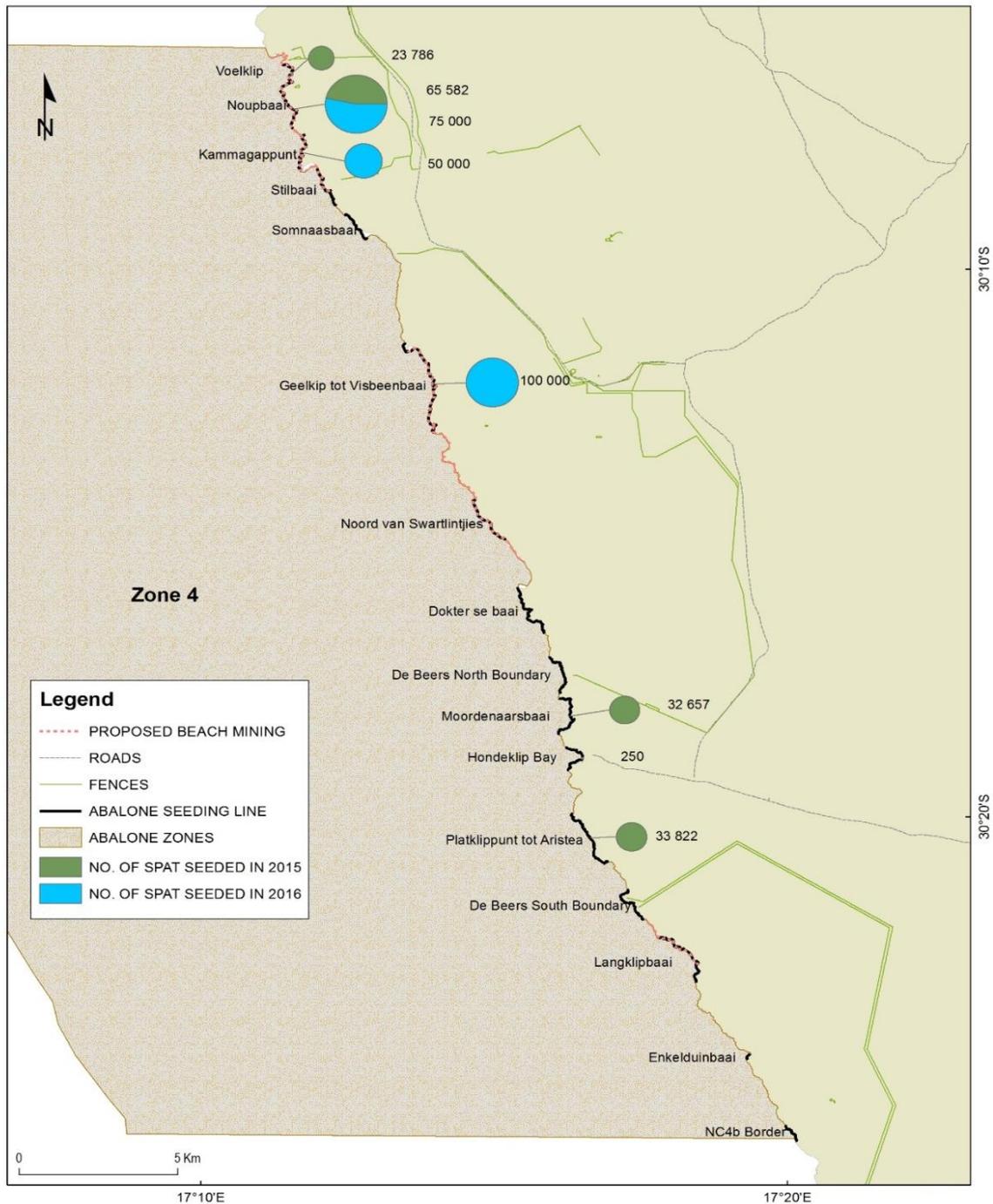


Figure 4: Map showing 16 potential seeding sites within abalone ranching zone 4. Number of spat seeded (2015) and number of spat proposed to be seeded (2016) at each site is annotated in pie graphs.

5.5 Oceanography along the west coast

The abalone ranching areas on the west coast fall within the nearshore central Benguela region (Shannon & Nelson, 1996; Shillington *et al.*, 1990). This areas experiences high wave energy dominated by southwesterly swells and strong southerly winds (Branch and Griffiths, 1988) that “periodically smother and expose the invertebrate and algal communities that inhabit the rocky substrate found in the surf zone” (Anchor Environmental, 2012). Small embayments along the coast provide the only respite from these conditions (Bally, 1987).

Upwellings drive nearshore water offshore and northwards, causing an upwelling of cold water which replaces it (Pulfrich, 2016; Anchor Environmental, 2012). This “coastal, wind-induced upwelling is the principal physical process that shapes the marine ecology of the Benguela region” (Pulfrich, 2016), and is the key input of food to the relatively sheltered bays along this section of coast (Bally, 1987). The most intense upwellings occur when winds are strongest and where the shelf is most narrow, particularly near Lüderitz, as well as near Hondeklipbaai and Cape Columbine (Fawcett et al., 2008; Shillington, 2003; Shannon & O’Toole, 1998). Longshore surface currents of 2 km/day are wind-driven and flow northward (Pulfrich, 2016; Fawcett et al., 2008; Shannon & Nelson, 1996; Shillington et al., 1990), however reversals in current flow at periods of three and a half days are common (Fawcett et al., 2008).

5.6 Socio-economic benefits of abalone ranching on the West Coast

The economy of the Namaqua coast communities depends primarily on employment in mining and on artisanal fishing. Both of these sectors are however declining, with detrimental impacts on local livelihoods (Anchor Environmental, 2012; Pulfrich, 2016). Local government recognises the need for alternative livelihood opportunities in these areas (Republic of South Africa, 2015). Particularly important is the sustainability of such livelihoods and the integration of opportunities with local human and ecological asset bases.

Aquaculture presents a prime opportunity for employment creation along the west coast, as it has the potential to support more jobs than fisheries do (Britz et al., 2000). The natural environment in the area is pristine, and presents ideal conditions for aquaculture. Furthermore, the type of skills required for the development of this sector, such as diving and boatmanship, are already present, as is the availability of labour (Britz et al., 2000). The abalone sector presents not only the opportunity for direct employment, but creates opportunities for the development of an entire sector, including other industries such as seaweed and post-harvest value adding (Troell et al., 2006).

Abalone farms employ an average of 60 people, at roughly 0.46 – 1.62 employees per ton. The total employment in the industry for 2004 being 1 390, with labourers earning an average of \$270 per month (Troell et al., 2006). Abalone culture is however labour intensive, employing primarily those without high levels of formal education. Men are primarily employed in ranching operations, but hatcheries and spin-off industries such as seaweed employ more women. The major advantage of aquaculture industries such as abalone over extractive industries such as mining is the sustainability of the sector, both in terms of longevity as well as its negligible ecological impact (Troell et al., 2006). Abalone ranching has the potential to provide 3,680 jobs directly, generating R154 million disposable income in the target towns (Britz et al., 2000) and is a sector with the potential for long-term sustainability.

5.7 Access arrangements

A significant portion of the concession area awarded to DCA is adjacent to and within the WCR diamond mining area. DCA previously concluded a mine area access agreement with De Beers Consolidated Mines (Pty) Ltd to facilitate access to required mining areas. Clarity was sought to ascertain if the MPRDA gives exclusive rights for access to the mining right holder.

5.8 Land-based Access

Several of the seeding sites are in access controlled areas namely Dokter se baai, Langklipbaai, Enkelduinbaai and NC4b border (fence lines are demarcated in Figure 3). DCA is required to submit a written request to WCR for permission to access these sites several weeks prior to the expected date that access is required. This includes access for seeding and harvesting. Vehicles are mobilised from Hondeklip Bay and follow roads indicated in Figure 3. Off-road (4x4) vehicles are required to reach the seeding sites of Stilbaai, Somnaasbaai, Langklipbaai, Enkelduinbaai and NC4b Border. Total travel distances from Hondeklip Bay to each of the seeding sites is indicated in Table 5.2.

Table 5.2: Travel distances from Hondeklip Bay (mobilisation base) to each of the seeding sites.

Seeding Site	Travel Distance from Hondeklip Bay (km)		Comments
	by land	by sea	
Voelklip	42.8	24.97	
Noupbaai	42.4	23.58	
Kammagappunt	43	22.12	
Stilbaai	45.6	20.54	4x4 required
Somnaasbaai	45.6	20.54	4x4 required
Geelkip tot Visbeenbaai	34	14.49	
Noord van Swartlintjies	No access from land	8.31	
Dokter se baai	11.85	5.79	need access to WCR security area
De Beers North Boundary	2.96	3.13	
Moordenaarsbaai	1.56	2.28	
Hondeklip Bay	0	0	
Platklippunt tot Aristeia	2.46	3.1	
De Beers South Boundary	5.13	5.28	
Langklipbaai	10.5	8.39	4x4 required; access controlled area
Enkelduinbaai	12.09	12.13	4x4 required; access controlled area
NC4b Border	17.26	15.35	4x4 required; access controlled area

5.9 Sea-based Access

To date, boats have not been used during seeding operations undertaken by DCA. If used, boats would be mobilised from Hondeklip Bay. Sea-based access bypasses the problem of access control however the weather window during which boats may safely mobilise and deploy divers on site is a restrictive factor. Approximately 60 to 80 (max) days per year are considered suitable for this method of access (Le Roux, pers comm.). Distances travelled by boat are shorter than those covered on land to most seeding sites. One seeding site is not accessible by land (Noord van Swartlintjies).

5.10 Cost of alternatives (boat-based vs land-based seeding)

Land-based access to the seeding sites is considered more efficient and cost-effective than access via boat (le Roux pers comm.). This is primarily due to the necessity of suitable weather conditions that are required for safe travel and deployment of divers at each site. The weather window period of approximately 60-80 days per year is a restrictive factor that makes this method of access less suitable than access by land. Furthermore, the additional cost of the hire or purchase of a boat would increase costs incurred for sea-based access.

Note: We assume that the 60-80 day weather window period relates to many factors and applies equally to both land-based diver access as well as sea-based access.

Constraints for access, whether by sea or land are as follows:

- I. The primary constraint is sea condition – rough seas would not permit either diving (from the shore) or nearshore access with a boat to allow divers in the kelp zones for seeding;

- II. High wind stress – either from the prevailing SE (summer condition mainly) or NW (winter condition mainly);
- III. Delayed access through the mining lease areas by land (WCR) (it takes two weeks to get a permit) subsequently losing a window of opportunity to seed a designated area; and
- IV. DAFF must also issue permits (Appendix 3) – if permits are not obtained timeously (from WCR or DAFF) then again windows of opportunity are lost, seed mortality can also occur.

In discussion with DCA (Le Roux, pers comm.) the preferred method of seeding is diver-based from land. The sea-based option using boats is therefore not considered to be an option (Appendix 2).

6.0 REVIEW OF APPLICABLE LEGISLATION

6.1 Abalone ranching

Abalone ranching in South Africa is guided by the “General Guidelines for Marine Ranching and Stock Enhancement in South Africa” which were gazetted on 20 August 2010.

The Abalone Ranching right is granted to DCA in terms of the following :

- I. Marine Living Resources Act, 1998 (Act No. 18 of 1998).

This act is the primary legal mechanism by which fishing rights are granted. Although abalone ranching is not wild-caught extraction (like a trawling or other fishing rights), it provides for a right to utilize a natural resource. Under this Act the gazetting of the Government Gazette, 20 August 2010 No. 729 advertised the intent to pilot (trial) abalone ranching through “*the general guidelines for marine ranching and stock enhancement in South Africa and publication of the guidelines and potential areas for marine ranching and stock enhancement of abalone (Haliotis midae) in South Africa*”.

Secondary legislation (although not directly applicable) is the following :

- II. The Marine living Resources Act: Policy for a Sustainable Marine Aquaculture Sector in South Africa;
- III. The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004); and
- IV. The FAO Code of Conduct for Responsible Fisheries, FAO: 1995.

In addition, once the right is activated, the rights holder requires numerous permits:

- V. General permits for abalone ranching (Appendix 3a);
- VI. Permit to seed (Appendix 3d);
- VII. Permit to harvest (Appendix 3c);
- VIII. Permit to process may also be needed for a hatchery (Fish Processing Establishment); and
- IX. Permit to transport

There are also various onerous reporting and monitoring requirements such as submitting monthly catch statistics (Appendix 3b).

Abalone ranching is a relatively new concept with the first ranching rights only recently being issued by the South African Government. On 30 January 2013, the Department of Agriculture, Forestry and Fisheries (DAFF) granted one of seven rights to engage in abalone ranching or stock enhancement pilot projects to DCA. The right is valid for 15 years, places no limit on production volume and allocates a 40 km abalone ranching concession area in the Northern Cape Province (NCP) to DCA. A significant portion of the concession area awarded to DCA is adjacent to and within the WCR diamond mining area. DCA previously concluded a mine area access agreement with De Beers Consolidated Mines (Pty) Ltd to facilitate access to required mining areas.

6.2 Mining right

The mining right to West Coast Resources (THG) right was issued by the Department of Minerals and Energy (DME) in terms of the Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act No. 28 of 2002).

The right granted to West Coast Resources commenced on 13 August 2012 and will continue to be in force for a period of 14 years ending on 12 August 2024⁶. The holder must continue to conduct mining operations failing which this right may be cancelled or suspended. Mining operations in the mining area must be conducted in accordance with the Mining Work Programme and any amendment to the Mining Work Programme and an approved Environmental Management Plan.

Restrictions and obligations imposed on the holder of the right :

The Holder is entitled to the rights referred to in section 5(2), (3) and section 25 of the Act, and such other rights as may be contained in this mining right. Pertinent points extracted from MPRDA, 2002 include:

5. (1) A prospecting right, mining right, exploration right or production right granted in terms of this Act is a limited real right in respect of the mineral or petroleum and the land to which such right relates;
- (2) The holder of a prospecting right, mining right, exploration right or production right is entitled to the rights referred to in this section and such other rights as may be granted to, acquired by or conferred upon such holder under this Act or any other law;
- (3) Subject to this Act, any holder of a prospecting right, a mining right, exploration right or production right may—
 - (a) enter the land to which such right relates together with his or her employees, and may bring onto that land any plant, machinery or equipment and build, construct or lay down any surface, underground or under sea infrastructure which may be required for the purposes of prospecting, mining, exploration or production, as the case may be;
 - (b) prospect, mine, explore or produce, as the case may be, for his or her own account on or under that land for the mineral or petroleum for which such right has been granted;
 - (c) remove and dispose of any such mineral found during the course of prospecting, mining, exploration or production, as the case may be;
 - (d) subject to the National Water Act, 1998 (Act No. 36 of 1998), use water from any natural spring, lake, river or stream, situated on, or flowing through, such land or from any excavation previously made and used for prospecting, mining, exploration or production purposes, or sink a well or borehole required for use relating to prospecting, mining, exploration or production on such land; and
 - (e) carry out any other activity incidental to prospecting, mining, exploration or production operations, which activity does not contravene the provisions of this Act.

Holder's Liability for payment of Compensation for Loss or Damage

Subject to section 43 of the Act, the Holder shall, during the tenure of this right while carrying out the mining operations under this right, take all such necessary and reasonable steps to adequately safeguard and protect the environment, the mining area and any person/s using or entitled to use the surface of the mining area from any possible damage or injury associated with any activities on the mining area.

Should holder fail to take reasonable steps referred to above, and to the extent that there is legal liability, the holder shall compensate such person or persons for any damage or losses, including but not limited to damage to the surface, to any crops or improvements, which such person or persons may suffer as a result of, arising from or in connection with the exercise of his/her rights under this mining right or any act or omission in connection therewith.

⁶ Unless cancelled or suspended in terms of clause 13 of this right and or section 47 of the Act.

Minister's liability for Payment of Compensation

The Minister shall not at any time be liable or responsible for the payment of compensation of whatever nature to the Holder, the Holder's successors-in-title or assignee, or any person whomsoever as a result of the conversion of this right.

6.3 Conflicting Rights

In terms of applicable legislation both the Abalone Ranching (DCA) and Mining rights holders (WCR) have been issued with legitimate rights to access their respective resources.

The Abalone ranching rights have however been issued well after the granting of Mining rights to WCR (noting that this mining right was previously owned by the DeBeers Group).

It would seem that the granting of Abalone Ranching Rights had not fully considered the potential conflict of interest that might arise. In this regard the Department of Agriculture, Forestry and Fisheries (DAFF) has promised to provide a legal review regarding the legal status of Abalone Ranching (see the minutes of the meeting with DAFF in Appendix 1).

7.0 METHODOLOGY

This study is a desktop review based on project background information and reports provided by Myezo Environmental Management Services. These include the Final Scoping Report submitted to DMR (29 April 2016), DCA abalone ranching areas seeding report (Zone 4) and the proceedings of a meeting held with WCR and DCA (23 May 2016) where concerns raised by DCA were noted and included in the terms of reference to be addressed in this report. In addition, meetings were held with representatives of DCA (Gert le Roux) and WCR to obtain additional information relating to the abalone ranching and proposed beach mining operations, respectively. DCA were able to provide a financial record of costs relating to seeding operations to date, as well as a forecast for future operations in line with their project plan. Relevant legislation was reviewed i.e. "General Guidelines for Marine Ranching and Stock Enhancement in South Africa" and the converted mining rights for each of the Koingnaas and Samsons Bak complexes.

Assessment of predicted significance of impacts for a proposed development is by its nature, inherently uncertain – environmental assessment is thus an imprecise science. To deal with such uncertainty in a comparable manner, standardized and internationally recognized methodology has been developed, and is applied in this study to assess the significance of the potential impacts of the proposed mining activities.

The significance of the impacts was determined through the following: For each impact, the SEVERITY (size or degree scale), DURATION (time scale) and EXTENT (spatial scale) are described (Table 7.1). These criteria are used to determine the CONSEQUENCE of the impact (Table 7.2), which is a function of severity, spatial extent and duration.

Table 7.1: Ranking criteria for environmental impacts.

SEVERITY/INTENSITY	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Limited loss of resources.
DURATION	H	Permanent. Beyond closure. Long term (>11 years)
	M	Reversible over time. Life of the project. Medium term (6-11 years)
	L	Quickly reversible. Less than the project life. Short term (0-5 years)
SPATIAL SCALE	H	Widespread – Far beyond site boundary. Regional/ national
	M	Fairly widespread – Beyond the site boundary. Local
	L	Localised - Within the site boundary.

Table 7.2: Determining the consequence.

SEVERITY	DURATION		SPATIAL SCALE		
			Site Specific (L)	Local (M)	Regional/ National (H)
Low	Long term	H	Medium	Medium	Medium
	Medium term	M	Low	Low	Medium
	Short term	L	Low	Low	Medium
Medium	Long term	H	Medium	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Low	Medium	Medium
High	Long term	H	High	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Medium	Medium	High

The SIGNIFICANCE of an impact is then determined by multiplying the consequence of the impact by the probability of the impact occurring, as shown in Table 7.3, with interpretation of the impact significance outlined in Table 7.4.

Table 7.3: Determining the significance rating.

PROBABILITY (of exposure to impacts)		CONSEQUENCE		
		L	M	H
Definite/ Continuous	H	Medium	Medium	High
Possible/ frequent	M	Medium	Medium	High
Unlikely/ seldom	L	Low	Low	Medium

Table 7.4: The interpretation of the impact significance.

SIGNIFICANCE	CRITERIA
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

Table 7.5: The interpretation of the status of the impact.

IMPACT STATUS	CRITERIA
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect on the environment

Once the significance of an impact has been determined, the CONFIDENCE in the assessment of the significance rating is ascertained using the rating systems outlined in Table 7.6.

Table 7.6: Definition of confidence ratings.

CONFIDENCE RATINGS*	CRITERIA
High	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact. Greater than 70% sure of impact prediction
Medium	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. Between 35% and 70% sure of impact prediction.
Low	Limited useful information on and understanding of the environmental factors potentially influencing this impact. Less than 35% sure of impact prediction.

* The level of confidence in the prediction is based on specialist knowledge of that particular field and the reliability of data used to make the prediction.

The degree to which the impact can be reversed is estimated using the rating system shown in Table 6.7.

Table 7.7: Definition of reversibility ratings.

REVERSIBILITY RATINGS	CRITERIA
Irreversible	Where the impact is permanent.
Partially Reversible	Where the impact can be partially reversed.
Fully Reversible	Where the impact can be completely reversed.

The degree to which there will be a loss of resources, as shown in Table 7.8 refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

Table 7.8: Definition of loss of resources.

LOSS OF RESOURCES	CRITERIA
Low	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
Medium	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
High	Where the activity results in an irreplaceable loss of a resource.

Lastly, the degree to which the impact can be mitigated or enhanced is shown in Table 7.9.

Table 7.9: Degree to which impact can be mitigated.

DEGREE TO WHICH IMPACT CAN BE MITIGATED	CRITERIA
None	No change in impact after mitigation.
Very Low	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
Low	Where the significance rating drops by one level, after mitigation.
Medium	Where the significance rating drops by two to three levels, after mitigation.
High	Where the significance rating drops by more than three levels, after mitigation.

Environmental Assessment Policy requires that, “as far as is practicable”, cumulative environmental impacts should be taken into account in all environmental assessment processes. EIAs have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires coordinated institutional arrangements; and
- Environmental assessments are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of the project level impacts, cumulative effects have been considered as far as it is possible (as High, Medium or Low) in striving for best practice. The sustainability of the project is closely linked to assessment of cumulative impacts.

8.0 DESCRIPTION OF IMPACTS

8.1 Overview

This assessment has had to take into consideration two different types of impacts. Firstly it considers the likely ENVIRONMENTAL impacts of the proposed mining ON abalone ranching. In the sense of an Environmental Impact Assessment this is relatively straight forward and the tables outlined in the methodology can be used.

Secondly, there is an OPERATIONAL impact of the proposed mining ON abalone ranching. This aspect has consequences for abalone ranching mostly of an economic nature.

With regard to the operational impacts it is clear from the legislative perspective that both the Mining and Ranching have legitimate “rights” issued in terms of the applicable legislation. Whereas mining is an established activity, abalone ranching is a relatively new concept. The Department of Agriculture Forestry and Fisheries, in their intent of promoting abalone ranching provided rationale in the abalone policy which preceded the rights application process (as followed by DCA). The DAFF policy (underpinned by the Marine Living Resources Act) outlined some of the benefits of abalone ranching, which included:

- 8.1.1 Development of Aquaculture as means of reducing pressure on wild stocks;
- 8.1.2 Generating wealth, particularly through community engagement and uplifting fishers in socially and economically depressed areas e.g. the West Coast;
- 8.1.3 Promoting long-term sustainable utilisation of a natural resource;
- 8.1.4 Creating empowerment and promoting equity; and
- 8.1.5 Promoting the development and exploring the broader opportunities provided by the ocean (the so-called Blue Economy through Operation Phakisa).

Some of these benefits are not dissimilar to the objectives of Mining with respect to wealth creation, community upliftment, empowerment etc. The main difference however between the two industries would be a question of scale and long-term sustainability.

Whereas the objective of abalone ranching is long-term (albeit untested fully), the Mining in the site-specific location (Zone 4 and overlap with abalone ranching), is a medium-term (11 years estimated) operation. With regard to scale, abalone ranching will employ relatively few individuals, although the wealth generation conceivably will be passed on to the broader west coast communities and is potentially sustainable. Mining on the other hand will employ many, will generate income in the west coast region on a much larger scale but has only a short time horizon.

It is also clear from our discussions and meetings that the abalone ranching initiatives have been actively promoted by DAFF and that the conflict with mining was certainly not anticipated by them. DAFF are, however, no strangers to the controversy around mining impacts and conflicts with fisheries. Records obtained by DAFF shows that in the 1980's and 1990's the West Coast Rock Lobster industry objected strongly to mining along the coast extending up to Namibia⁷. The principle objections to the mining at the time was the impact mining would have on beaches and the intertidal areas which were the principle habitat of west coast rock lobster. Although the terms of reference for this study do not include west coast rock lobster, certainly potential impacts from mining the nearshore zones would apply to this resource as well. The Minister, and her delegated authority (DAFF) clearly have not anticipated user conflict and it would seem were unaware of the historical user conflict, or at least did not anticipate that mining would extend into the exact marine areas for which abalone ranching was being proposed. Compounding the discussions on impacts is that the reported natural distribution of abalone does not extend beyond St Helena Bay. Abalone ranching (on the west coast beyond St Helena Bay at least) is therefore an entirely commercial opportunity and certainly there can be no benefits to improving wild stocks which are severely depleted (apart from perhaps reducing demand for illegally caught abalone).

Within Zone 4, both abalone ranching and mining are therefore strictly commercial operations and access to their respective resources and any impacts one may have on the other should be subjected to legal scrutiny⁸. Nevertheless this assessment must maintain its objective of assessing only the impact of the proposed mining on abalone ranching *per se*, whether it is environmental or operational in nature.

The identified impacts of the proposed mining on abalone ranching are follows:

- Impact on abalone seed areas due to loss of habitat available for abalone seeding;
- Impact of suspended sediment plumes and elevated turbidity on abalone seed;
- Restrictions on access to identified abalone seed areas; and
- Cumulative impact of the proposed mining on abalone ranching.

8.2 Ecological Impacts

With respect to the ecological impacts this study draws on the report of Pulfrich (2016) undertaken for WCA. The abalone ranching areas on the west coast fall within the nearshore central Benguela region (Shannon & Nelson, 1996; Shillington *et al.*, 1990). This area experiences high wave energy dominated by southwesterly swells and strong southerly winds (Branch and Griffiths, 1988) that “periodically smother and expose the invertebrate and algal communities that inhabit the rocky substrate found in the surf zone” (Anchor Environmental, 2012). Small embayments along the coast provide the only respite from these conditions (Bally, 1987). Coastal, wind-induced upwelling is the principal physical process that shapes the marine ecology of the Benguela region (Pulfrich, 2016), and is the key input of food to the relatively sheltered bays along this section of coast (Bally, 1987). The most intense upwellings occur when winds are strongest and where the shelf is most narrow, particularly near Lüderitz, as well as

⁷ Personal discussions and siting of historical information provided by D. van Zyl of DAFF.

⁸ This assessment considers legislation but the authors are not qualified to judge the legal pros and cons of the rights issued to mining and abalone ranching.

near Hondeklipbaai and Cape Columbine (Fawcett *et al.*, 2008; Shillington, 2003; Shannon & O’Toole, 1998). Longshore surface currents of 2 km/day are wind-driven and flow northward (Pulfrich, 2016; Fawcett *et al.*, 2008; Shannon & Nelson, 1996; Shillington *et al.*, 1990), however reversals in current flow at periods of three and a half days are common (Fawcett *et al.*, 2008).

Intertidal mining presents a number of opportunities for introducing sediment into coastal ecosystems. Accretion, berm construction and dissolution and fines may all contain sand, silt and clay, the dispersion of which through wave actions and currents may increase water turbidity and influence marine ecosystems (Speybroek *et al.*, 2004; Greene, 2002). Sediment plumes may become trapped in the surf zone, being transported alongshore with relatively little dilution. The higher the proportion of fine material, the more persistent such plumes are likely to be.

Alternatively, undertows and rip currents could carry sediment beyond the surf zone, re-depositing it alongshore during calm conditions. Modelling has suggested however that it is likely to be rapidly distributed alongshore in a predominantly southerly direction by wave-driven currents, ultimately extending seawards beyond the bay mouth (WSP, 2015). Sediment as a result of dredging, berm construction etc. that settle at depths shallower than 90 m from the disturbance may become re-suspended by wave action (Smith & Mocke, 2002; Lane & Carter, 1999). Current velocities typical of the Benguela are also capable of re-suspending sediment and transporting it northwards, and sediment that remains suspended for longer durations would be entrained with the slower southerly undercurrents (Rogers & Bremner, 1991; Shillington *et al.*, 1990).

Mining through the accretion of sandy beaches and the construction of berms will inevitably have severely negative effects on the benthic community in adjacent intertidal and subtidal habitats, either through disturbing, or by eliminating habitats (Pulfrich, 2016). The immediate impact of beach accretion and berm construction is the burial of benthos beneath quarried sands and sediments as well as the complete destruction of benthos within the mined area. While these effects are localised, the dispersal of sediment may have further reaching effects on benthic species in the surrounding environment (Pulfrich, 2016)⁹.

Comparable operations in Southern Carolina show that hard substratum habitats are more vulnerable to siltation and smothering by sand than sandy shorelines. In this case, the smothering of near shore reef habitats destroyed productive fishing grounds (Van Dolah *et al.*, 1994). Mining in Namibia shows that similar effects may be expected off the Namaqualand coast, where sediment deposits from shoreline accretion caused permanent losses of intertidal habitats (Pulfrich & Branch 2014a, 2014b; Pulfrich & Atkinson, 2007; Clark *et al.* 2004, 2005).

Increased sedimentation is shown to be the overriding influence on reducing habitat complexity on beta diversity at small and large spatial scales (Balata *et al.*, 2007). This is because of the negative impacts of sedimentation on kelp photosynthesis, larval survival, filter feeding efficiency and reducing water quality. Sediment plumes increase water turbidity, which reduce light penetration through the water column, reducing photosynthetic capability of aquatic plants such as kelp (O’Toole, 1997; Monteiro, 1998; Parsons *et al.*, 1986a, 1986b; Kirk, 1985; Poopetch, 1982). Furthermore, experimentation shows that the settling of sediment on *Saccharina latisimma* kelp leaves reduces photosynthesis, growth and nutrient uptake, as it causes leaf tissue to bleach and decay (Roleda & Dethleff, 2011). Sedimentation also diminishes the efficiency of filter feeders and reduces viability of invertebrate egg and larval survival (Pulfrich, 2016). The combined effect is therefore the reduced recovery rate of impacted areas and the potential for invasion of exotic species that are more resilient to desiccation, sediment burial and to light and nutrient stress (Roleda & Dethleff, 2011).

The impacts of suspended sediment plumes and elevated turbidity as a result of mining operations therefore is considered a critical potential impact on abalone seeding and the growth and survival of this seed once established. Whereas mortality of abalone seed is a recognised¹⁰, DCA based their financial model on the assumption that a

⁹ This would include settlement of abalone as well as any “seeded” abalone

¹⁰ Annexure 4 refers “The model incorporates previously published natural mortality data, with an expected mortality rate of 50% in year 1, 30% in year 2 and 20% per year thereafter. This results in an ultimate harvest recovery rate of 20.9%”.

harvesting rate of 20.9% would be achieved. Turbidity was certainly a consideration by the abalone ranching proponents although it is assumed the models were based on turbidity associated with prevailing environmental conditions (sea state etc.). To some extent, DCA also recognised the potential impact of mining when they selected preferred sites for seeding (DCA, 2016). Increased turbidity near mining site(s) may also compromise water quality at the seawater intakes to land-based abalone farms.

An important consideration then when determining the impacts of silting and turbidity on abalone seeds is the relative location to not only areas of naturally high siltation and turbidity, but also the proximity to mining sites and the likely persistence of any effects mining might have.

8.3 Operational Impacts

There is only one major operational impact considered – that of access to sites for seeding and harvesting operations. A significant portion of the concession area awarded to DCA is within the proposed WCR diamond mining areas. Access to several seeding sites is controlled by WCR and DCA is required to submit a written request for permission to access these sites several weeks prior to the expected date that access is required. To mitigate this impact the alternative is to seed only from boats so that land-based access would not be required. Both boat and land-based seeding options however have similar constraints, primarily limited weather and sea-condition windows for access (either for seeding or harvesting in the future). Land-based seeding is the preferred option for DCA (Le Roux pers. comm.) primarily because of the logistics of using boats as well as the capital and running costs thereof. Further, land-based seeding is more easily controlled with respect to handling of seed both from a transport perspective and transporting (with divers) to selected settlement areas. Seeding by hand (as done by divers) is the preferred method of seeding as it facilitates site selection for seed on a site by site basis. This method enables careful selection of settlement positions of seed (such as natural crevices and shelters as used by wild-caught populations). Access via boat is technically more challenging as divers must operate from outside the kelp and surf zones to access the selected seed areas. In our discussions with DCA several alternative seeding methods were discussed, such as for example use of enclosed pipes or artificial structures that provide temporary shelter for abalone seed and juveniles – this theoretically allows for a measure of “early stage” protection and migration from these artificial structures over time. DCA (Le Roux pers comm.) stated that these options had been investigated but that no advantage to these methods over the hand seeding of divers was apparent.

Assuming attrition associated with natural mortality, the expected survival of seed from seeding stage to harvesting is expected to be about 20.9% (Le Roux pers comm.)¹¹. Any increase in factors such as mining-induced sediment plumes, silting and loss of habitat will certainly alter the expected mortality of artificially seeded abalone.

8.4 Opportunities and risks posed on local economy

The economy of the Namaqua coast communities depends primarily on employment in mining and on artisanal fishing. Both of these sectors are however declining, with detrimental impacts on local livelihoods (Anchor Environmental, 2012; Pulfrich, 2016). Local government recognises the need for alternative livelihood opportunities in these areas (Republic of South Africa, 2015). Particularly important is the sustainability of such livelihoods and the integration of opportunities with local human and ecological asset bases.

Aquaculture presents a prime opportunity for employment creation along the west coast, as it has the potential to support more jobs than (wild-capture) fisheries do (Britz *et al.*, 2000). The natural environment in the area is pristine, and presents ideal conditions for aquaculture. Furthermore, the type of skills required for the development of this sector, such as diving and boatmanship, are already present, as is the availability of labour (Britz *et al.*, 2000). The abalone sector presents not only the opportunity for direct employment, but creates opportunities for the development of an entire sector, including other industries such as seaweed and post-harvest value adding (Troell *et al.*, 2006).

¹¹ Britz, (2000) refers to mortality of about 70%

Abalone farms employ an average of 60 people, at roughly 0.46 – 1.62 employees per ton. The total employment in the industry for 2004 being 1390, with labourers earning an average of \$270 per month (Troell *et al.*, 2006). Abalone is labour intensive, employing primarily those without high levels of formal education.

Men are primarily employed in ranching operations, but hatcheries and spin-off industries such as seaweed employ more women. The major advantage of aquaculture industries such as abalone over extractive industries such as mining is the sustainability of the sector, both in terms of longevity as well as its negligible ecological impact (Troell *et al.*, 2006).

Abalone ranching has the potential to provide 3680 jobs directly, generating R154 million disposable income in the target towns (Britz *et al.*, 2000) and is a sector with the potential for long-term sustainability (note this applies to all ranching and not just ranching within Zone 4).

9.0 IMPACT ASSESSMENT RESULTS

9.1 Impact of loss of habitat for abalone seed

The immediate impact of both beach accretion and berm construction would be the physical loss of potential seeding area. The proposed mining areas would however target bays and sandy (alluvial) areas that are not expected to be primary seeding areas (see the report by DCA who have estimated the likely effects of mining on each selected seeding location). Seeding areas adjacent to mining activity (secondary impacts) would be where the greatest impacts are expected.

The localised impacts of loss of habitat through beach accretion, berm construction and subsequent mining of the impounded area is considered to be of high intensity in and immediately adjacent to the mining target areas. Impacts are likely to persist over the medium (open coast berms) to long term (Mitchell’s Bay) and are thus considered to be of **HIGH** significance. There are no mitigation practicable measures proposed (Table 9.1).

Table 9.1: Impact ratings for the loss of abalone habitat due to the proposed mining activities

Loss of habitat		
	Without Mitigation	Assuming Mitigation
Severity	High	High
Duration	Medium (for the duration of the project) to High (permanent)	Medium (for the duration of the project) to High (permanent)
Extent/Spatial Scale	Medium (local) to High (regional)	Medium (local) to High (regional)
Consequence	High	High
Probability	High	High
Significance	High	High
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Unknown	
Degree to which impact can be reversed	Partially to fully reversible once mining ceases with expected recovery of habitat and kelp growth in the medium term	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	None	

9.2 Impact of suspended sediment plumes and elevated turbidity

According to the results of the marine specialist assessment (Pulfrich, 2016), the coarser fractions of the sediments and boulders used for berm construction and for beach accretion would settle out rapidly, but any silts and clays in the material would remain in suspension for longer and disperse further. Depending on the proportion of fines in the stripped overburden used for accretion, or the quarried material used as the berm core, wave action would winnow these from the coarser components resulting in increased turbidity in the surf-zone and nearshore water

column (Greene 2002; Speybroek et al. 2004). Sediment plumes can become trapped in the surf-zone and may subsequently be transported for considerable distances alongshore with relatively little further dilution, thereby reducing their effective dispersion. The suspended sediment concentrations, the extent and area over which plumes disperse, and their duration, depend largely on the proportions of silts, muds and clays (<63 µm) in the discharged sediments, as well as local sea conditions. The higher the proportion of fine material, the larger and more persistent the suspended sediment plume is likely to be (Newell *et al.*, 1998; Johnson & Parchure, 1999; Posford Duvivier Environment 2001; Greene, 2002).

One of the more apparent effects of increased concentrations of suspended sediments and consequent increase in turbidity, is a reduction in light penetration through the water column with potential adverse effects on the photosynthetic capability of phytoplankton (Poopetch, 1982; Kirk, 1985; Parsons *et al.*, 1986a, 1986b; Monteiro, 1998; O'Toole, 1997) and the foraging efficiency of visual predators (Clark *et al.*, 1998; Simmons, 2005; Braby, 2009; Peterson *et al.*, 2001). Furthermore, experimentation shows that the settling of sediment on *Saccharina latisimma* kelp leaves reduces photosynthesis, growth and nutrient uptake, as it causes leaf tissue to bleach and decay (Roleda & Dethleff, 2011).

It is anticipated that the sediments proposed for berm construction would have a negligible clay and silt fraction, so the generation of suspended sediment plumes above natural background levels during construction are expected to be insignificant. Likewise, the proportion of fines (<63 µm) in the overburden dune sands used to facilitate accretion, is expected to be insignificant. Turbidity offshore of the mine site(s) is thus unlikely to exceed levels attained naturally during turn-over of nearshore sediments by wave action or seasonal inputs in river discharges. As turbid water is a natural occurrence along the southern African west coast, any turbidity-related effects in the near-shore environment as a direct result of mining operations are likely to be low.

The construction of berms and general disturbance of the intertidal area would be expected to result in the generation of localised suspended sediment plumes, which may affect primary productivity, reduce the availability and suitability of food for abalone (table 9.2). Due to the transient nature of such plumes, the potential impacts are, however, considered to be of low intensity and are thus considered to be of **MEDIUM to LOW** significance both without and with mitigation. Suspended sediment concentrations within plumes are unlikely to exceed maximum levels occurring naturally along the wave-dominated coastline. No mitigation measures are possible.

Table 9.2: Impact ratings for the increased suspended sediment plumes and elevated turbidity on abalone seed due to the proposed mining activities

Effects of suspended sediment plumes and silting		
	Without Mitigation	Assuming Mitigation
Severity	Low	Low
Duration	Low (plumes would be transient)	Low (plumes would be transient)
Extent/Spatial Scale	Medium (beyond the site boundary)	Medium (beyond the site boundary)
Consequence	Medium to Low	Medium to Low
Probability	High	High
Significance	Medium	Medium
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Biota in the Benguela ecosystem have behavioural and physiological mechanisms for coping with this feature of their habitat therefore cumulative impacts are unlikely. Abalone does not naturally occur in the mining areas and natural mortality of seeded abalone in the area would be expected to be higher than in	

	areas where they do occur naturally (estimated to be 20-30%). The effects of mining would elevate mortality of seeded abalone, but this is not expected to be significantly higher than that of an area in which abalone do not naturally occur. Reduced kelp growth immediately adjacent to mined areas is likely and this will have a localised impact on food availability for seeded abalone.
Degree to which impact can be reversed	Fully reversible
Degree to which impact may cause irreplaceable loss of resources	Medium
Degree to which impact can be mitigated	None

9.3 Restrictions on access to identified abalone seed areas

A significant portion of the concession area awarded to DCA falls within the proposed WCR diamond mining areas. Access to several seeding sites is controlled by WCR and DCA is required to submit a written request for permission to access these sites several weeks prior to the expected date that access is required. Boat-based access is a mitigation option but is not considered an economically viable or operational option by the ranching permit holders (Table 9.3).

The impact of restricted access to seeding sites is summarised in Table 9.3 below. The potential impacts are considered to be of high intensity in the medium-term and are thus considered to be of **MEDIUM** significance without mitigation. The impact could be reduced to low significance if access to the specific locations could be expedited within a short time frame (24 hours) in order to allow windows of opportunity to be utilised.

Table 9.3: Impact ratings for the restriction of access to seeding sites.

Access to abalone seed areas		
	Without Mitigation	Assuming Mitigation
Severity	High	Low
Duration	Medium-term	Low
Extent/Spatial Scale	Medium (beyond the site boundary)	Medium (beyond the site boundary)
Consequence	Medium	Low
Probability	High	Low
Significance	Medium	Low
Status	Negative	Neutral
Confidence	High	Medium
Nature of Cumulative impact	For abalone to be seeded in the selected sites access to the specific locations needs to be expedited within a short time frame (24 hours) in order to allow windows of opportunity to be utilised (relates to sea and weather conditions). Boat-based seeding is not considered a viable option by the abalone seeding rights holder although this could be explored further between conflicting parties. This would include exploring security alternatives which are the primary concern of the mining operators.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Medium	

9.4 Cumulative impact of the proposed mining on abalone ranching

Abalone ranching rights in Zone 4 were issued for a period of 15 years. Commencing in 2013, DCA invested substantial amounts in air surveys and land-based verification of potential seeding sites to detail the seafloor topography, sand movements, silting and kelp cover. A processing facility was purchased at Hondeklip Bay. The operation is capital intensive with an expected R39 million invested. Annual costs include salaries and wages (R 2.7 million) and security measures (R 1.8 million).

During 2015, DCA seeded 156 097 abalone spat across five sites¹², two of which coincide with targeted mining areas. DCA planned to seed 225 000 abalone during 2016 across three seeding sites¹³, all of which are targeted mining areas. With the uncertainty cast by the intention of future mining activities, DCA has not seeded any areas during 2016. Loss of habitat for seeding will occur and there is a medium to low likelihood mining operations will in addition increase turbidity and silting on a localised scale. This will have the effect of increasing abalone seed mortality in the medium term (or at least for the grow-out period from seeding to harvesting over five years). Currently the target is to seed 200 000 spat per month, ultimately achieving a target production of 100 t per month. The forecast is that a harvestable size of 176 g or 96 mm would be achieved 51 months after seeding. Total financing of R 39 million is required over the initial six years before costs are recovered. This includes capital expenditure of R 8.6 million. Some abalone sales from the spat seeded during the pilot phase occur during years 2, 3 and 4. The first sales of abalone seeded from 2017 onwards only commence in year 5.

The ranching industry in Zone 4 would create 50-60 permanent jobs or about 24 jobs per 100 t production as well as approximately 24 jobs in the hatchery in Port Nolloth. Although employment numbers within the sector are small in comparison to the mining sector, the benefit would be long-term and would also result in knock-on effects such as support for families and sustaining local development.

¹² Voelklip, Noupbaai, Moordenaarsbaai, Hondeklip Bay and Platklippunt tot Aristeia

¹³ Noupbaai, Kammagappunt and Geelklip tot Visbeenbaai

Operational impacts would add to the cumulative environmental impact through increased risk of missing key periods to seed. Loss of habitat for seeding will occur and there is risk that increased turbidity and silting from mining operations will increase overall mortality of seeded abalone from seeding stage to harvesting. Although the individual impacts are relatively low the cumulative impacts are negative and will lead to overall increase in risk to the operations and economic and social benefits.

Table 9.4 below lists the impact ratings with and without mitigation measures in place. Lack of mitigation assumes complete closure of abalone ranching operations (without mitigation). The local to regional impacts of loss of seeded abalone due to mining is considered to be of high intensity in and adjacent to the mining target areas. Impacts are considered to be of **HIGH** significance. Should mining activities be delayed until the seeded abalone reach a harvestable size, this impact could be avoided with **LOW** significance

Table 9.4: Impact ratings for the the cumulative impact of the proposed mining activities on abalone ranching.

Loss of seeded abalone		
	Without Mitigation	Assuming Mitigation
Severity	High	Low
Duration	Medium-term (for the duration of the project)	Medium-term (for the duration of the project)
Extent/Spatial Scale	Medium (local) to High (regional)	Medium (local) to High (regional)
Consequence	High	Low
Probability	High	High
Significance	High	Low
Status	Negative	Negative
Confidence	High	Medium
Nature of Cumulative impact	Increased abalone overall mortality and economic loss due to restrictions on access and use of optimal windows for both seeding and harvesting abalone.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	High	

10.0 MANAGEMENT AND MITIGATION MEASURES

A form of co-existence for abalone activities to continue is necessary. With the intention of future mining activities, DCA has not seeded any areas during 2016. Loss of seeded abalone and the destruction of habitat in targeted mining areas would be unavoidable therefore it would be crucial that the mine plan and the aquaculture activities be synchronised. The co-existence could be successfully achieved if the mining schedules for specific targeted areas could be shared with DCA, who would also present their plans and schedules. It is suggested that mining activities in seeded sites should not take place until the seeded abalone reach a marketable size and can be harvested. It should be noted that WCR does not intend to mine along the entire length of coastline (shown in Figure 4) but rather would mine selected embayments coinciding with alluvial beds. There is no suggested mitigation measure for the increased turbidity and silting that could potentially result from suspended fine sediment. In addition to those management options listed by Pulfrich (2016) (see below), specific measures related to abalone ranching are added:

The following management actions are proposed:

1. Develop the mine plan to ensure that mining proceeds systematically and efficiently from one end of the target area to the next, and that the target area is mined to completion in as short a time as possible (Pulfrich, 2016);

- **Abalone ranching** : In conjunction with (1) above, coordinate this systematic mining plan to facilitate abalone ranching operations, aiming to minimise areas of operation to allow seed to harvest grow out and rotation of areas. This is not ideal but by synergising between mining and ranching operations, appropriate compromise is possible.
2. To allow impacted communities to recover to a condition where they are functionally equivalent to the original condition, the beaches should not be re-mined for at least five years, if at all. Efficient, high intensity mining methods are thus preferable to repeated operations (Pulfrich, 2016).
 - **Abalone ranching** : Abalone seeding and harvesting in mined areas will not be possible until recovery of the mined area has been achieved – conceivably this will take at least five years (as proposed by Pulfrich, 2016). At this stage the abalone ranching right will be near to or completed and the opportunity to test the feasibility of abalone ranching lost. This opportunity will not be lost in areas where mining will not occur but under the current scenario, the mining operator would need access to all proposed mining areas. Further, the abalone ranching right in Zone 4 was premised on the basis that the whole area would be available for the selection of abalone seeding and trial grow-out for the duration of the abalone harvesting right. There would seem few alternatives if abalone ranching cannot be accommodated in a systematic way within a plan that incorporates both mining and abalone ranching options.
 3. Initiate restoration and rehabilitation as soon as mining is complete in an area. This should involve removal (and re-use) of as much of the rock armour off the berms as possible, levelling of seawalls above the low water mark to facilitate more rapid natural erosion by the sea, back-filling excavations using seawall material, tailings and discards and restoring the beach profile to that resembling the pre-mining situation (Pulfrich, 2016).
 - **Abalone ranching** : This will have no material benefits or mitigate impacts on abalone ranching except if abalone ranching were delayed until the mining has been completed and impacted areas rehabilitated.
 4. Berms should be designed in such a way that they will erode naturally as rapidly as possible as soon as active maintenance ceases. Once mining has been completed in an area, as much of the berms as possible should be actively removed, leaving only those portions below the low water mark to be eroded naturally.
 - **Abalone ranching** : This will have no material benefits or mitigate impacts on abalone ranching except if abalone ranching were delayed until the mining has been completed and impacted areas rehabilitated.
 5. **Abalone Ranching** : Develop a comprehensive security and access plan to facilitate abalone ranching for land-based access to potential seeding and abalone harvesting areas. This plan should be pro-active and responsive to environmental conditions and windows of opportunity to facilitate optimal operational needs of the abalone ranching whether it be land or sea-based.

11.0 DISCUSSION AND CONCLUSIONS

Mining and abalone ranching are in direct conflict in terms of geographic space usage. Embayments in areas such as Noup, Visbeen, Koingnaas, Somnaas Langklip and Langklip Central, which are target areas for intertidal mining, are also pristine seeding sites proposed for abalone ranching. Furthermore, the ripple effects that mining will have on reducing or eliminating local habitats will further limit options for abalone seeding. The impact on kelp, the availability of which plays a key role in the expansion of the abalone sector also cannot be ignored.

The main marine impacts to the abalone ranching industry associated with the proposed mining activities are related to disturbance and loss of rocky habitats in the mining footprint. From the results of past studies, it is now well established that mining in the intertidal zone of sandy beaches using seawall/coffer dam technology and active beach accretion severely influences the benthic biota of adjacent rocky intertidal and shallow subtidal habitats

(Pulfrich, 2016). However, as shoreline accretion and berm construction are an unavoidable consequence of the proposed mining, there can be no direct mitigation for their impacts on the habitat of abalone seeding sites.

Whereas abalone production and spin-off industries present numerous and plentiful opportunities for sustainable income creation, using local human and ecological asset bases, mining is an extractive industry and therefore has a lifespan. Regardless of employment opportunities that mining may afford, cognisance must be taken of the negative impacts the closing down of this sector will have on local economies.

Finalising, the minutes of the meeting between WCR and DCA (Myezo, 2016) refers :

“A need for coexistence of economically productive industries is paramount and any connotations that suggest sector superiority, should be avoided. For example, mining might provide more jobs but as resources deplete the sector will reach the end of its life span. Abalone might provide fewer jobs but is a sustainable sector in the long term and should provide long-term, sustainable livelihoods. A steering committee is being set up and its term of reference are being finalised. The DMR and DAFF have to be involved in the harmonisation and streamlining of co-existence of the two sectors. A bilateral agreement is needed and Operation Phakisa already provides for that.

Further, the mining right states that the right holder has a *“liability for payment of compensation to any person/s using or entitled to use the surface of the mining area from any possible damage or injury associated with any activities on the mining area. Should holder fail to take reasonable steps referred to above, and to the extent that there is legal liability, the holder shall compensate such person or persons for any damage or losses, including but not limited to damage to the surface, to any crops or improvements, which such person or persons may suffer as a result of, arising from or in connection with the exercise of his/her rights under this mining right or any act or omission in connection therewith”*.

Further, in consideration of the granting of the right to ranch abalone in Zone 4, it is clear the conflict of interest between mining and abalone ranching was not foreseen – pending the outcome of a legal opinion from DAFF, there is clearly a need for DAFF to provide guidance on the options for abalone ranching in areas where impacts from alternate activities might occur (such as mining).

12.0 CONSULTATION PROCESS

This study is a desktop review based on project background information and reports provided by Myezo Environmental Management Services. These include the Final Scoping Report submitted to DMR (29 April 2016), DCA abalone ranching areas seeding report (Zone 4) and the proceedings of a meeting held with WCR and DCA (23 May 2016) where concerns raised by DCA were noted and included in the terms of reference to be addressed in this report. In addition, meetings were held with representatives of DCA (Gert le Roux) and WCR to obtain additional information relating to the abalone ranching and proposed beach mining operations, respectively. DCA were able to provide a financial record of costs relating to seeding operations to date, as well as a forecast for future operations in line with their project plan. Relevant legislation was reviewed i.e. “General Guidelines for Marine Ranching and Stock Enhancement in South Africa” and the converted mining rights for each of the Koingnaas and Samsons Bak complexes.

13.0 REFERENCES

- Anchor Environmental. 2012. Environmental risk assessment for an application for a right to engage in an abalone ranching pilot project. Applicant: Port Nolloth Seafarms (Ranching) (Pty) Ltd. Concession area: NC3 (Swartduine to Kleinzee). Application no: MARANCH 1014.
- Balata D, Piazzì L and Beneditti-Cecchi L. 2007. Sediment disturbance and loss of beta diversity on subtidal rocky reefs. *Ecology*, 88(10):2455-2461.
- Bally R. 1987. The ecology of sandy beaches of the Benguela ecosystem. *South African Journal of Marine Science*, 5: 759-770.
- Branch G.M, Griffiths C.L, Branch M.L, Beckley L.E. 2010. *Two Oceans - A guide to the marine life of Southern Africa*, David Philip, Cape Town and Johannesburg. Revised edition.
- Britz P, Sauer W, Mather D and Philips L. 2000. Towards equity, sustainability and stability: a sector planning approach to fishing and mariculture development in the Northern Cape Province, South Africa. *IIFET 2000 Proceedings*.
- Clark B.M, Atkinson L.J, Pulfrich A. 2005. Sandy Beach and Rocky Intertidal Monitoring Studies in the Bogenfels Mining Licence Area, Namibia. Monitoring Report 2005. Report to NAMDEB Diamond Corporation (Pty) Ltd., Oranjemund, Namibia.
- Clark B.M, Atkinson L.J, Steffani N, Pulfrich A. 2004. Sandy Beach and Rocky Intertidal Baseline Monitoring Studies in the Bogenfels Mining Licence Area, Namibia. Monitoring Report 2004. Report to NAMDEB Diamond Corporation (Pty) Ltd., Oranjemund, Namibia.
- Department of Agriculture, Forestry and Fisheries Marine Living Resources Act, 1998 (Act No. 18 of 1998). Publication of the general guidelines for marine ranching and stock enhancement in South Africa and publication of the guidelines and potential areas for marine ranching and stock enhancement of abalone (*Haliotis midae*) in South Africa. *Government Gazette*, 20 August 2010 No. 729.
- Diamond Coast Abalone (Pty) Ltd. 2016. NC Zone 4 Abalone Ranching Areas (unpub. report).
- Fawcett A.L, Pitcher GC and Shillington FA. 2008. Nearshore currents on the southern Namaqua shelf of the Benguela upwelling system. *Continental Shelf Research*, 28:1026-1039.
- Greene K. 2002. Beach Nourishment: A Review of the Biological and Physical Impacts, ASMFC Habitat Management Series #7 (Atlantic States Marine Fisheries Commission). Pp 179
- Kirk J.T.O. 1985. Effects of suspensoids on penetration of solar radiation in aquatic ecosystems. *Hydrobiologia*, 125: 195-208.
- Lane S.B, Carter R. 1999. Generic environmental management programme for marine diamond mining off the west coast of South Africa. Marine Diamond Miners Association, Cape Town, South Africa. 6 Volumes.
- Monteiro P.M.S. 1998. Assessment of sediment biogeochemical characteristics in the Espirito Santo Estuary-Maputo, Bay system in order to devise a low risk dredging-disposal management plan linked to the proposed MOZAL Matola Terminal. CSIR Report No: ENV/s-C98131 A. pp 39.
- Myezo. 2016. Proceedings of the meeting for EIA over the existing mining rights areas for Koingnaas right, Samson's Bak right and Namaqualand right, Namaqualand Mines, in Northern Cape (Document Name: WNE-PI-Meetings-Proceedings of the Meeting held with Department of Agriculture, Forestry and Fisheries (DAFF) on 03 June 2016) Myezo Ref Number: WNE 2015/02/M
- O'Toole M.J. 1997. A baseline environmental assessment and possible impacts of exploration and mining of diamond deposits (Prospecting Grants Areas M46/3/1946, 1950) off the coast of Namibia. In: Lane S, CMS, 1996. Environmental Assessment and Management Plan report for deep sea diamond mining in Namibia by Arena Mining (Pty) Ltd.

- Parsons T.R, Kessler T.A, Guanguo L. 1986a. An ecosystem model analysis of the effect of mine tailings on the euphotic zone of a pelagic ecosystem. *Acta Oceanol. Sin.*, 5: 425-436.
- Parsons T.R, Thompson P, Wu Yong, Lalli C.M, Hou Shumin, Xu Huaishu. 1986b. The effect of mine tailings on the production of plankton. *Acta Oceanol. Sin.*, 5: 417-423.
- Poopetch T. 1982. Potential effects of offshore tin mining on marine ecology. Proceedings of the Working Group Meeting on environmental management in mineral resource development, Mineral Resource Development Series, 49: 70-73.
- Pulfrich A, Atkinson L.J. 2007. Monitoring environmental effects of sediment discharges from the Uubvlei treatment plant on sandy beach and rocky intertidal biota in Mining Area 1, Namibia. Report to NAMDEB Diamond Corporation (Pty) Ltd., Oranjemund, Namibia, September 2007, 87pp.
- Pulfrich A, Branch G.M. 2014a. Using diamond-mined sediment discharges to test the paradigms of sandy-beach ecology. *Estuarine, Coastal and Shelf Science*, 150: 165-178.
- Pulfrich A, Branch G.M. 2014b. Effects of sediment deposition from Namibian diamond mines on intertidal and subtidal rocky-reef communities and the rock lobster *Jasus lalandii*. *Estuarine, Coastal and Shelf Science*, 150: 179-191.
- Pulfrich A. 2016. Environmental impact assessment in support of the amendment to the mining right held by West Coast Resources (Pty) Ltd over the Namaqualand Mines, Northern Cape Province.
- Republic of South Africa. 2015. State of the province address. [online]. Available <http://www.northern-cape.gov.za/index.php/speeches/1222-state-of-the-province-address-2015> (Accessed 2016, June 22).
- Rogers J, Bremner J.M. 1991. The Benguela Ecosystem. Part VII. Marine-geological aspects. *Oceanogr. Mar. Biol. Ann. Rev.*, 29: 1-85.
- Roleda M.Y. and Dethleff D. 2011. Storm-generated sediment deposition on rocky shores: simulating burial effects on the physiology and morphology of *Saccharina latissima* sporophytes. *Marine Biology Research*, 7:213-223.
- Sales J. and Britz P.J. 2001. Research on abalone (*Haliotis midae* L.) cultivation in South Africa. *Aquaculture Research*, 32:863-874.
- Shannon L.V, Nelson G. 1996. The Benguela: Large scale features and processes and system variability. In: Wefer G, Berger WH, Siedler G, Wells D.J (eds.). *The South Atlantic: Present and Past Circulation*. Berlin; Springer: 163-210.
- Shannon L.V, O'Toole M.J. 1998. Integrated overview of the oceanography and environmental variability of the Benguela Current region. Synthesis and Assessment of Information on the BCLME: Thematic Report 2. UNDP/GEF (RAF/96/G43), 58pp
- Shepherd S.A. and Turner J.A. 1985. Studies on southern Australian abalone (genus *Haliotis*). VI. Habitat preference, abundance and predators of juveniles. *Journal of experimental marine biology and Ecology*, 93(3):285-298.
- Shillington F. 2003. Oceanography. In: Molloy F, Reinikainen T (eds) *Namibia's Marine Environment*. Directorate of Environmental Affairs of the Ministry of Environment and Tourism, Namibia: 7-18.
- Shillington F.A, Peterson W.T, Hutchings L, Probyn T.A, Waldron H.N, Agenbag J.J. 1990. A cool upwelling filament off Namibia, South West Africa: Preliminary measurements of physical and biological properties. *Deep-Sea Res.*, 37(11A): 1753-1772.
- Smith G.G, Mocke G.P. 2002. Interaction between breaking/broken waves and infragravity-scale phenomena to control sediment suspension and transport in the surf zone. *Marine Geology*, 187: 320-345.
- Speybroeck J, Bonte D, Courtens W, Gheskiere T, Grootaert P, Maelfait J-P, Mathys M, Provoost S, Sabbe K, Stienen E, Van Lancker V, Vincx M, Degraer S. 2004. Studie over de impact van zandsuppleties op het ecosysteem, Ministerie van de Vlaamse Gemeenschap. Afdeling waterwegen kust.

- Sweijd N, Snethlage Q, Harvey D, Cook P. 1998. Experimental abalone (*H. midae*) seeding in South Africa. *J Shellfish Res.*, 17(3): 897-904.
- Tarr R.J.Q, Williams P.V.G. and Mackenzie A.J. 1996. Abalone, sea urchins and rock lobster: a possible ecological shift that may affect traditional fisheries. *South African Journal of Marine Science*, 17(1):319-323.
- Troell M, Robertson-Andersson D, Anderson R.J, Bolton J.J, Maneveldt G, Halling C. and Probyn T. 2006. Abalone farming in South Africa: an overview with perspectives on kelp resources, abalone feed, potential for on-farm seaweed production and socio-economic importance. *Aquaculture*, 257:266-281.
- Van Dolah R.F, Martore R.M, Lynch A.E, Levisen M.V, Wendt P.H, Whitaker D.J, Anderson W.D. 1994. Final Report: Environmental Evaluation of the Folly Beach Nourishment Project. U.S. Army Corps of Engineers, Charleston District, Charleston, SC.
- WSP Coastal and Port Engineers. 2015. Coastal Protection for beach mining in the Koingnaas Area. Report to West Coast Resources, August 2015, 50pp (Report 19943/11.2/001 Rev01)

APPENDIX 1: MINUTES OF MEETING HELD WITH DEPARTMENT OF AGRICULTURE FORESTRY AND FISHERIES ON 25/07/2016

<p>BRANCH: FISHERIES MANAGEMENT</p> <p>Meeting Between DAFF: Sustainable Aquaculture Management and CapMarine Employed to Conduct Aquaculture Specialist Study For West Coast Resources For Koilgnaas and Samsons Bak Complexes</p> <p>Date: Monday, 25th July 2016. Time: 10:00 Venue: Small AED Boardroom, Foretrust, Cape Town. Chairperson: Asanda Njobeni</p>
--

No.	Agenda Item	Responsibility
1.	Welcome & Introductions	AN
2.	<p>Present & Apologies</p> <p>1. Asanda Njobeni (AN) 2. Zimasa Jika (ZJ) 3. Andrea Bernatzeder (AB) 4. Michelle Pretorius (MP) 5. Maxhoba Jezile (MJ) 6. Dave Japp (DJ) 7. Sarah Wilkinson (SW)</p>	All
3.	Matters for discussion	
3.1	<p>Background to the project</p> <p>DJ gave a brief introduction and outline that CapMarine were subcontracted by Myezo Environmental Management Service to undertake an Aquaculture Assessment as part of the Environmental Impact Assessment process for West Coast resources. He explained the approach they intend on undertaking with the assessment.</p>	CapMarine
3.2	<p>DAFF's overview of the engagements</p> <p>AN explained to CapMarine that there had been meetings between DAFF the applicant, Myezo Environmental and Diamond Coast Abalone (DCA) in which the DAFF emphasised the need for both sectors to coexist. The DAFF had also had engaged the Northern Cape Provincial Coastal Committee (PCC) and the Department of Mineral Resource (DMR) on the matter.</p> <p>AN explained that DCA raised concerned around access to the ranching sites where they had already seeded abalone. DAFF are of the view that this is an issue that should be resolved between TransHex Group and DCA. DCA have a legitimate right and access should not be an inhibiting factor.</p> <p>DCA indicated to CapMarine that they have limited period in which seeding can be undertaken – about 60-90 days maximum so delays with regards to restricted access to the seeding areas will be prove problematic. DCA had indicated that they had not seeded this year due to the unresolved issue with WCR, but this may not be the only reason that they had not seeded.</p> <p>ZJ stated that DCA were granted a 10 year ranching permit in terms of the Marine Living Resources Act which was granted in 2012 after an appeal process so effectively their right was valid from 2012 and runs through to 2022. AN stated that the ranching is not an “experiment” but a commercial “Pilot” programme aimed at testing the viability of abalone ranching. The tenure of the right would extend to 15 years. It was not clear if THG had a right to exclude others from access to the area. AN also told CapMarine that DAFF would consult internally with the legal experts to provide an opinion on the legal aspects of the granting of the right (with respect to abalone right and not the mining aspects).</p> <p>AN told the meeting that DAFF understood that WCR (THG) took over the mining right from De Beers who previously had worked closely and had facilitated access to the communities as needed. However</p>	DAFF and CapMarine

	<p>the THG proposed mining seawards posed new environmental issues as well as access and conflicts with the abalone ranching.</p> <p>AN clarified the funding issue to CapMarine in that, DCA were self-funding and had loans from various sources – mainly IDC. Operation Phakisa was the main driver of the abalone ranching and DAFF was committed to its development.</p> <p>CapMarines enquired about the reporting requirements as per DCA permit conditions, ZJ indicated that abalone ranching required baseline monitoring to be undertaken before seeding and the rights holders need permits to transport spat, and would need permits to harvest as well as a permit for the spat holding or grow out facilities eg. Hondeklip bay.</p> <p>AN told CapMarine that abalone ranching had potential for providing employment and social upliftment in the area. If abalone ranching worked this would be of a long term sustainable nature. The mining and ranching should not be seen as separate entities providing social and economic value, including employment in the region – the two should work together with other economic opportunities. DAFF expressed that the importance of ranching should not be “minimised” i.e. not undervalued and that the economic issue of jobs comparing jobs created between ranching and mining was not a fair way of valuing the one against the other. Mining was short-term and had significant environmental impacts whereas ranching had the potential for longer-term more stable employment.</p> <p>CapMarine indicated Abalone distribution does not natural spread beyond St Helena and studies have shown little to no signs of the species in the region which may affect the feasibility of the ranching sites. AN indicated that research was done which has led to this pilot project to test the commercial viability of the product. AB stated that inhibiting factors to abalone distribution could be several such as predation, interaction with other species such as sea urchin, temperature for reproduction. However the importance of the ranching was that seeding allowed spat to settle and grow which eliminated the need for reproduction and natural settlement and survival.</p> <p>There was some discussion and explanations regarding the nature of the proposed mining. AB was concerned regarding the impact that the silt material would have on the abalone and the quality of water. There were questions regarding how the rehabilitation would be done. DJ explained that the built berms would as far as possible be reduced in size when mining was completed to allow ingress of the sea to hasten the rehabilitation of the area.</p> <p>ZJ stated that in general there had been good collaboration between parties in the past – in some areas there was overlap with Marine Protected Areas (Eastern Cape) but this had been resolved. ZJ would provide DJ with copies of permit conditions granted for DCA.</p> <p>Security was seen as not a major concern as both parties could have a joint security to protect both products.</p> <p>DJ asked about the rights allocation process – DCA had undertaken an Environmental Risk Assessment and had developed a business model (provided to CapMarine) – DAFF responded that as far as they recalled no objections or comments had been received from the mining groups regarding the ranching rights – ZJ suggested that this was most likely because that at the time the mining operations were “land-based”.</p> <p>Regarding Environmental Impacts DJ asked if DAFF had a view on the likely impacts and risks. DAFF felt that they would wait for the impact assessments before commenting and at this point had no opinion. AB asked what the baseline had reported (PISCES) – DJ could not comment at this stage until all the available material had been reviewed.</p>	
4.	Way forward	
4.1	CapMarine to finalise the Aquaculture Assessment report. A suggestion from DAFF was that both parties need to sit down and come to an arrangement in which both parties would co-exist on areas where they work and in areas where they both can provide employment for the local people.	CapMarine and DAFF
5.	Closure	AN

APPENDIX 2: SUMMARY OF MEETING HELD BETWEEN CAPMARINE AND DIAMOND COAST ABALONE

Note: These are not formal minutes – they are an *aide memoir* and presented here as a record of the discussion for CapMarines purposes.

Date: 13 July 2016

Present : Diamond Coast Abalone : G. Le Roux
CapMarine : D. Japp, C. Heinecken and S. Wilkinson

1. GL – DCA had been granted an Abalone Ranching right for 15 years (up to 2028) from 2013. This is a “Pilot” right and is not guaranteed i.e. rights need to be renewed after this period
2. Abalone spat will be transported by truck to Hondeklip Bay where they are “grown out” to 30 mm in size for seeding
3. DCA have 2 rights – one in Zone 4 (after an appeal process) and another (Zone 1?).
4. The ranching right is a Marine aquaculture right for abalone only – to activate permits are required from DAFF for seeding, to harvest and also for a land-based processing facility (Hondeklip Bay)
5. DCA surveys the whole of Zone 4 in 2010 for suitability of ranching particularly to map available Kelp areas. This was followed by verification.
6. DCA had to purchase a processing facility at Hondeklip Bay – this process was delayed and costly.
7. Logistics of seeding and harvesting still in process of finding best options
8. Site selection is critical – DCA have spent significant amounts on site location (see figure 4 in this report) including air surveys and land-based verification detailing bottom topography, sand movements, silting, kelp cover (two species), algae etc. Mining activity likelihood was also anticipated at each location . Seeding capacity was determined using two levels viz. 3.7 (lower) or 11 abalone per M²
9. The target was / is to seed 200 000 spat per month ultimately achieving production of 100 t per month. Harvest size would be about 175 gm or 96.3 mm. This growth rate could be achieved in 51 months
10. Currently the 2016 seeding programme has been halted due to the uncertainty around the possible mining impact;
11. With regard to cost the investment (total) approximated R51 million. This was partly funded through an IDC loan as well as direct funds from DCA and the balance from the main shareholder (noting that shareholding was subject to change).
12. Risks – the main risks to the abalone ranching were :
 - a. Poaching
 - b. Access
 - c. Habitat destruction (mining)
 - d. Silting (which is an indirect impact on kelp growth which impacts food availability for abalone). Silting from “fine sands” also affects visibility with affects seeding (diving) and potentially harvesting in the future;
13. With regard to access to the selected sites the use of boats was not anticipated as land-based harvesting was preferred. Access to the seeding grounds from the sea would only be between 60-80 days, would require a vessel of at least 8-12 m (for both harvesting and seeding). The cost of using a boat was therefore more risk (than land-based diving), boats are capital intensive (cost not determined but probably in excess of R2-4 million for a suitable vessels (Japp, Capmarine estimate). For land-based access there were also risks due to delays in issuing permits from TransHex (takes 2 weeks) and this might result in losing a window of opportunity to seed when sea conditions were suitable for seeding (or harvesting). Noted also that WCR were very concerned about the influx of criminals and how this would be controlled if open access to the area was provided.
14. DCA was spending approximately R300 000 pm on security
15. Socio-economics – ranching in Zone 4 would create 50-60 permanent jobs or about 24 jobs per 100t production as well as approx. 24 jobs in the hatchery in Port Nolloth;
16. With regard to activities in other zones – Zone 1 had done no seeding, Zone 2 No seeding but have a land-based factory for abalone, Zone 3 some seeding with spat provided by Abagold
17. GL emphasized the long-term investment and trade off with investment in setting up against the long-term benefits – although employment numbers were small, the benefit was long-term and would also have benefits to many others (knock-on effects) such as support for families, sustaining local development etc. Mining was a short-term process that could not be sustained (11 year time horizon).
18. GL suggested that a clear mining plan was needed that could facilitate / accommodate the ranching – if a clear mining strategy was provided and impacts on abalone ranching could in part be mitigated – as things stood (this point in time) there appeared no compromise options.

APPENDIX 3A: GENERAL PERMITS CONDITIONS RELATED TO ABALONE RANCHING

SECTION B

PERMIT CONDITIONS: STANDARD ABALONE RANCHING 2016

1. GENERAL

1.1 This permit is issued subject to the provisions and regulations of the following legislation:

- (a) Marine Living Resources Act, 1998 (Act No. 18 of 1998), ("the Act"),
- (b) National Environmental Management Act, 1998 (Act No. 107 of 1998),
- (c) National Environmental Management Act, 1998 (Act No. 107) Environmental Impact Assessment Regulations, 2010 (Gazette No. 33306),
- (d) National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004),
- (e) National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004): Alien and Invasive Species Regulations, 2004 (Gazette No. 37885),
- (f) National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003),
- (g) Animal Protection Act, 1962 (Act No. 71 of 1962),
- (h) Seashore Act, 1935 (Act No. 21 of 1935),
- (i) National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008),
- (j) Occupational Health and Safety Act, 1993 (Act No. 85 of 1993),
- (k) Labour Relations Act, 1995 (Act No. 66 of 1995),
- (l) Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947),
- (m) Medicines and Related Substances Act, 1965 (Act No. 101 of 1965), and
- (n) General Guidelines for Marine Ranching and Stock Enhancement in South Africa and Guidelines and Potential Areas for Marine Ranching and Stock Enhancement of Abalone (*Haliotis midae*) in South Africa (No. 33470 Government Gazette, 2010).

The following legislation is applicable to the culture of organisms intended for human consumption and must be complied with where relevant:

- (o) National Health Act, 2003 (Act No. 61 of 2003),
- (p) Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972),
- (q) National Regulator for Compulsory Specifications Act, 2008 (Act No. 5 of 2008), and
- (r) Standards Act, 2008 (Act No. 8 of 2008).

This permit does not exempt the Permit Holder from complying with any other applicable legislation.

- 1.2 The Delegated Authority, Chief Director: Aquaculture and Economic Development shall be entitled to amend these permit conditions when deemed necessary.
- 1.3 Any reference to the Permit Holder in these permit conditions includes the entity or person, his/her/its employees (whether permanent or temporary), his/her/its contractors, agents or advisers, in the course and scope of their contractual relationship.
- 1.4 The Permit Holder shall store at their authorised marine aquaculture site the original permit issued for the current operational year. The Permit Holder shall at all times, have available a **true certified copy** of this permit which should be produced on demand by any Fishery Control Officer(s) or any other authorised official(s).
- 1.5 This permit authorises the Permit Holder to undertake ranching activities for those species specified in **Section A**. The Permit Holder may not possess, keep, harvest from the concession area, transport, export or process any other species or undertake those activities not specified in **Section A** of this permit.

2. SPECIFIC CONDITIONS

- 2.1 The Permit Holder shall comply with the specific conditions attached in the relevant **ANNEXURES**.

3. TRANSPORT

- 3.1 The Permit Holder may in terms of this permit possess and transport the species referred to in **Section A**.

- 3.2 The Permit Holder shall only transport the specified species in the nominated vehicles and/or vessels listed in this permit and in the event where a temporary vehicle and/or trailer/vessel is used which has not been nominated in **Section A** then the Regional Fishery Control Office in the local area should receive prior written notification.
- 3.3 Relocation of species detailed in **Section A** between disease management zones (e.g. abalone) or between culture operations where disease management zones have not been established, shall be done with the prior written authorization from the Department.

4. VESSELS (if applicable)

- 4.1 The Permit Holder's nominated vessel(s) (**NAME OF VESSEL(S)**) shall be authorised to conduct ranching activity (**TYPE OF ACTIVITY**) in the (**LOCATION**).
- 4.2 The Permit Holder shall not use any vessel unless it bears the registration letters and numbers assigned thereto by the Director General. Such letters and numbers shall be painted in white on a black background or in black on a white background on both bows in characters not less than 15 cm in height, 10 cm in breadth and 2 cm in thickness (width of stroke). The space between adjacent letters and figures shall be between 2 cm and 5 cm.
- 4.3 The Permit Holder shall affix the letters "RA" on all vessel(s) used for ranching activity and the letter must at all times be clear, and legible, the size of the letters "RA" shall not be smaller than 20 cm in height and 2 cm in thickness.
- 4.4 The Permit Holder shall notify the local Fishery Control Officer of nominated vessels.
- 4.5 Radio call signs must be clearly visible and displayed as stipulated in terms of Regulation 78 (Regulation GNR 1111 of 2 September 1998) promulgated under the Act.
- 4.6 The Permit Holder shall allow a Fishery Control Officer(s) to enter and inspect the nominated vessel if required.
- 4.7 The Permit Holder, and all persons employed on the vessel shall immediately comply with any instruction or request given by a Fishery Control Officer(s), facilitate his or her safe entry and inspection of the vessel, records, documents, fish and fish products and take all measures necessary to ensure the safety of a Fishery Control Officer(s) in the performance of this or his/her duties.

5. INSPECTION OF FACILITIES

- 5.1 The Permit Holder shall, when requested by the Department or its agent, allow access to a Fishery Control Officer(s) or any other authorised official(s) at its place of business.
- 5.2 The Permit Holder shall allow the Fishery Control Officer(s) or authorised official(s) unrestricted access to monitor ranching activities and compliance with permit conditions and all applicable laws, and shall facilitate safe entry and inspection of the sites/areas, records, documents, animals, and sampling.
- 5.3 Should the Department reasonably believe that a Fishery Control Officer(s) or any authorised official(s) is threatened or being prevented from carrying out his/her obligations in any way, the Department may immediately suspend the ranching activities being undertaken by the Permit Holder(s).
- 5.4 In the event of ranching and harvesting being undertaken in restricted areas (e.g. mining areas), the Permit Holder shall obtain the necessary authorisation from the relevant authorities to allow access to these sites/areas.
- 5.5 Fishery Control Officer (FCO) or authorized official(s) of the Department may be allowed to give instructions with which the Permit Holder shall adhere to in terms of any Food Safety Programmes implemented by the Department.

6. ENVIRONMENTAL MONITORING

- 6.1 The Permit Holder shall be required to comply with an approved Environmental Management Programme (EMPr). The Environmental Management Programme (EMPr) shall be drawn up by the Permit Holder in consultation with the Department and other stakeholders.

7. AQUATIC ANIMAL HEALTH

- 7.1 The Permit Holder shall comply with an approved disease monitoring plan for introduced and transferred stocks. The disease monitoring plan shall be developed in consultation with the Department and other stakeholders.
- 7.2 The Permit Holder shall comply with a contingency plan, developed in consultation with the Department and other stakeholders, in the event of a disease outbreak being detected in the ranching concession area.

- 7.3 The Permit Holder shall allow any disease or pathogen related investigation of the ranching site, to be conducted if deemed necessary by the Department and/ or veterinary authority.
- 7.4 The Permit Holder shall notify the Department of the occurrence of any unusual mortalities, suspected case or occurrence of an infectious disease in the ranching site. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Animal Health and Environmental Interactions, Sasha Saugh, tel. (021) 430 7052/ 7076, fax (021) 434 2899 and e-mail AcquaHealth@daff.gov.za.
- 7.5 The Permit Holder shall ensure that abalone spat to be seeded in the ranching concession area are obtained from an authorised hatchery with a recognized animal health monitoring programme.

8. USER CONFLICT AND ACCESS BY OTHER USERS

- 8.1 The Permit Holder shall not restrict access to other users within the ranching concession area.
- 8.2 The Permit Holder shall avoid conflict with other users within the ranching concession area.

9. LOCAL COMMUNITY BENEFICIATION

- 9.1 The Permit Holder shall ensure that the local community within the ranching concession area takes first preference in terms of socio-economic benefits and employment.

10. SAMPLING & ANALYTICAL COSTS

- 10.1 The Permit Holder shall be responsible for the sampling, couriering and analytical costs related to compliance with these permit conditions.
- 10.2 The Permit Holder shall notify the Department at least 24 hours prior to any sampling event, with information on sample size and purpose of sampling exercise.
- 10.3 The Permit Holder shall be responsible for the analytical costs related to compliance with paragraphs 6 and 7 above.
- 10.4 The Permit Holder shall be responsible for specific sampling, couriering and analytical costs as required by the South African Molluscan Shellfish and Animal Health Programme (i.e. diagnostic testing and animal health examinations).

11. SUBMISSION OF INFORMATION AND REPORTS

- 11.1 The Permit Holder shall submit to the Department notification of any change of contact details (including postal address and contact telephone numbers) within 30 days of such change. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Authorisations, Zimasa Jika, tel. (021) 402 3356 and e-mail ZimasaJ@daff.gov.za.
- 11.2 The Permit Holder shall submit to the Department the transformation profile of their operation relating to the shareholding, ownership and management annually by 30th November. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Authorisations, Zimasa Jika, tel. (021) 402 3356 and e-mail ZimasaJ@daff.gov.za.
- 11.3 The Permit Holder shall complete an Abalone Ranching Catch Statistic Form in the format requested by the Department and submit to the Department for the attention of the Directorate: Inshore Fisheries Research, tel. (021) 402 3203, fax (021) 402 3034 and e-mail GenevieveM@daff.gov.za.
- 11.4 The Permit Holder shall submit a monthly report by the 15th day of every month, in the format requested by the Department. For attention of the Directorate: Aquaculture Technical Services (ATS), Aquaculture Information and Economics, Keagan Halley, tel. (021) 402 3326 and e-mail Aquaculturedata@daff.gov.za (Cc KeaganH@daff.gov.za).
- 11.5 The Permit Holder shall submit to the Department a bi - annual health and laboratory health reports in the format requested by the Department. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Animal Health and Environmental Interactions, Sasha Saugh, tel. (021) 430 7052/ 7076, fax (021) 434 2899 and e-mail AquaHealth@daff.gov.za.
- 11.6 The Permit Holder shall provide any information relating to the Right or permit including but not limited to economic, socio-economic, financial, transformation or statistical information requested by the Department. The information shall be supplied in the format requested and shall be submitted within 21 days of the date of request to the relevant official.
- 11.7 The Permit Holder subject to an Environmental Management Programme shall submit environmental monitoring data annually to the Department by the 31st May. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Animal Health and Environmental Interactions, Michelle Pretorius, tel. (021) 430 3034, fax (021) 434 2144 and email EnvironAssessments@daff.gov.za.

12. COMPLIANCE

- 12.1 The Permit Holder shall not harvest any wild species or engage in any fishing or other regulated activity not stipulated in **Section A**.
- 12.2 The Permit Holder shall not engage in ranching activity in a location or site not stipulated in **Section A**.
- 12.3 The Permit Holder may not be in possession of any species at the authorised ranching site other than those species listed in **Section A**.
- 12.4 The Minister or Delegated Authority may refuse to issue a subsequent permit should the conditions stipulated in this permit not be adhered to.
- 12.5 A failure to comply with the provisions of the Act or these permit conditions by the Permit Holder may result in, but not limited to, the initiation of legal proceedings (civil or criminal). In terms of the Act, a breach includes:
- (a) withholding information to which the Department is entitled, or furnishing information, which is not true, complete or accurate;
 - (b) contravening or failing to comply with a permit condition or with the provisions of the Act;
 - (c) being convicted of an offence in terms of the Act, or
 - (d) failing to effectively utilise the permit.
- 12.6 In terms of the Act, the Permit Holder is obliged to report to the Minister any contravention of the provisions of the Act by any other person. Any such contravention must be reported to the Department in writing for attention of the Chief Directorate: Monitoring, Control and Surveillance, Fatima Savel, tel. (021) 402 3539, fax (021) 402 3663 and e-mail FatimaSA@daff.gov.za.
- 12.7 Any diving activities to be undertaken in areas where diving is prohibited, must be authorised through a permit in terms of the Regulations for the Protection of Wild Abalone (*Haliotis midae*) as published in the Government Notice R62 of 1 February 2008.
- 12.8 Should the Permit Holder fail to submit information or submit false or incorrect information as outlined in 11.5 above, the Department may institute proceedings under Section 28 of the Act. In addition, the Department may refuse to issue a subsequent permit until such time as the required information has been received, verified and processed.

- 12.9 The contact details for local Fishery Control Officer(s) are provided in Table 1. Should the relevant contact details change during the course of the validity period of this permit, then the Department will update the relevant contact details accordingly and notify the Permit Holder.

Table 1. Fishery Control Officer (FCO) Representatives

OFFICIAL NAME	REGION	TELEPHONE	E-MAIL
1. Buyekezwa Polo	Western Cape	(021) 402 3110	BuyekezwaP@daff.gov.za
2. Wade Theron	Saldanha	(022) 714 1710	WadeT@daff.gov.za
3. Dakalo Gabisi	Gansbaai	(028) 364 0235	DakaloG@daff.gov.za
4. Nomonde Simon	Hermanus	(028) 312 2609	NomondeS@daff.gov.za
5. Mphakamisi Fifana	East London	(043) 722 2091	MphakamisiF@daff.gov.za
6. Dennis Mostert	Port Elizabeth	(041) 585 4051	DennisM@daff.gov.za
7. Zameka Mphangwa	Northern Cape	(027) 851 8363	ZamekaM@daff.gov.za

13. TRACEABILITY AND FOOD SAFETY

- 13.1 The Permit Holder shall be obliged to comply with traceability protocols implemented by the Department for food safety and compliance purposes, where applicable.
- 13.2 The Permit Holder shall adhere to the South African Molluscan Shellfish Monitoring and Control Programme. For additional information you may access the programme manual available on the website www.daff.gov.za or contact the Directorate: Sustainable Aquaculture Management (SAM), Shellfish Monitoring and Control Programme, John Foord, tel. (021) 430 7003/ 7065 and e-mail SAMSanitation@daff.gov.za.
- 13.3 The Permit Holder shall complete the relevant sections of the movement document obtained from the Department when transporting live shellfish in accordance with the South African Molluscan Shellfish Monitoring and Control Programme. For further enquiries please contact the Directorate: Sustainable Aquaculture Management (SAM), Shellfish Monitoring and Control Programme, John Foord, tel. (021) 430 7003/ 7065, fax (021) 434 2899 and e-mail SAMSanitation@daff.gov.za.

14. FISH PROCESSING ESTABLISHMENT (If applicable)

- 14.1 Any fish processing shall be subject to specific conditions as set out in **Section B** of the **Marine Aquaculture Fish Processing Establishment (FPE)** permit conditions.
- 14.2 The Permit Holder shall only allow such fish to be processed at an authorised Fish Processing Establishment (FPE) which has a valid marine aquaculture processing permit and is authorised to process cultured species.

15. VALIDITY OF PERMIT

- 15.1 This permit shall automatically expire and become invalid should the Right allocated by the Minister or his/her delegate be cancelled or revoked in terms of Section 28 of the Act.
- 15.2 The Permit Holder shall submit a renewal application on notification prior to expiry of this permit to the Department.
- 15.2 This permit shall be valid from the date stipulated in **Section A** until **31 December 2016**.

A. H. J. B. T.

DIRECTOR: SUSTAINABLE AQUACULTURE MANAGEMENT

DATE: 2015/12/14

ANNEXURE 3C. ABALONE RANCHING PERMIT CONDITIONS: HARVESTING OF RANCHED ABALONE (ANNEXURE R4) 2016

ANNEXURE R4: HARVESTING OF RANCHED ABALONE - NORTHERN CAPE 2016

2. SPECIFIC CONDITIONS

2.1 LIMITATIONS AND RESTRICTIONS

(a) This permit is only valid for harvesting of ranched abalone (*Haliotis midae*) as per **Section A**.

2.2 STOCK MOVEMENT

(a) Relocation of ranched abalone for the purpose of grow out shall not be allowed.

2.3 HARVESTING AND LANDING

(a) The Permit Holder shall only harvest abalone in consultation with the Department. This consultative process will be limited to compliance to the requirements of the permit and the Right granted. The Permit Holder shall undertake an annual stock assessment of the seeded area, which shall be conducted by an independent practitioner in consultation with the Department's Directorate: Inshore Fisheries Research, tel. (021) 402 3203, fax (021) 402 3034 and e-mail GenevieveM@daff.gov.za.

(b) The Permit Holder shall inform the local Fishery Control Officer (FCO) at least 24 hours prior to harvesting of abalone within the seeded area.

(c) The Permit Holder shall undertake harvesting on working days from 08h00 to 15h00 (excluding weekends and public holidays) so that the harvested stocks may be inspected by the local Fishery Control Officer (FCO).

(d) The Permit Holder shall contact the local Fishery Control Officer (FCO) and the Directorate SAM 24 hours prior to harvesting if required to harvest outside the stipulated time frame in clause 2.3 (h) above.

(e) The Permit Holder shall ensure that any stock harvested or landed outside the stipulated harvesting time frame is held in wet storage until the end of the next working day. If the local Fishery Control Officer (FCO) is not available for inspection then processing of the harvested abalone may proceed without supervision.

(f) The Permit Holder shall only commence with harvesting after providing the Fishery Control Officer (FCO) in the area with full details of the diver(s), the exact site location, the time he/ she expects to commence harvesting and the expected time of landing if applicable.

(g) The Permit Holder shall land all abalone in a whole state (i.e. not shucked) even if shell damage was incurred during the process of harvesting.

(h) The Permit Holder shall not simultaneously collect any other species, or engage in fishing or any other activity, when harvesting abalone in terms of this permit. Abalone Ranching Permit Conditions: Harvesting of Ranched Abalone (Annexure R4) 2016

(i) The Permit Holder shall ensure that harvesting is undertaken by diver(s) registered with the Department. Diver(s) shall at all times have positive proof of identification with him/her when harvesting or transporting abalone. A maximum of twenty (20) registered divers may be nominated as indicated in **Section A**, where applicable.

(j) The Permit Holder shall ensure that an enforcement plan is in place to monitor and enforce issues related to access and legal harvesting.

2.4 HARVESTING AND PROCESSING

(a) The Permit Holder shall comply with clauses 11.3 and 13.2 and of the Standard Abalone Ranching permit conditions 2015.

(b) The Permit Holder shall request the Fish Processing Establishment (FPE) to keep the shells after shucking the abalone, for later determination of size composition of the catch by the Department. Arrangements shall be made for the inspection of these shells by the Directorate: Inshore Fisheries Research, tel. (021) 402 3203, fax (021) 402 3034 and e-mail GenevieveM@daff.gov.za.

2.5 RECEIPT AND MARKETING

(a) Ranched abalone harvested in terms of **Section A** may be sold and marketed.

(b) The Permit Holder shall keep a copy of all original invoices issued for any sale of cultured abalone from the establishment for no less than 60 (sixty) months and such invoices shall contain at least the following details:

(i) The names and addresses of the parties to the transaction;

(ii) the name of the product;

(iii) the date of delivery/receipt; and

(iv) the quantity (number or mass) of product sold.

2.6 VALIDITY OF PERMIT

(a) This permit shall automatically expire and become invalid should the Right allocated by the Minister or his/her delegate be cancelled or revoked in terms of Section 28 of the Act.

(b) The Permit Holder shall submit a renewal application on notification prior to expiry of this permit to the Department.

(c) This permit shall be valid from the date stipulated in **Section A**. Abalone Ranching Permit Conditions: Harvesting of Ranched Abalone (Annexure R4) 2016

APPENDIX 3D. ABALONE RANCHING PERMIT CONDITIONS: SEEDING OF ABALONE FOR RANCHING - NC (ANNEXURE R2) 2016

ANNEXURE R2: SEEDING OF ABALONE FOR RANCHING – NORTHERN CAPE 2016

2. SPECIFIC CONDITIONS

2.1 LIMITATIONS AND RESTRICTIONS

(a) This permit is only valid for seeding of abalone (*Haliotis midae*) as per **Section A**.

(b) The following table includes the boundary and co-ordinates of the Northern Cape ranching concession areas:

Table 1. Boundaries and co-ordinates (i.e. latitude and longitude) of the Northern Cape ranching concession areas NC 1 – NC 4.

AREA	BOUNDARY	LATITUDE	LONGITUDE
NC 1	NC 1a	Boegoeberg Noord	28°45'41,35"S 16°33'41,93"E
	NC 1b	Beach north of North Point	29°14' 7,65" S 16°51'14,08"E
NC 2	NC 2a	Rocks outside south end of McDougall Bay	29°17'34,23"S 16°52'32,08"E
	NC 2b	Rob Island	29°43' 7,12"S 16°59'50,45"E
NC 3	NC 3a	Beach at Kleinzee	29°40'43,9"S 17° 3' 3,5" E
	NC 3b	Swartduine	30° 2'52,04S 17°10'39,69E
NC 4	NC 4a	Skulpfontein	30° 6' 8,15S 17°11' 8,03E
	NC 4b	2 small rocks 200m from shore	30°25'56,26"S 17°20' 5,43E

(c) Seeding of abalone for ranching shall only take place between sunrise and sunset. The Permit holder shall inform the local Fishery Control Officer (FCO) at least 24 hours prior to undertaking any seeding operations.

(d) The Permit Holder shall ensure that a baseline survey is conducted by an independent specialist in consultation with the Department in order to quantify existing wild fauna and flora, prior to the seeding of abalone in the ranching concession area.

Abalone Ranching Permit Conditions: Seeding of Abalone for Ranching - NC (Annexure R2) 2016

(e) The Permit Holder shall ensure that the carrying capacity (stocking density) of the seeded area is assessed and evaluated annually by an independent specialist in consultation with the Department.

(f) The Permit Holder shall ensure that a record of all seeded animals is provided to the Department on a monthly basis, which should be forwarded to the Directorate: Sustainable Aquaculture Management (SAM), Zimasa Jika, tel. (021) 402 3356 and e-mail ZimasaJ@daff.gov.za.

(g) The Permit Holder shall only commence with seeding after providing the local Fishery Control Officer (FCO) with full details of the diver(s), the exact site location, the time he/she expects to commence seeding and the expected time of landing if applicable.

(h) The Permit Holder shall ensure that seeding is undertaken by diver(s) registered with the Department. Diver(s) shall at all times have positive proof of identification with him/her when seeding or transporting abalone. A maximum of twenty (20) registered divers may be nominated as indicated in **Section A**, where applicable.

2.2 ANIMAL MOVEMENT: DISEASES

(a) The Permit Holder shall ensure that quarantine procedures are implemented such as described in the ICES Code of Practice on the Introduction and Transfer of Marine Organisms 2004 (ICES 2004) when undertaking seeding operations.

(b) The Permit Holder shall comply with clause 10.1 and 10.2 of the Standard Marine Aquaculture permit conditions 2015 and provide proof of written notification for animal movement.

2.3 SPECIAL CONDITIONS: ABALONE DISEASE CONTROL

(a) All suspected cases of Abalone Tubercle Mycosis or unexplained mortalities shall be reported to the Department within 24 hours. For attention of the Directorate: Sustainable Aquaculture Management (SAM), Aquaculture Animal Health and Environmental Interactions, Sasha Saugh, tel. (021) 430 7052/ 7076, fax (021) 434 2899 and e-mail AquaHealth@daff.gov.za.

(b) The Permit Holder shall obtain approval from the Department prior to seeding and ensure that all abalone spat to be seeded at the ranching site show no clinical signs of disease.

Abalone Ranching Permit Conditions: Seeding of Abalone for Ranching - NC (Annexure R2) 2016

2.4 VALIDITY OF PERMIT

- (a) This permit shall automatically expire and become invalid should the Right allocated by the Minister or his/her delegate be cancelled or revoked in terms of Section 28 of the Act.
 - (b) The Permit Holder shall submit a renewal application on notification prior to expiry of this permit to the Department.
 - (c) This permit shall be valid from the date stipulated in Section A.
-

APPENDIX 4: FINANCIAL ANALYSIS OF THE DCA ABALONE RANCHING VENTURE – JUNE 2015

The following is a summary of the financial model developed by DCA (in part only) that formed the basis for the proposed Abalone ranching in Zone 4. Only information considered pertinent to this report are reproduced

There are many reasons to pursue the potential for abalone ranching in South Africa. The projected internal rate of return of a full commercial 90 ton abalone ranching venture is conservatively expected to be around 26.8%. The forecast earnings before interest, tax and depreciation (EBITDA) margin, around 64%, indicates a very high level of profitability from the operational side of the business.

The relevance of the model in practice will, however, be influenced by and be directly linked to the actual decisions made by Diamond Coast Abalone when they implement the full commercial venture and by the operational decisions of its management. In the long term, sustained growth in earnings will depend on the complementary and mutually supportive functioning of many factors, including maintaining suitable and secure ranching habitats, security of tenure, efficient farming procedures, sought-after products on reliable markets and the ability to maintain margins.

Funding requirement

Total financing of R 39 million is required over the initial 6 years before the project breaks even on a cash flow basis and includes capital expenditure of R 8.6 million. A key aspect of the project is that production has been conservatively phased, with 25 000 spat seeded per month in the first year, 100 000 spat per month in the second year and 200 000 spat per month thereafter. This is due to limited spat availability expected initially. Some abalone sales from the spat seeded during the pilot phase occur during years 2, 3 and 4. The first sales of abalone seeded from 2017 onwards only commence in year 5. The project reaches full production in year 7, where after sales stabilize at 91 tons per year.

Overheads (excluding depreciation and interest) are initially around R 4.2 million and then increase to R 7.9 million in year 4 when a second dive team is added. This results in a negative EBITDA during the first 4 years (except that it is positive in year 3 due to sales from the pilot project).

A key risk and cost factor is that abalone spat must be purchased and seeded in the ocean. It is then only harvested and sold 5 years later. If the volume of spat purchased is decreased it will negatively impact on later sales and profitability. Lower spat prices improve profitability but do not significantly change the financing requirement. Other major annual cost items are salaries and wages (R 2.7 million) and security (R 1.8 million).

In conclusion, while the DCA abalone ranching venture requires substantial funding, it shows very high levels of profitability albeit with correspondingly high levels of risk. The main risk relates to the start-up nature of the sea-based production component of the business and the largely untested nature of some of the underlying assumptions. The business has limited income for the initial 4 years and only comes into full production in year 7. There is a high risk associated with ranching abalone in the sea with the related uncertainty on mortality / harvest recovery rates. The business will be most exposed around year 5 and 6 by when it would have spent almost R 39 million and be on the verge of harvesting the first large abalone that were seeded at the start of the expansion phase. It must, however, be recognized that the pilot project will mitigate many of the abovementioned risks and be of tremendous benefit to the full commercial venture. This upside has not been built into the analysis. The business has relatively low fixed capital requirements and extremely high margins and profitability once in full production. The business should therefore over time provide very high levels of returns that compensate for the initial high risk.

Production volume

The model assumes production of an ultimate average animal harvest size of 175g. It assumes a total ultimate per annum spat input of 200 000 spat per month (from year 3 onwards). This results in a total round weight production volume of 91 tons per annum from year 7 onwards. On current (conservative) carrying capacity estimates, a 91 ton production output would require at least 107 hectares of suitable habitat. Note that the model reduces seeding to 25 000 spat per month in year 1 and 100 000 spat per month in year 2 because of an expected initial shortfall in spat availability.

Production cycle

The model is based on a monthly spat input cycle. Diamond Coast Abalone buys 10 mm spat and grows the spat to seeding size in its land-based system. The seeding size of spat is very important as it is expected to significantly influence harvest recovery rates. In addition spat costs are a key cost item. In this regard various scenarios were tried on the model to determine the optimal seeding size and it was ultimately assumed that the project would stock 30 mm spat. The model assumes an abalone growth rate of 1.3 mm shell length per month, based on an adjusted natural mass length relationship algorithm. Based hereon, seeded abalone reach a harvest size of 175 g after 51 months.

Production costs and overheads

The major cost elements in abalone ranching are spat, processing, salaries and wages (including divers), security as well as the cost of environmental monitoring. The assumed spat price is R 1.30 for 10 mm spat, in line with the current industry average price. Processing costs are based on current SPP Canning costs at R 35.62 / kg. The cost for environmental monitoring was obtained from an actual quote. The model incorporates an inflation rate of 6% per year.

Mortality / harvest recovery

Haliotis midae appear to be relatively resistant to bacterial infections, even when subjected to trauma and other factors that predispose them to such infections and microbial, nutritional and other diseases of cultured abalone are limited. Accordingly the primary cause of mortalities is expected to be predation and theft, with dispersal also affecting recovered harvest volumes. The model incorporates previously published natural mortality data, with an expected mortality rate of 50% in year 1, 30% in year 2 and 20% per year thereafter. This results in an ultimate harvest recovery rate of 20.9%.
