Application for a Mining Permit

Basic Assessment Report and Environmental Management Programme

Report Prepared for:

Whale Head Minerals (Pty) Ltd

DMR Reference Number: NC30/5/1/3/2/10829MP

Report Prepared by:

PHS CONSULTING

PHS Consulting

May 2020

EXECUTIVE SUMMARY

1. Introduction

Whale Head Minerals (Pty) Ltd has identified a mineral sand deposit with the aim of developing this resource to produce a saleable heavy mineral concentrate product from the wet concentrator plant (WCP), which would include garnet, ilmenite, monazite, zircon and rutile. It is estimated that approximately 622 700t of ore will be mined from the beach over a 5-year period, producing high grade heavy minerals concentrates.

The proposed mine site is situated approximately 2 km north of Jackals Pit, and 15 km north of Port Nolloth. The proposed 5 ha mining area is located in the surf zone adjacent to the Concession Cliffs.

2. Project Description

The previously mined beach at Walviskop will now be mined for heavy minerals using an excavator fitted with a dredge pump (hydraulically driven submersible dredge pumps) onto the boom of an excavator feeding directly into a booster pump that will deliver the slurry into a main pipe spine along the beach. The mining rate has been estimated at rate of 260 tonnes per hour based on applying a non-conventional mining method to the project.

The mining operation proposed here will consist essentially of a land-based operation advancing from the beach into the surf zone by carrying a mining tool, the HY 300A hydraulic dredge pump, which will replace the bucket on an 80 t excavator. The pump is equipped with a high-pressure water jet ring system that delivers 100 m^3 of water at 6 – 7 bar onto the pump suction area. This water jet system will cause the liquefaction of the sand layer to the extent that the sand in the immediate vicinity of the pump will be kept in suspension through a combination of the turbulence caused by the water jets and motion of the sea water. Dredging will then focus on the suspended sediment comprising mainly sand at a rate of 900 m^3 slurry (up to 50 % solids). The mined sediment is pumped from the mining area on the beach, surf zone and breaker zone to the back beach via a 250 mm diameter pipe line to the WCP.

The mining operation will receive water from the process water dam as already mentioned, and it is foreseen that the water requirement would reduce as the amount of water in the feed increases with increasing depth of mining. Indications are that only the top 1.5 m of sand will be dry and the remainder of the resource 1.5 to 5 m deep will be waterlogged.

The process water dam will be fed from a single fixed sea water intake located close to the WCP. The sea water intake (SWI) will be in the form of a well field buried in this section of the beach. The SWI will supply water to the process water dam at a nominal rate of 360 m^3/h. The water table at the beach is approximately 1.5 m below the surface on average. This would also be a function of the distance from the shoreline and the tide.

The proposed mining activity is summarised below:

<u>Phase 1: Construction Phase – Plant Area and Infrastructure:</u>

- Road works
  - Existing access road to be upgraded (200mx7m)
- Plant Area ($250m^2$) - Above the HWM
  - The entire plant area will have a plastic lining to contain all possible sea water drainage and to avoid seawater infiltration into terrestrial areas. The plant site will also have a berm around it to contain spillage run off. No excavation will be required for the Plant Area.
  - Fuel storage area incl. 68 000l diesel tank to be located above ground and bunded.
  - Diesel Generators
  - Bag and bulk storage area.
  - Laboratory.
  - Ablution block c/w sewage and waste disposal facilities. A French drain will be installed.
  - Freshwater to be carted in for domestic use from Muisvlak.
  - Office block.
  - Tea room.
  - Wet Concentrator Plant (WCP).
  - Process Water Dam.
  - ROM Stockpile Gantry; feed bin and feed conveyor.
  - Workshop and Storage Shed
- Main pipe spine will be anchored at various points and will consists of 3 lines: a water line transporting water from the process water dam to the mining operation, a tailings line

returning WCP tailings to the beach running adjacent to the water line, and a line transporting ROM slurry to the WCP from the mining operation.

- Two booster pumps will be installed on the pipeline.

Phase 2: Mining Operation:

- Beach material/slurry pumped at 260 tonnes per hour into main pipe spine along beach via excavator fitted with dredge pump.
- Sediment is pumped from mining area in surf zone and breaker zone to the beach via 250mm diameter pipe to the WCP.
- Mining operation will receive water via main pipe spine from a process water dam.
- The process water dam will be fed from a single fixed sea water intake located close to the WCP at $360m^3/h$.

Phase 3: Processing:

- Wet Concentrator Plant (WCP) will receive sediment at a rate of approximately 260t/h. Some 5 - 10% of this will be retained as concentrate and the remaining 90 to 95% will be discarded as tailings.
- The plant will use sea water from the process water dam.

Phase 4: Waste Disposal:

- The non heavy mineral sand and oversize gravel fraction tailings from the WCP is considered waste and gets returned to the surf zone by means of gravity flow and gets re-distributed and deposited by the wave action on the beach.

Phase 5: Stockpile and Removal of heavy minerals:

- Volume of storage is approximately 35 000t with a frequency of removal of 4 x 34t loads daily.
- To be removed from site and taken to Minrite at Lutzville.
- No security required.

Phase 6: Rehabilitation/Closure:

- Rehabilitation as per specialist recommendations.
- Rehabilitation of access roads.
- Dismantling of processing plant.

- Demolition of steel buildings & structures.
- Demolition of reinforced concrete structures.
- Demolition of housing and facilities.
- Opencast rehabilitation including final voids and ramps.
- Rehabilitation of overburden and spoils.
- Processing waste deposits and evaporation ponds (salt).
- General surface rehab and grassing.
- Water management.
- 2-3 years of maintenance and aftercare.

3. Need and Desirability

Best practice, as well as the EIA Regulations, 2014 requires that the need and desirability of a project are considered and evaluated against the requirement for sustainability. This requires an analysis of the effect of the project on social, economic and ecological systems; and places emphasis on consideration of a project's justification not only in terms of financial viability, but also in terms of the specific needs and interests of the community and the opportunity cost of development.

Socio-Economic Aspects:

Planning documents such as the NDM IDP and EMF incorporate specific social objectives and emphasise the need to promote the social well-being, health, safety and security of communities, especially underprivileged and/or vulnerable communities.

Whale Head Minerals requires economic growth and job creation as a means for improved social wellbeing. The project will provide long-term employment opportunities at the Mine and the project could therefore benefit the local and regional communities and economy.

The socio-economic impacts have been assessed in Section j of this document.

Ecological Aspects:

It is essential that the implementation of social and economic policies takes cognisance of strategic ecological concerns such as climate change, food security, as well as the sustainability in supply of natural resources and the status of our ecosystem services.

Sustainable development is the process that is followed to achieve the goal of environmental sustainability.

Sustainable development implies that a project should not compromise natural systems. In this regard, the Best Practicable Environmental Option (BPEO) is that which provides the most benefit and causes the least damage to the environment, at a cost acceptable to society, in the long term as well as in the short term.

NEMA and the EIA Regulations, 2014, call for a hierarchical approach to the selection of development options, as well as impact management which includes the investigation of alternatives to avoid, reduce (mitigate and manage) and/or remediate (rehabilitate and restore) negative (ecological) impacts.

Considering the proposal is located in a previously disturbed area there will be some ecological impacts associated with the mining footprint, which will need to be carefully planned and managed. The potential ecological impacts of the project have been identified and are assessed in this document under Section j.

The proposed development of WH Mine is compatible with some, but not all, of the regional planning objectives, and addresses many of the needs expressed in these policies, particularly with regards to job creation and economic growth.

The socio-economic benefits of mining at WH Mine need to be considered and weighed up against ecological concerns; and social, economic and ecological factors have been considered and are assessed in Section j. Mitigation measures have been recommended to prevent, minimise (and optimise) impacts and to secure stakeholders' environmental rights. An EMPr has been drafted and must be implemented to ensure that potential environmental pollution and degradation can be minimised, if not prevented.

4. Alternatives Considered

Diamonds have been actively mined in the Alexkor Licence Areas since 1928. Historical mining areas associated with the marine Mining Rights and future targets outlined in Alexkor's 2017 Mine Plan. From this it is evident that the Walviskop area has been actively mined on an ongoing basis since 2004. During the amendment process of the Alexkor Environmental Management Programmes for Mining Rights 554MRC, 10025MRC, 512MRC and 513MRC (SLR 2018), the Walviskop pocket beach, was identified as a future mining target and was included as part of Alexkors Mining Works Plan.

The Walviskop target falls within Alexkor's Mining Right 554MRC. Mining operations at Walviskop have focused on the surf zone using primarily shore-based diver-assisted dredge pumps (walpompe) and to a lesser extent vessel-based diver-assisted dredge pumping in slightly deeper water. Beach mining using heavy earth-moving equipment has taken place during at least two mining campaigns since 2013 (Johan Hattingh, Geological & GIS Consulting, pers. comm. March 2020).

The proposed site was selected based on extensive research and also following on information from previous prospecting activities in the area. This area has been extensively mined for diamonds during the past 90 years by Alexkor and its predecessor the State Alluvial Diggings. This development resulted directly in the establishment of good infrastructure with two large well serviced towns accommodating some 15 000 inhabitants. Many of these inhabitant are directly dependant on the jobs provided by the mine or service industries to the mine.

Heavy mineral mining could provide contribute to the further development of infrastructure of the area that will be to the advantage of the greater community. A very important aspect is that heavy mineral mining will result in the systematic rehabilitation of the area including the slimes and coarse tailing dumps that will be mined and eradicated from the landscape presently littered by large dumps.

The locations of the WHM beach deposits are fixed, which dictates the possible mining location. The property or location where it is proposed to undertake the activity was selected based on existing knowledge of Heavy Mineral deposits in the area. The WHM mine area has been identified based on knowledge of these mineral deposits and as such, no site alternatives have been considered for the proposed activities.

In terms of the technologies proposed, these have been chosen based on the known long term success of the selected mining method. The purpose of the project is to establish mining operations along the coastline. No other activity alternatives (other than the No-Go alternative) are considered acceptable or viable by the proponent, and activity alternatives (other than the No-Go alternative) are not considered further in the EIA process.

The final layout of the mining area was determined on advice of the terrestrial and marine ecology specialists. This layout design has been selected for assessment and no other design alternatives were assessed.

Although technology alternatives enabling beach mining, such as the use of dredging techniques and machinery; the high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators.

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2014. The No-Go alternative implies no change in the sites' status quo.

The “no-development” alternative implies that the heavy mineral sands beach mining operation does not go ahead. From a marine perspective this is undeniably the preferred alternative, as all impacts associated with beach disturbance, shoreline changes, loss of biota, unplanned pollution events and indirect sedimentation will not be realised. This must, however, be seen in context with existing mining and exploration rights and sustainability of the associated mines, and thus needs to be weighed up against the potential positive socio-economic impacts undoubtedly associated with accessing the potentially rich placer deposits present in the surf zone.

5. Environmental Impact Statement

The main marine impacts associated with the proposed mining activities are related to disturbance and loss of sandy and rocky habitats and their associated benthic flora and fauna in the mining footprint. From the results of past studies, it is now well established that mining in the intertidal zone of sandy beaches severely influences the diversity and community structure of the invertebrate macrofauna of the beach itself, and potentially the benthic biota of adjacent rocky intertidal and shallow sub tidal habitats as well. However, as removal and treatment of beach sediments are an unavoidable consequence of the proposed mining, there can be no direct mitigation for their impacts on marine biological communities. Other than the ‘no go’ option, the impacts to the intertidal and shallow sub tidal marine biota are thus unavoidable should mining go ahead. As mining operations have been ongoing along this section of the coast for decades, however, the proposed mining target cannot be considered particularly ‘pristine’. Nonetheless, from a marine perspective the ‘no go’ option is undeniably the preferred alternative, as all impacts associated with the disturbance of beach and rocky habitats would no longer be an issue.

The highly localised, yet significant impacts of heavy minerals mining in the Walviskop pocket beach will endure over the short- to medium term, and these impacts thus need to be weighed up against the benefits of the mining project. Provided the impacts are meticulously managed and pro-active rehabilitation is undertaken as far as is feasible in the coastal environment, there is no reason why the proposed mining of the heavy mineral sands at Walviskop should not go ahead.

The potential environmental impacts associated with the proposed WHM Mine project considered in the BAR process include soil and land capability, air quality, noise, groundwater, marine ecology, freshwater ecology, terrestrial ecology, socio-economic, heritage, visual, traffic and geotechnical impacts. Assuming that the recommended mitigation measures will be effectively implemented, the proposed mine is not projected to have unacceptably significant adverse impacts, while socio-economic benefits are noteworthy.

The impacts associated with the WHM Mine are considered to be acceptable.

A number of mitigation and monitoring measures have been identified to avoid, minimise and manage potential environmental impacts associated with the proposed mine. These are further laid out in the EMPr.

Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further palaeontological specialist studies are required, the Fossil Finds Procedure be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

A summary of the identified potential impacts are indicated below:

Impact	Significance (before mitigation)	Significance (after mitigation)
1. IMPACTS ON MARINE ECOLOGY		
a. Destruction and loss of supra-tidal habitats and associated biota	High	Low
b. Disturbance and loss of intertidal and shallow sub-tidal sandy beach macro-fauna	Medium	Very Low
c. Smothering of benthic biota by discarded tailings	Low	Insignificant
d. Changes in community structure in response to alterations in the biophysical characteristics of the beach	Low	Low
e. Impacts of noise from mining operations on coastal biota	Insignificant	Insignificant
f. Impacts of an operational spill on intertidal and sub-tidal benthic macro-fauna	Low	Insignificant
g. Impacts of tailings discharge on water column and bottom-water biochemistry (turbidity and light)	Insignificant	Insignificant
h. Indirect Impacts of tailings discharges: development of anoxic sediments	Insignificant	Insignificant
i. Sedimentation of intertidal and shallow sub-tidal reefs	Very Low	Very Low
j. Impacts of mining operations on higher-order consumers	Insignificant	Insignificant
2. IMPACT ON SOCIO-ECONOMIC ENVIRONMENT		
k. Visual Impacts - Altered sense of place and visual intrusion caused by mining activities	Low	Very Low
l. Investment in and contribution to the local economy	Medium (+)	High (+)
m. Increased employment, income and skills development	Medium (+)	High (+)
n. Reduced access to the coast	Low	Very Low

o. Possible decline of tourism	Low	Very Low
p. Traffic Impacts - Increased nuisance on existing road users and surrounding residents from construction traffic and road widening	Low	Very Low
q. Air Quality Impacts - Impaired human health from increased pollutant concentrations associated with mining and processing activities	Low	Very Low
3. IMPACT ON HERITAGE RESOURCES		
r. Possible impact on Heritage Resources	Low	Very Low
4. IMPACTS ON SOIL AND LAND CAPABILITY		
s. Soil erosion caused by mining activities	Low	Very Low
t. Loss of land capability	Low	Very Low
1. IMPACTS ON TERRESTRIAL ECOLOGY		
u. Impact on terrestrial habitat	Low	Very Low
5. GEOTECHNICAL IMPACTS		
No impacts identified.		
6. IMPACTS ON FRESHWATER ECOLOGY		
No impacts identified.		

6. Reasoned opinion why activity should be authorised

This draft BAR Report has identified and assessed the potential biophysical and socio-economic impacts associated with the WHM Mine project.

In terms of Section 31 (n) of NEMA, the EAP is required to provide an opinion as to whether the activity should or should not be authorised. In this section, a qualified opinion is ventured, and in this regard PHS believes that sufficient information is available for DMR to take a decision.

The WHM Mine project will result in unavoidable environmental impacts. None of these impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures. In addition, the project will directly and indirectly benefit the local and regional economy. The site is located where previous mining took place as such it will sustain the mining industry in the area.

Working on the assumption that WHM is committed to ensuring that beach mining and the associated processing activities are undertaken to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, PHS believes and the EIA Report demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts of this project can be reduced to levels compliant with national standards or guidelines.

The fundamental decision is whether to allow the development, which brings economic benefits and is generally consistent with development policies for the area, but which may have limited biophysical impacts.

PHS believes that the specialist studies have shown that the WHM Mine extension project is generally acceptable. The BAR has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion PHS is of the opinion that on purely 'environmental' grounds (i.e. the project's potential socio-economic and biophysical implications) the application as it is currently articulated should be approved, provided the essential mitigation measures are implemented. Ultimately, however, the DMR will need to consider whether the project benefits outweigh the potential impacts.

7. Conditions that must be included in the authorisation

Key recommendations, which are considered essential, are:

- Implement the EMPr to guide construction, operations and closure activities and to provide a framework for the ongoing assessment of environmental performance;
- Appoint an Environmental Control Officer (ECO) to oversee the implementation of the EMPr;
- Implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use existing roads to access this stretch of coast;
- Actively backfill mined beaches and profile the mining area to resemble the natural beach profile;
- Implement the Rehabilitation Plan (Appendix J); and
- Obtain other permits and authorisations as may be required.

8. Financial Provision

The Company is required to make the prescribed financial provision for the rehabilitation or management of negative environmental impacts. If the Company fails to rehabilitate or manage any negative impact on the environment, the DMR may, upon written notice to the Company, use all or part of the financial provision to rehabilitate or manage the negative environmental impact in question. The Company will specify that the mining contractor is required to comply with all the environmental measures specified in the EMPr. This will include avoiding unnecessary disturbance of natural vegetation and the rehabilitation of mining site, immediately after mining has been completed. All tracks to the mining site must be rehabilitated at the end of use. The closure objective is to leave the site as it was found. The financial provision provides for the final checking of the site before closure.

The quantum of the financial provision required is R 665 848.77 The Company must annually update and review the quantum of the financial provision (as per Regulation 54 (2) of the MPRDA). The financial Quantum Calculation is found under Appendix J.

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mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT

AND

ENVIRONMENTAL MANAGEMENT PLAN

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA).

NAME OF APPLICANT: Whale Head Minerals (Pty) Ltd

TEL NO: 084 588-2263

FAX NO:-

POSTAL ADDRESS: P O Box 245, Alexander Bay, Northern Cape

PHYSICAL ADDRESS: 6 Reier Avenue, Alexander Bay, Northern Cape

FILE REFERENCE NUMBER SAMRAD: NC30/5/1/3/2/10829MP

1. IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining “will not result in unacceptable pollution, ecological degradation or damage to the environment”.

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template.

Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2. Objective of the basic assessment process

The objective of the basic assessment process is to, through a consultative process–

(a) determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;

(b) identify the alternatives considered, including the activity, location, and technology alternatives;

(b) describe the need and desirability of the proposed alternatives;

(d) through the undertaking of an impact and risk assessment process, inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage, and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine:

(i) the nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and

(ii) the degree to which these impacts—

(aa) can be reversed;

(bb) may cause irreplaceable loss of resources; and

(cc) can be avoided, managed or mitigated; and

(e) through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to—

(i) identify and motivate a preferred site, activity and technology alternative;

(ii) identify suitable measures to avoid, manage or mitigate identified impacts; and

(iii) identify residual risks that need to be managed and monitored.

PART A
SCOPE OF ASSESSMENT AND BASIC ASSESSMENT REPORT

1. Contact Person and correspondence address:

a) Details of EAP:

i) Details of EAP

Name of Practitioner: PHS Consulting - Paul Slabbert (Review) and Nadine Duncan

Tel No: 0827408046 / 0722314439

E-mail address: paul@phsconsulting.co.za **/** nadine@phsconsulting.co.za

ii) Expertise of the EAP:

i. The qualifications of EAP :
(with evidence)

<u>Paul Slabbert:</u>

- Honours degree B Art Et Scien, Environmental Planning
- Registered Impact Practitioner - Environmental Assessment Practitioners Association of South Africa (EAPASA). Registration Number 2019/1036.
- Professional Certified Member of the Association of Professional Heritage Practitioners (APHP)
- Professional Member of the International Association for Impact Assessment (IAIA)

ii. Summary of the EAP's past experience:

(In carrying out the Environmental Impact Assessment Procedure)

18 years experience as an EAP& mining related application.

(**Refer to Appendix A: PHS Prospectus**).

b) **Location of the overall activity:**

Farm Name:	The majority of the mining area is located below the high water mark (HWM) of the sea. Small sections above the HWM is located on the Remainder of Farm 1in the Namakwa District.
Application Area:	4.98 ha
Magisterial district:	Richtersveld Local Municipality (Ward 5)
Distance and direction from nearest town:	30 km North of Port Nolloth, Northern Cape Province.
21 digit Surveyor General Code from each farm portion:	C05300000000000100000

c) **Locality map**

(show nearest town, scale not smaller than 1:250000)

The proposed mine site is situated approximately 2 km north of Jackals Pit, and 15 km north of Port Nolloth. The proposed 5 ha mining area is located in the surf zone adjacent to the Concession Cliffs. Most of the site is located below the High Water Mark (**Refer to Figure 1 below and Appendix B for enlarged figure**).

Figure 1: Locality Map

d) Description of the scope of the proposed overall activity:

Whale Head Minerals (Pty) Ltd has identified a mineral sand deposit with the aim of developing this resource to produce a saleable heavy mineral concentrate product from the wet concentrator plant (WCP), which would include garnet, ilmenite, monazite, zircon and rutile. It is estimated that approximately 622 700t of ore will be mined from the beach over a 5-year period, producing high grade heavy minerals concentrates (**Refer to Figure 2 and Appendix C for enlarged figure**).

The proposed mining activity entails the following:

Phase 1: Construction Phase – Plant Area and Infrastructure:

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  - Existing access road to be upgraded (200mx7m)
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  - The entire plant area will have a plastic lining to contain all possible sea water drainage and to avoid seawater infiltration into terrestrial areas. The plant site will also have a berm around it to contain spillage run off. No excavation will be required for the Plant Area.
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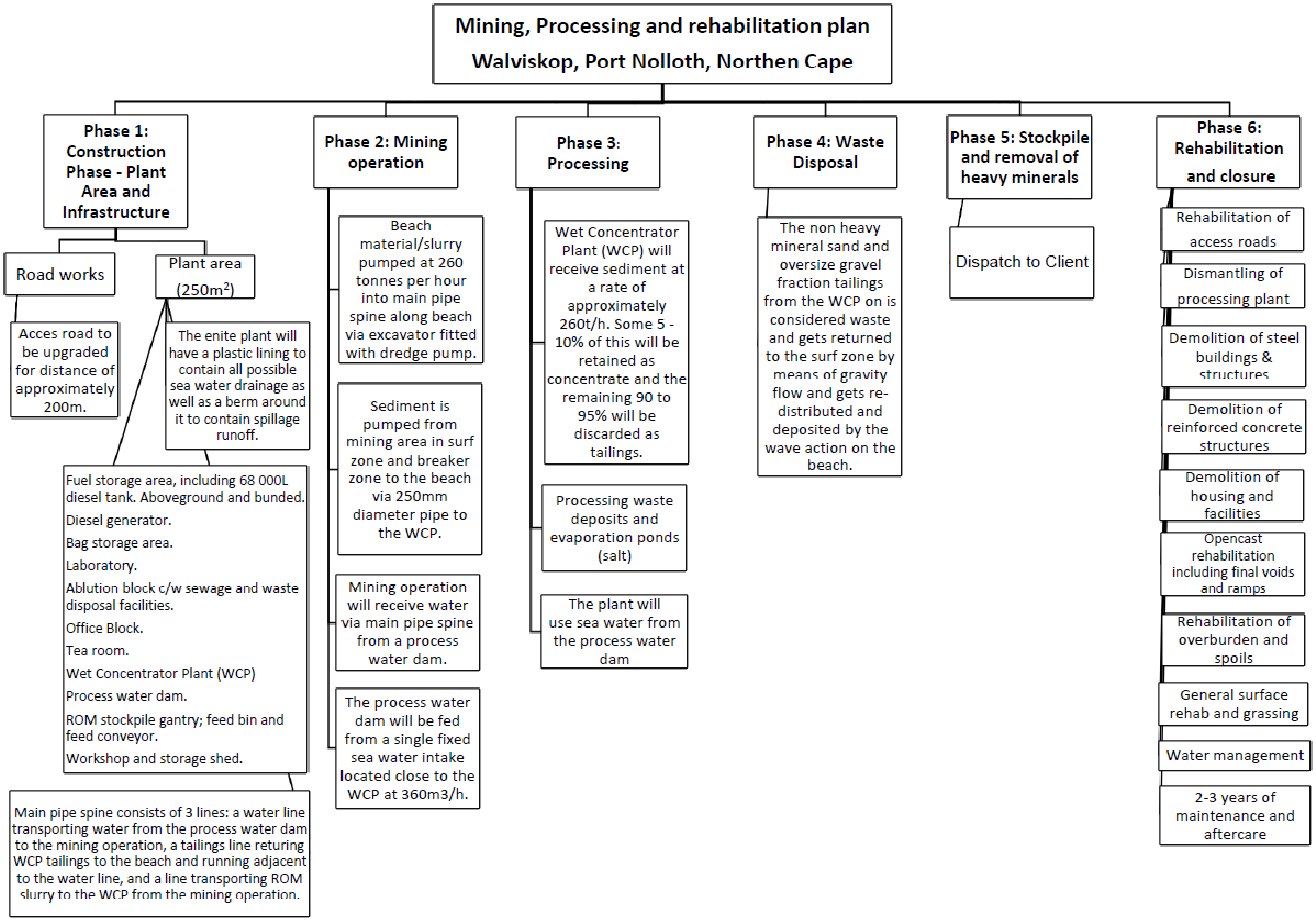

Figure 2: Project flow diagram

i. Listed and specialised activities:

NAME OF ACTIVITY	AERIAL EXTENT OF THE ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
The development of structures in the coastal public property where the development footprint is bigger than 50 square metres.	0.25 ha	Yes	GN No. R983 Activity 15
Construction activities associated with the WCP, the ROM gantry, plant buildings and product storage areas.	0.25ha	Yes	GN No. R983 Activity 17 Development within a distance of 100 metres inland of the high-water mark of the sea
Developing mineral sand deposit to produce a saleable heavy mineral concentrate product from the wet concentrator plant (WCP), which would include garnet, ilmenite, monazite, zircon and rutile.	4.98 ha	yes	GN No. R983 Activity 21 Any activity including the operation of that activity which requires a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002),

Rehabilitation and closure	4.98 ha	yes	GN No. R983 Activity 22
Storage - 68 000l diesel within 1km of the HWM of the sea outside an urban area.		yes	GN No. R985 Activity 10
The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.		yes	GN No. R985 Activity 18

(ii) Description of the activities to be undertaken

(Describe Methodology or technology to be employed, including the type of commodity to be prospected /mined and for a linear activity, a description of the route of the activity)

Process Description

The previously mined beach at Walviskop will now be mined for heavy minerals using an excavator fitted with a dredge pump (hydraulically driven submersible dredge pumps) onto the boom of an excavator feeding directly into a booster pump that will deliver the slurry into a main pipe spine along the beach. The mining rate has been estimated at rate of 260 tonnes per hour based on applying a non-conventional mining method to the project.

The mining operation proposed here will consist essentially of a land-based operation advancing from the beach into the surf zone by carrying a mining tool, the HY 300A hydraulic dredge pump, which will replace the bucket on an 80 t excavator. The pump is equipped with a high-pressure water jet ring system that delivers 100 m^3 of water at 6 – 7 bar onto the pump suction area. This water jet system will cause the liquefaction of the sand layer to the extent that the sand in the immediate vicinity of the pump will be kept in suspension through a combination of the turbulence caused by the water jets and motion of the sea water. Dredging will then focus on the suspended sediment comprising mainly sand at a rate of 900 m^3 slurry (up to 50 % solids). The mined sediment is pumped from the mining area on the beach, surf zone and breaker zone to the back beach via a 250 mm diameter pipe line to the WCP (**Refer to Figure 3**).

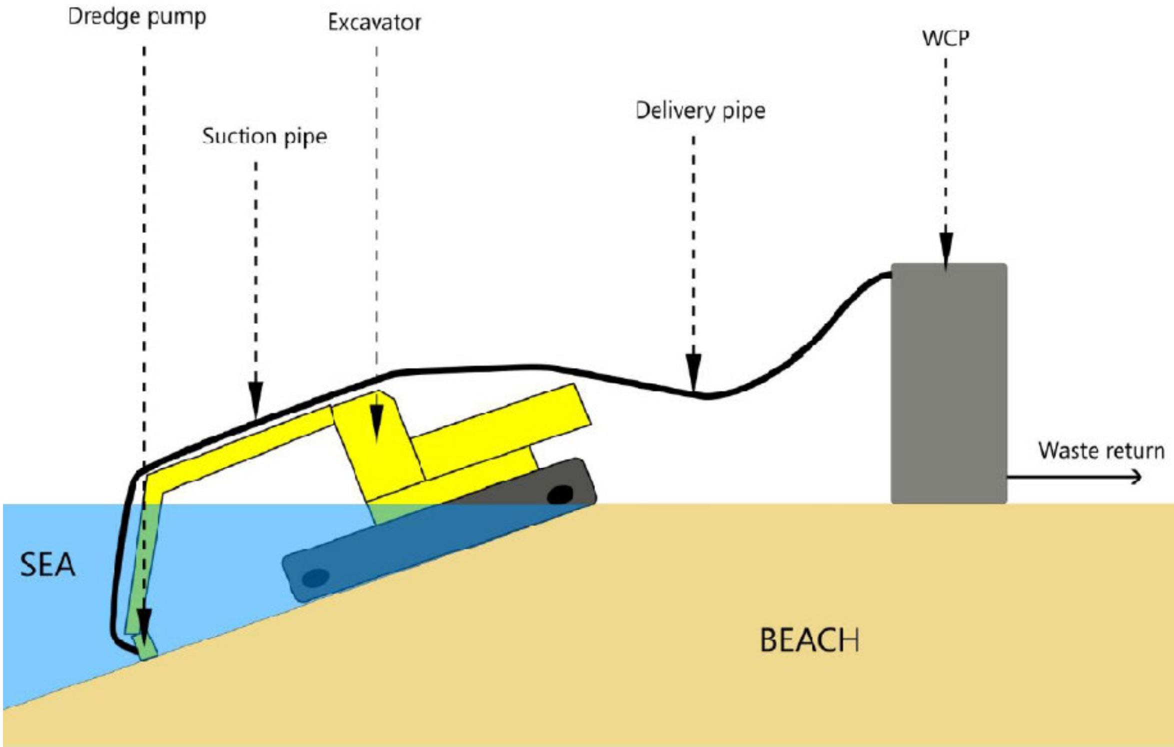

Figure 3: Mining Operation on the beach

The sand-size gangue and oversize gravel fraction tailings from the WCP is considered waste and gets returned to the surf zone by means of gravity flow and gets re distributed and deposited by the wave action on the beach. Mine planning will have to take the direction of longshore drift into consideration by commencing mining at the down current end of the mining block. The mining will be done by means of a mining tool attached to a high flow rate suction pump. The Dragflow suction tool is attached to the boom of the excavator where it will perform the mining by means of a dredging action. The excavator is equipped with a GPS system to ensure that precise mining take place and that mined-out areas are avoided. Mining will take place at a nominal rate of 260 tonnes per hour at an average utilisation of 75% as a result of beach availability due to tidal events. The mining system is designed at an engineering availability of 85% equating to a mining design capacity of 350tph. The mine area will be divided into mine blocks some 100 x 100m in size and mined from south to north starting with the blocks on the seaward side (**Refer to Figure 4**).

The mining operation will have a main pipe spine that runs along the length of the beach 10m from the cliff bottom. This pipe spine consists of 3 lines: a water line transporting water from the process water dam to the mining operation, a tailings line returning WCP tailings to the beach running adjacent to the water line, and a line transporting ROM slurry to the WCP from the mining operation. There will be tie in points on the pipe spine every 50m along the beach to facilitate the relatively high advance rate along the beach estimated at around 27m per day. The excavators will be connected to the booster pumps using flexible hose that will allow the excavators to move as the mining operation advances.

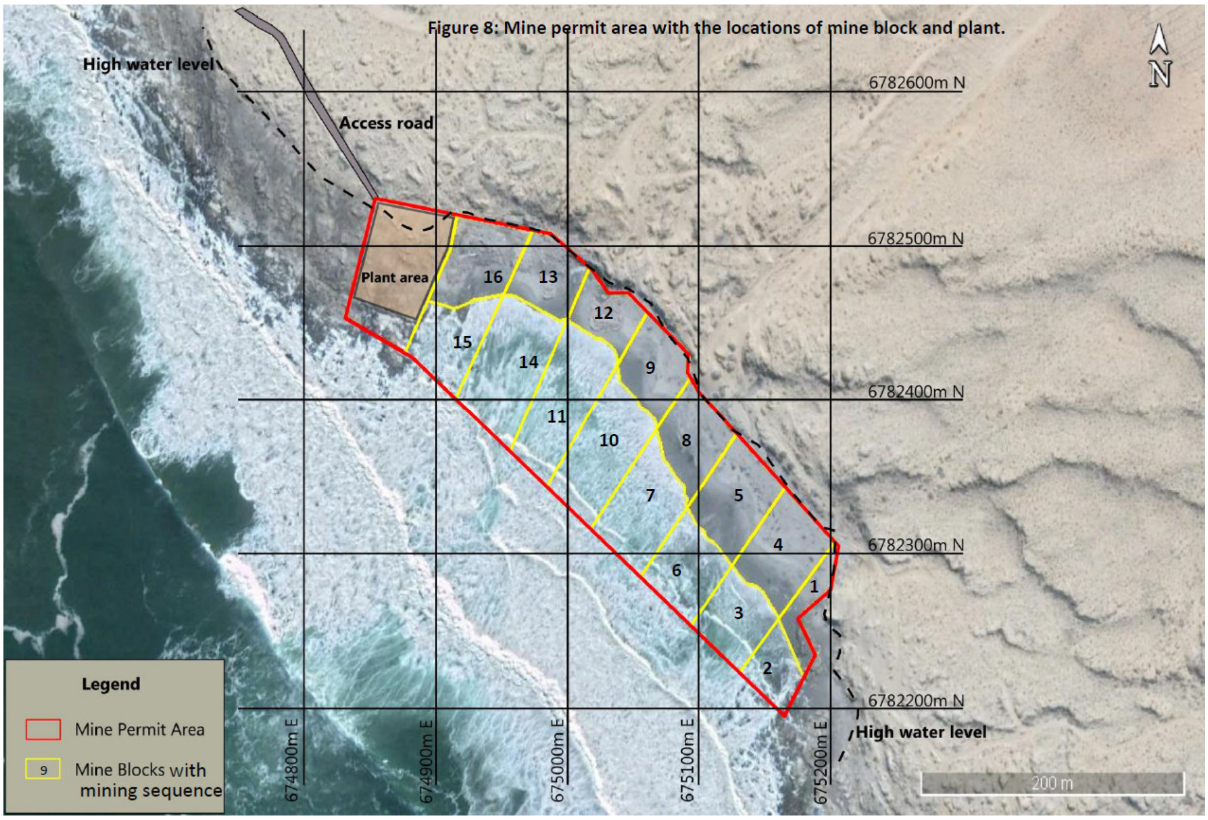

Figure 4: Mine blocks with mining sequence

The mining operation will receive water from the process water dam as already mentioned, and it is foreseen that the water requirement would reduce as the amount of water in the feed increases with increasing depth of mining. Indications are that only the top 1.5 m of sand will be dry and the remainder of the resource 1.5 to 5 m deep will be waterlogged.

The process water dam will be fed from a single fixed sea water intake located close to the WCP. The sea water intake (SWI) will be in the form of a well field buried in this section of the beach. The SWI will supply water to the process water dam at a nominal rate of 360 m^3/h. The water table at the beach is approximately 1.5 m below the surface on average. This would also be a function of the distance from the shoreline and the tide.

e) Policy and Legislative Context

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).	**REFERENCE WHERE APPLIED**	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT** **(E.g. in terms of the National Water Act a Water Use License has/ has not been applied for)**
National Environmental Management Act 107 of 1998 (NEMA)	N/A	The proponent has a responsibility to ensure that the proposed activities and the Basic Assessment (BAR) process conform to the principles of NEMA. The proponent is obliged to take actions to prevent pollution or degradation of the environment in terms of Section 28 of NEMA, and to ensure that the environmental impacts associated with the project are considered and mitigated where possible.
EIA Regulations, 2014 as amended	N/A	The proponent is obliged to apply for Environmental Authorisation (EA) for the activities listed in Listing Notice 1. A BAR process is required to assess activities listed in terms of NEMA . The proponent is therefore required to undertake a BAR process in support of the application, in accordance with the procedure stipulated in GN R983 and GN R985 under NEMA.
National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA)	N/A	The project will include the development of infrastructure in the coastal protection zone (defined as being within 1 km of the shoreline in rural areas). Impacts on the coastal environment have been assessed in the Marine Ecology Impact Assessment (**Appendix D1**).
National Environmental Management: Waste Act 59 of 2008 (NEM:WA)	N/A Waste Permit not required in terms of NEM:WA	The generation of potential waste will be minimised through ensuring employees of the mining contractor are subjected to the appropriate Environmental awareness campaign before commencement of mining. All waste generated during the mining activities will be disposed of in a responsible legal manner. No other waste, requiring a waste licence, will be generated.

National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA)	N/A	The vegetation types of the area include Richtersveld Coastal Duneveld and Namaqualand Seashore Vegetation. Vegetation has been heavily disturbed over significant areas within the greater study area. The result is that the remaining vegetation is important not only since it represents particular types but because it is important for functioning of the ecosystem. (One of the most significant benefits of vegetation is the stabilization of the sandy soil. Since active mining has been underway, wind-blown sand and dust have caused major environmental and health and safety issues within the project area). CBA areas have been documented for the study area (Mcdonald, 2017), indicating a low sensitivity for Richtersveld Coastal Duneveld and high sensitivity for Namaqualand Seashore Vegetation (this rating is expected to be lower for the proposed mining area seeing that it is disturbed).
National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)	N/A	The mining activity and processing will not generate any atmospheric emissions. Atmospheric Emissions Licence will not be required.
Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015	N/A	The planning, design, operation and decommissioning of the residue stockpiles and deposits must be compliant with the requirements of GN R632.
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)	NC30/5/1/3/2/10829MP	A Mining Permit is applied for.
National Water Act 36 of 1998 (NWA)	N/A	No water uses applicable. Water Use Authorisation from the Department of Water and Sanitation (DWS) will not be required. DWS will be consulted during the public participation process.
National Heritage Resources Act 25 of 1999 (NHRA)	Unknown	The project and associated infrastructure triggers listed activities in Section 38(8) of the NHRA. It is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Refer to Appendix D-3: Heritage Impact

		Information
Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA)	N/A	SPLUMA provides broad principles for provincial laws that regulate planning. SPLUMA also provides clarity on how planning law interacts with other laws and policies. SPLUMA delegates the responsibility for land use and zoning applications to the municipality. The land use, zoning and spatial planning is therefore driven by the municipal level IDP and SDF which, according to SPLUMA, must be aligned with the Provincial IDP and SDF. The municipal SPLUMA by-laws prescribe the mechanisms for land use applications and appeals. A property is compliant with SPLUMA if: • There are approved building plans; • The use of the property is in accordance with the municipal zoning; and • There are no encroachments over the building lines and property boundaries.
Namakwa District Municipality Integrated Development Plan, 2017-2022	N/A	The NDM IDP recognises mining as the largest employing industry in the Richtersveld. One of the strategic objectives of the NDM's IDP is to ''Promote and facilitate Local Economic development". Mining is one of the main economic sectors in this District.
Namakwa District Municipality Environmental Management Framework And Strategic Environmental Management Plan, 2011	N/A	The NDM EMF recognises that economic activity in the district is largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments. It states that the coastline has been highly impacted upon by diamond mining and access has been restricted for the best part of two generations. As diamond resources become fully exploited, and access to the coastline improves, the extent of the damage, and of the opportunities that the change of land use presents will become evident to the residents of the district and the region.

		According to the EMF, the site is situated in a ''Very High Sensitivity Zone'' which is described as follows: Several environmentally sensitive features are present. Development should be restricted in terms of type and magnitude of impact. This rating is not very lenient in terms of development but does recognise that development cannot be excluded where compelling economic and social benefits will be derived for the local and regional population. All legislative requirements should be adhered to and a fully inclusive consideration of the biophysical receptors should be undertaken. Development in these areas will also require a comprehensive public participation process with input from stakeholders and government organisations. The Basic Assessment Process and Mining Permit Application, including comprehensive public participation process will insure adherence to the NDM EMF.

f) Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

Best practice, as well as the EIA Regulations, 2014 requires that the need and desirability of a project are considered and evaluated against the requirement for sustainability. This requires an analysis of the effect of the project on social, economic and ecological systems; and places emphasis on consideration of a project's justification not only in terms of financial viability, but also in terms of the specific needs and interests of the community and the opportunity cost of development.

Socio-Economic Aspects:

Planning documents such as the NDM IDP and EMF incorporate specific social objectives and emphasise the need to promote the social well-being, health, safety and security of communities, especially underprivileged and/or vulnerable communities.

Whale Head Minerals requires economic growth and job creation as a means for improved social wellbeing. The project will provide long-term employment opportunities at the Mine and the project could therefore benefit the local and regional communities and economy.

The socio-economic impacts have been assessed in **Section j** of this document.

Ecological Aspects:

It is essential that the implementation of social and economic policies takes cognisance of strategic ecological concerns such as climate change, food security, as well as the sustainability in supply of natural resources and the status of our ecosystem services. Sustainable development is the process that is followed to achieve the goal of environmental sustainability.

Sustainable development implies that a project should not compromise natural systems. In this regard, the Best Practicable Environmental Option (BPEO) is that which provides the most benefit and causes the least damage to the environment, at a cost acceptable to society, in the long term as well as in the short term.

NEMA and the EIA Regulations, 2014, call for a hierarchical approach to the selection of development options, as well as impact management which includes the investigation of alternatives to avoid, reduce (mitigate and manage) and/or remediate (rehabilitate and restore) negative (ecological) impacts.

Considering the proposal is located in a previously disturbed area there will be some ecological impacts associated with the mining footprint, which will need to be carefully planned and managed. The potential ecological impacts of the project have been identified and are assessed in this document under **Section j**.

The proposed development of WH Mine is compatible with some, but not all, of the regional planning objectives, and addresses many of the needs expressed in these policies, particularly with regards to job creation and economic growth.

The socio-economic benefits of mining at WH Mine need to be considered and weighed up against ecological concerns; and social, economic and ecological factors have been considered and are assessed in **Section j**. Mitigation measures have been recommended to prevent, minimise (and optimise) impacts and to secure stakeholders' environmental rights. An EMPr has been drafted and must be implemented to ensure that potential environmental pollution and degradation can be minimised, if not prevented.

g) Motivation for the overall preferred site, activities and technology alternative.

Diamonds have been actively mined in the Alexkor Licence Areas since 1928. Historical mining areas associated with the marine Mining Rights and future targets outlined in Alexkor's 2017 Mine Plan are indicated in **Figure 5**. From this it is evident that the Walviskop area has been actively mined on an ongoing basis since 2004. During the amendment process of the Alexkor Environmental Management Programmes for Mining Rights 554MRC, 10025MRC, 512MRC and 513MRC (SLR 2018), the Walviskop pocket beach, was identified as a future mining target and was included as part of Alexkors Mining Works Plan.

The Walviskop target falls within Alexkor's Mining Right 554MRC. Mining operations at Walviskop have focused on the surf zone using primarily shore-based diver-assisted dredge pumps (walpompe) and to a lesser extent vessel-based diver-assisted dredge pumping in slightly deeper water. Beach mining using heavy earth-moving equipment has taken place during at least two mining campaigns since 2013 (Johan Hattingh, Geological & GIS Consulting, pers. comm. March 2020).

Figure 5: Historical and future marine mining locations (adapted from SLR 2018) (PES, 2020).

The proposed site was selected based on extensive research and also following on information from previous prospecting activities in the area. This area has been extensively mined for diamonds during the past 90 years by Alexkor and its predecessor the State Alluvial Diggings. This development resulted directly in the establishment of good infrastructure with two large well serviced towns accommodating some 15 000 inhabitants. Many of these inhabitant are directly dependant on the jobs provided by the mine or service industries to the mine.

Heavy mineral mining could provide contribute to the further development of infrastructure of the area that will be to the advantage of the greater community. A very important aspect is that heavy mineral mining will result in the systematic rehabilitation of the area including the slimes and coarse tailing dumps that will be mined and eradicated from the landscape presently littered by large dumps.

h) Full description of the process followed to reach the proposed preferred alternatives within the site.

NB!! – This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

i) Details of the development footprint alternatives considered.

With reference to the site plan provided as Appendix 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to: **(Refer to Appendix F for Site Plan)**

(a) the property on which or location where it is proposed to undertake the activity:

The locations of the WHM beach deposits are fixed, which dictates the possible mining location. The property or location where it is proposed to undertake the activity was selected based on existing knowledge of Heavy Mineral deposits in the area. The WHM mine area has been identified based on knowledge of these mineral deposits and as such, no site alternatives have been considered for the proposed activities. Find the constraints analysis attached under Appendix H.

(b) the type of activity to be undertaken:

In terms of the technologies proposed, these have been chosen based on the known long term success of the selected mining method. The purpose of the project is to establish mining operations along the coastline. No other activity alternatives (other than the No-Go alternative) are considered acceptable or viable by the proponent, and activity alternatives (other than the No-Go alternative) are not considered further in the EIA process.

(c) the design or layout of the activity:

The final layout of the mining area was determined on advice of the terrestrial and marine ecology specialists. This layout design has been selected for assessment and no other design alternatives were assessed.

(d) the technology to be used in the activity:

Although technology alternatives enabling beach mining, such as the use of dredging techniques and machinery; the high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators.

(e) the operational aspects of the activity:

Given the nature of beach and strip mining, alternative physical mining technologies are not expected to have any meaningful implications for environmental impacts.

(f) the option of not implementing the activity:

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2014. The No-Go alternative implies no change in the sites' status quo.

The "no-development" alternative implies that the heavy mineral sands beach mining operation does not go ahead. From a marine perspective this is undeniably the preferred alternative, as all impacts associated with beach disturbance, shoreline changes, loss of biota, unplanned pollution events and indirect sedimentation will not be realised. This must, however, be seen in context with existing mining and exploration rights and sustainability of the associated mines, and thus needs to be weighed up against the potential positive socio-economic impacts undoubtedly associated with accessing the potentially rich placer deposits present in the surf zone.

ii) Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

The Draft and Final Basic Assessment Report will be made available for comment to the competent authority, commenting authorities, landowners, surrounding property owners and other identified stakeholders for review (see list of identified stakeholders attached under Appendix E). Comments received will be recorded and reflected in the Final Basic Assessment Report to be submitted to DMR. (Refer to Appendix E for the detailed public participation process).

The following public participation will be conducted for the proposed project:

- Identification of stakeholders, including occupiers of the property, owners and occupiers of land adjacent to the site, municipal officials and relevant State Departments as part of the Public Participation Process. All respondents will then be placed on the project database. The database will be used throughout the process to inform the stakeholders of the project.

- In order to canvass the issues and concerns of the broader public and to ensure that all IAPs will be afforded the opportunity to comment on the application. The proposed project will be announced as follows:

    - Erection of notices at the various municipal pay or public points in the area; advertising the proposed development and displaying the contact details of the EAP. The notices will serve the purpose of informing potential IAPs of the project and therefore afford them the opportunity to comment.

    - Distribution of notification letters to I&AP's via registered mail or e-mail or SMS with basic background and the locality map.

    - An advert will be placed in Die Plattelander newspaper to notify the public about the Basic Assessment process, invite members of the public to register as I&APs on the project's database and notify the public of the availability of the Draft Basic Assessment Report and date of the public meeting (if required).

    - A hard copy of the Draft Basic Assessment will be available at the Port Nolloth library.

    - All comments received during the review period of the draft Basic Assessment as well as responses provided will be captured and recorded within the Comments and Response Report in Appendix E.

    - Once DMR has made a decision, an Environmental Authorisation will be issued, all registered I&APs will be notified of the outcome of the application as well as the appeal process.

iii) Summary of issues raised by I&APs - To be completed after Public Participation

Interested and Affected Parties List the names of persons consulted in this column, and Mark with an X where those who must be consulted were in fact consulted.		Date Comments Received	Issues raised	EAPs response to issues as mandated by the applicant	Section and paragraph reference in this report where and or response were incorporated.
AFFECTED PARTIES					
Landowners					
Lawful occupiers of the land					
Landowners or lawful occupiers of adjacent properties					
Municipal councillor					
Municipality					
Organs of State (responsible for Infrastructure that may be affected Roads Department, Eskom, Telkom,					

DWA					
Communities					
Dept. Land Affairs					
Traditional Leaders					
Dept. Environmental Affairs					
Other Competent Authorities affected					
INTERESTED PARTIES					

iv) The Environmental attributes associated with the alternatives.

(The environmental attributed described must include socio- economic, social, heritage, cultural, geographical, physical and biological aspects)

(1) Baseline Environment

a. Type of environment affected by the proposed activity

(its current geographical, physical, biological, socio-economic, and cultural character)

1. MARINE ENVIRONMENT

1.1. Geophysical Characteristics - Bathymetry and Coastal Topography

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km). Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone, sloping steeply seawards to a depth of around 80 m. The middle and outer shelf typically lacks relief, sloping gently seawards before reaching the shelf break at a depth of ~300 m.

Walviskop is a south-west facing pocket beach approximately 13 km south of the Holgat River mouth. It is typical of the short beaches within small embayments that characterise the rugged quartzite and sandstone coastline south of the Orange River mouth. Although detailed bathymetry of the nearshore regions of the project area are not available, 1 m bathymetry contours from Concession 1a suggest that the depth just beyond the surf zone in small bays similar to that at Walviskop is in the order of -5 m. The seabed slope of the bay averages 0.01. A feature of the bay is a prominent sand-influenced rocky outcrop in the mid- to lowshore on the southern portion of the ~400 m long beach. The beach, which is the northern-most of a series of three small beaches, is bounded to the north and south by rugged rocky coastline and rocky cliffs. The two beaches to the south of the target area have sands in the upper shore only, with the mid- and lowshore reaches being characterised by rocky shores. Some 2 km south of the target beach, the coastline becomes cliffed. These coastal cliffs that characterise the shoreline of the Cliffs and Langpan concessions have been identified as having high natural sensitivity (SLR 2018).

Figure 6: GoogleEarth image indicating the position of the target area (red polygon) in relation to nearby pocket beaches, cliffed coastline and historic mining damage (PES, 2020).

1.2 Coastal Geology and Seabed Geomorphology

The description of the coastal geology in the project area is drawn from Alexkor's 2004 EMPr (CSIR1994), the 2008 Revised EMPr (Site Plan Consulting 2008) and the Whale Head Minerals' Mine Works Programme.

The Alexkor mine is underlain by Late Precambrian basement rocks of the Gariep Complex comprising the Holgat, Oranjemund and Grootderm Suites, and the Stinkfontein Formation. A few small scattered outcrops of Cambrian granite of the Swartbank Pluton occur in the east of the licence area. The Boegoeberg Twins, which consist of remnant Gariep metamorphic rocks, make the Alexkor coastline the only inselberg coast in southern Africa.

The project area at Walvislop falls within the Holgat Suite, which extends from Cape Voltas southwards to just north of Cliff Point. It consists of schist, gneiss, greywacke, arenite, limestone, quartzite and arkose.

Early Pliocene to Late Quaternary hiatuses in sea level regression resulted in the erosion of four wave cut platforms ranging from 95 m above current sea level to mean sea level. The various terraces are generally separated by areas of bedrock covered by littoral sands. Marine sediments have been left behind on the terraces either as beach deposits or lag gravels, consisting of basal diamondiferous gravels intermittently overlain by marine sands, gravels and shells, which may occasionally be indurated to sandstone, and conglomerate, locally referred to as "Vaalbank". These marine sediments, vary in thickness from a few centimetres to more than 10 m. The entire sequence including the Lower Terrace deposits and adjacent bedrock are covered by coastal dune sands along the coastal strip. These dune sands and the underlying terrigenous sands are of Pleistocene age and belong to the Bredasdorp Formation.

The coast is predominantly rocky with 42% being rocky headlands and 32% wave-cut rocky platforms. Approximately 26% of the Alexkor coastline is classified as sandy beaches. These beaches are usually backed by a relatively narrow hummock dune zone.

At Walviskop, the nearshore sediments comprise a marine gravel layer resting on a gently seaward sloping bedrock platform. The gravel in turn is overlain by a medium to coarse-grained layer of beach sand, which hosts the mineralised heavy minerals. The bed rock basement on the platform is characterised by an uneven surface with gullies, potholes and large boulders (>400 mm) in places. The gravel layer, which varies in thickness between 1.0 and 1.5 m, rests on the bedrock. The gravel consists of gravel clasts, which range in size from >100 mm (8%) to 100 – 2 mm (92%) and comprise almost entirely of quartzite and vein quartz, as well as shell fragments and subordinate sand-size material.

The overlaying beach sand layer is on average 3 - 5 m thick, comprising a ~50/50% mix of coarse- to medium-grained quartz sand, broken shell material and heavy minerals. The heavy minerals occur as a compact well-packed layer prone to continuous relocation by bottom currents, particularly during storm events. As part of a natural sedimentary cycle, the coastline is subject to gradual accumulation of sand deposits during summer, and subsequent beach erosion during winter. Superimposed on this seasonal pattern are bi-weekly, daily, and storm-associated sand movements, when temporary reversal in the sediment transport direction occurs in response to short-term changes in wave conditions. Erosion of sand from the beach during storm events can result in a severe thinning of the sand layer, or the total absence of sands.

On the southern African West coast, mineralization of heavy minerals develop in the sandy beach deposits of well-developed south facing log spiral bays. The heavy mineral suites in the project area are diverse, consisting of various proportions of ilmenite and its related alteration products, hematite, magnetite as well as rutile, zircon, garnet, amphibole, pyroxene, epidote, aluminosilicates, titanite, monazite, staurolite, collophane and glauconite. The economically viable minerals, ilmenite, rutile, garnet, monazite and zircon constitute a very large portion of the total heavy mineral suite, often an order of magnitude greater than the gangue. Generally, the total heavy mineral suite in the area is dominated by ilmenite (50 – 73 wt%), with garnet (6 –12 wt%), zircon (5 -7 wt%), monazite (2 – 3 wt%), and rutile (1 wt%) constituting the rest of the economic fraction.

1.3. Marine Environment - Biophysical Characteristics

1.3.1 Wind Patterns

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the perennial South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure field over the subcontinent. The south Atlantic anticyclone undergoes seasonal variations, being strongest in the austral summer, when it also attains its southernmost extension, lying south west and south of the subcontinent. In winter, the south Atlantic anticyclone weakens and migrates north-westwards.

These seasonal changes result in substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system, and the associated series of cold fronts, moves northwards in winter, and southwards in summer. The strongest winds occur in summer, during which winds blow 99% of the time Virtually all winds in summer come from the southeast to south-west , strongly dominated by southerlies which occur over 40% of the time, averaging 20 30 kts and reaching speeds in excess of 100 km/h (60 kts). South-easterlies are almost as common, blowing about one-third of the time, and also averaging 20 - 30 kts. The combination of these southerly/south-easterly winds drives the offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component. This ‘reversal’ from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which develop in summer. There are more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerlies winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

1.3.2 Large –scale Circulation and Coastal Currents

The West Coast is strongly influenced by the Benguela Current, with current velocities in continental shelf areas ranging between 10–30 cm/s (Boyd & Oberholster 1994). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. The Benguela current widens northwards to 750 km, with flows being predominantly wind-forced, barotropic and fluctuating between poleward and equatorward flow (Shillington et al. 1990; Nelson &Hutchings 1983).Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Near-bottom shelf flow is mainly poleward (Nelson 1989) with low velocities of typically 5 cm/s.

The major feature of the Benguela Current Coastal is upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Taunton-Clark 1985, PES 2020). The project area falls into the Namaqua cell. Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. An example of one such strong upwelling event in December 1996, followed by relaxation of upwelling and intrusion of warm Agulhas waters from the south.

Where the Agulhas Current passes the southern tip of the Agulhas Bank(Agulhas Retroflection area), it may shed a filament of warm surface water that moves north-westward along the shelf edge towards Cape Point, and Agulhas Rings, which similarly move north-westwards into the South Atlantic Ocean. These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold sub-antractic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelgic fish species (Best 2007, PES 2020).

1.3.3 Waves and Tides

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action, rating between 13-17 on the 20 point exposure scale (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing southerly winds. The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

The wave regime along the southern African west coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the SW - S direction. Winter swells are strongly dominated by those from the SW - SSW, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

Summer swells tend to be smaller on average (~2 m), with a more pronounced southerly component. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves (CSIR 1996).These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves.

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

1.3.4 Water

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the project area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinities range between 34.5 ‰ and 35.5‰ (Shannon 1985).

Seawater temperatures on the continental shelf typically vary between 6°C and 16°C. Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey et al. 1985; Chapman & Shannon 1985).

Nutrient concentrations of upwelled water attain 20 μm nitrate-nitrogen, 1.5 μM phosphate and 15-20 μM silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey et al. 1985). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

1.3.5 Upwelling and Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

1.3.6 Organic Inputs

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s the Benguela region supported biomasses of 76.9 tons/km2 of phytoplankton and 31.5 tons/km2 of zooplankton alone (Shannon et al. 2003). Thirty six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (see Shannon & Pillar 1985; Pitcher 1998). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water.

1.3.7 Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (e.g. Visser 1969; Bailey et al. 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches, there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey1991; Shannon & O'Toole 1998; Bailey 1999; Fossing et al. 2000). The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft et al. 2000). The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by algal blooms is the main cause for these mortalities and walkouts. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures where high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

1.3.8 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, the PIM loading in nearshore waters is strongly related to natural inputs from the Orange River or from 'berg' wind events. 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999). For example,a 'berg' wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20,000 km^2.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley et al. 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/ℓ, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. During storm events, concentrations near the seabed may even reach up to 10,000 mg/ℓ (Miller & Sternberg 1988). In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/ℓ at Alexander Bay just south of the mouth (Zoutendyk 1995) to peak values of 7,400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood (Bremner et al. 1990).

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of re-suspending and transporting considerable quantities of sediment equator wards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow pole ward undercurrent (Shillington et al. 1990; Rogers & Bremner 1991).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bed load sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake et al. 1985; Ward 1985). Data from a Waverider buoy at Port Nolloth have indicated that 2-m waves are capable of re-suspending medium sands (200 μm diameter) at ~10 m depth, whilst 6-m waves achieve this at ~42 m depth. Low-amplitude, long-period waves will, however, penetrate even deeper. Most of the sediment shallower than 90 m can therefore be subject to re-suspension and transport by heavy swells (Lane & Carter 1999).

Mean sediment deposition is naturally higher near the seafloor due to constant re-suspension of coarse and fine PIM by tides and wind-induced waves. Aggregation or flocculation of small particles into larger aggregates occurs as a result of cohesive properties of some fine sediments in saline waters. The combination of re-suspension of seabed sediments by heavy swells, and the faster settling rates of larger inorganic particles, typically causes higher sediment concentrations near the seabed. Significant re-suspension of sediments can also occur up into the water column under stronger wave conditions associated with high tides and storms. Re-suspension can result in dramatic increases in PIM concentrations within a few hours (Sheng et al. 1994). Wind speed and direction have also been found to influence the amount of material re-suspended (Ward 1985).

Although natural turbidity of seawater is a global phenomenon, there has been a worldwide increase of water turbidity and sediment load in coastal areas as a consequence of anthropogenic activities. These include dredging associated with the construction of harbours and coastal installations, beach replenishment, accelerated runoff of eroded soils as a result of deforestation or poor agricultural practices, and discharges from terrestrial, coastal and marine mining operations (Airoldi 2003). Such increase of sediment loads has been recognised as a major threat to marine biodiversity at a global scale (UNEP 1995).

1.4 Marine - Biological Environment

Biogeographically, the study area falls within the cold temperate Namaqua Bioregion (Emanuel et al.1992; Lombard et al. 2004), which in the 2018 National Biodiversity Assessment (Sink et al. 2019) is referred to as a sub region of the Southern Benguela Shelf ecoregion. The coastal, wind-induced upwelling characterising the western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions. The West Coast is, however, characterized by low marine species richness and low endemicity (Awadet al. 2002).

Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type (i.e. hard vs. soft bottom), exposure to wave action, or water depth. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The mining target area extends from the high water mark on the coast to ~5 m depth. The benthic and coastal habitats of South Africa have been mapped by Sink et al. (2019). Those specific to the study area can be broadly grouped into:

- Sandy intertidal and unconsolidated sub tidal substrates, and
- Intertidal rocky shores and sub tidal reefs.

The biological communities ‘typical’ of these benthic habitats and the overlying water body are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the mining activities. No rare or endangered species have been recorded (Awad et al. 2002).

1.4.1. Sandy and Unconsolidated Habitat and Biota

The benthic biota of unconsolidated marine sediments constitute invertebrates that live on (epifauna) or burrow within (in fauna) the sediments, and are generally divided into macro fauna (animals >1 mm) and meiofauna (<1 mm).

The coastline from the Orange River mouth to Kleinzee is dominated by rocky shores, interspersed by isolated short stretches of sandy shores. Sandy beaches are one of the most dynamic coastal environments. With the exception of a few beaches in large bay systems (such as St Helena Bay, Saldanha Bay, Table Bay), the beaches along the South African west coast are typically highly exposed. Exposed sandy shores consist of coupled surf zone, beach and dune systems, which together form the active littoral sand transport zone (Short & Hesp 1985). The composition of their faunal communities is largely dependent on the interaction of wave energy, beach slope and sand particle size, which is termed beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan *et al.* 1993). Generally, dissipative beaches are relatively wide and flat with fine sands and low wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities.

Reflective beaches in contrast, have high wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities. Intermediate beach conditions exist between these extremes and have a very variable species composition (McLachlan *et al.*1993; Jaramillo *et al.* 1995, Soares 2003). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of e.g. kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch & Griffiths 1988). As a result of the combination of typical beach characteristics, and the special adaptations of beach fauna to these, beaches act as filters and energy recyclers in the near shore environment (Brown & McLachlan 2002).

Numerous methods of classifying beach zonation have been proposed, based either on physical or biological criteria. The macro faunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone. Due to the exposed nature of the coastline in the study area, most beaches are of the intermediate to reflective type. The supralittoral zone is situated above the high water spring (HWS) tide level, and receives water input only from large waves at spring high tides or through sea spray. This zone is characterised by a mixture of air breathing terrestrial and semi-terrestrial fauna, often associated with and feeding on kelp deposited near or on the drift line. Terrestrial species include a diverse array of beetles and arachnids and some oligochaetes, while semi-terrestrial fauna include the oniscid isopod *Tylos granulatus*, and amphipods of the genus *Talorchestia*. The intertidal zone or mid-littoral zone has a vertical range of about 2 m. This mid-shore region is characterised by the cirolanid isopods *Pontogeloideslatipes*, *Eurydice* (*longicornis*=)

kensleyi, and *Excirolananatalensis*, the polychaetes *Scolelepissquamata*, *Orbiniaangrapequensis*, *Nepthyshombergii* and *Lumbrineristetraura*, and amphipods of the families Haustoridae and Phoxocephalidae. In some areas, juvenile and adult sand mussels *Donax serra* may also be present in considerable numbers.

The inner turbulent zone extends from the Low Water Spring mark to about -2 m depth. The mysid *Gastrosaccus psammodytes* (Mysidacea, Crustacea), the ribbon worm *Cerebratulus fuscus* (Nemertea), the cumacean *Cumopsis robusta* (Cumacea) and a variety of polychaetes including *Scolelepis squamata* and *Lumbrineris tetraura*, are typical of this zone, although they generally extend partially into the midlittoral above. In areas where a suitable swash climate exists, the gastropod *Bullia digitalis* (Gastropoda, Mollusca) may also be present in considerable numbers, surfing up and down the beach in search of carrion.

The transition zone spans approximately 2-5 m depth beyond the inner turbulent zone. Extreme turbulence is experienced in this zone, and as a consequence this zone typically harbours the lowest diversity on sandy beaches. Typical fauna include amphipods such as *Cunicus profundus* and burrowing polychaetes such as *Cirriformia tentaculata* and *Lumbrineris tetraura.*

The outer turbulent zone extends below 5 m depth, where turbulence is significantly decreased and species diversity is again much higher. In addition to the polychaetes found in the transition zone, other polychaetes in this zone include *Pectinaria capensis,* and *Sabellides ludertizii*. The sea pen Virgularia schultzi (Pennatulacea, Cnidaria) is also common as is a host of amphipod species and the three spot swimming crab *Ovalipes punctatus* (Brachyura, Crustacea).

The marine component of the 2018 National Biodiversity Assessment (Sink et al. 2019), rated portions of the inner continental shelf on the West Coast as 'endangered', whereas sections of the coastline in the broader project area are rated as either 'vulnerable' or of 'least concern'.

1.4.2 Rocky Substrate Habitats and Biota

The following general description of the intertidal and subtidal habitats for the West Coast is based on Field et al. (1980), Branch & Griffiths (1988), Field & Griffiths (1991) and Branch & Branch (2018).

1.4.2.1 Intertidal Rocky Shores

Several studies on the west coast of southern Africa have documented the important effects of wave action on the intertidal rocky-shore community. Specifically, wave action enhances filter-feeders by increasing the concentration and turnover of particulate food, leading to an elevation of overall biomass despite a low species diversity (McQuaid & Branch 1985, Bustamante & Branch 1995a, 1996a, Bustamante *et al.* 1997). Conversely, sheltered shores are diverse with a relatively low biomass, and only in relatively sheltered embayments does drift kelp accumulate and provide a vital support for very high densities of kelp trapping limpets, such as *Cymbula granatina* that occur exclusively there (Bustamante *et al.* 1995). In the subtidal, these differences diminish as wave exposure is moderated with depth.

West Coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities: The Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones. These biological zones correspond roughly to zones based on tidal heights. Tolerance to the physical stresses associated with life on the intertidal, as well as biological interactions such as herbivory, competition and predation interact to produce these five zones.

The uppermost part of the shore is the supralittoral fringe, which is the part of the shore that is most exposed to air, perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny periwinkle *Afrolittorina knysnaensis*, and the red alga *Porphyra capensis* constituting the most common macroscopic life.

The upper mid-littoral is characterised by the limpet *Scutellastra granularis*, which is present on all shores. The gastropods *Oxystele variegata*, *Nucella dubia*, and *Helcion pectunculus* are variably present, as are low densities of the barnacles *Tetraclita serrata*, *Octomeris angulosa* and *Chthalamus dentatus*. Flora is best represented by the green algae *Ulva* spp.

Toward the lower Mid-littoral or Lower Balanoid zone, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds with a variable representation of: green algae – *Ulva* spp, *Codium* spp.; brown algae – *Splachnidium rugosum*; and red algae – *Aeodes orbitosa*, *Mazzaella (=Iridaea) capensis*, *Gigartina polycarpa* (=*radula*), *Sarcothalia* (=*Gigartina*) *stiriata*, and with increasing wave exposure *Plocamium rigidum* and *P. cornutum*, and *Champia lumbricalis*. The gastropods *Cymbula granatina* and *Burnupena* spp. are also common, as is the reef building polychaete *Gunnarea capensis*, and the small cushion starfish *Patiriella exigua*. On more exposed shores, almost all of the primary space can be occupied by the dominant alien invasive mussel *Mytilus galloprovincialis*. First recorded in 1979 (although it is likely to have arrived in the late 1960s), it is now the most abundant and widespread invasive marine species spreading along the entire West Coast and parts of the South Coast (Robinson *et al.*2005). *M. galloprovincialis*has partially displaced the local mussels *Choromytilus meridionalis* and *Aulacomyaater* (Hockey & Van Erkom Schurink 1992), and competes with several indigenous limpet species (Griffiths *et al.* 1992; Steffani & Branch 2003a, b). Another alien invasive recorded in the past decade is the acorn barnacle *Balanus glandula*, which is native to the west coast of North America where it is the most common intertidal barnacle (Simon-Blecher *et al.* 2008). There is, however, evidence that it has been in South Africa since at least 1992 (Laird & Griffith 2008). At the time of its discovery, the barnacle was recorded from 400 km of coastline from Misty Cliffs near Cape Point to Elands Bay (Laird & Griffith 2008). It has been reported on rocky shores as far north as Lüderitz in Namibia (Pulfrich 2016), and was identified in the Alexkor mining licence area 554MRC during a site visit in July 2017. When present, the barnacle is typically abundant at the mid zones of semi-exposed shores.

Along the sublittoral fringe, the large kelp-trapping limpet *Scutellastra argenvillei* dominates forming dense, almost monospecificstands achieving densities of up to 200/m^2 (Bustamante *et al.* 1995). Similarly, *C. granatina* is the dominant grazer on more sheltered shores, also reaching extremely high densities (Bustamante *et al.* 1995). On more exposed shores *M. galloprovincialis* dominates. There is evidence that the arrival of the alien *M. galloprovincialis* has led to strong competitive interaction with *S. argenvillei* (Steffani & Branch 2003a, 2003b, 2005). The abundance of the mussel changes with wave exposure, and at wave-exposed locations, the mussel can cover almost the entire primary substratum,whereas in semi-exposed situations it is never abundant. As the cover of *M. galloprovincialis* increases, the abundance and size of *S. argenvillei* on rock declines and it becomes confined to patches within a matrix of musselbed. As a result exposed sites, once dominated by dense populations of the limpet, are now largely covered by the alien mussel. Semi-exposed shores do, however, offer a refugepreventing global extinction of the limpet. In addition to the mussel and limpets, there is variable representation of the flora and fauna described for the lower mid-littoral above, as well as the anemone *Aulactinia reynaudi*, numerous whelk species and the sea urchin *Parechinus angulosus*. Some of these species extend into the subtidal below.

More recently, the invasion of west coast rocky shores by another mytilid, the hermaphroditic Chilean *Semimytilus algosus*, was noted (de Greef *et al.* 2013). It is hypothesized that this species was introduced either by shipping traffic from Namibia (Walvis Bay and Swakopmund) or through the importing of oyster spat from Chile for mariculture purposes. First reported in 2009 from Elands Bay, its distribution spread rapidly to cover 500 km of coastline within a few years (de Greef *et al.* 2013). Its current range extends from Lüderitz (pers. obs) to Bloubergstrand in the south. Where present, it occupies the lower intertidal zone completely dominating primary rock space, while *M. galloprovincialis* dominates higher up the shore. Many shores on the West Coast have thus now been effectively partitioned by the three introduced species, with *B. glandula* colonizing the upper intertidal, *M. galloprovincialis* dominating the mid-shore, and now *S. algosus* smothering the low-shore (de Greef *et al.* 2013).The shells of *S. algosus*are, however, typically thin and weak, and have a low attachment strength to the substrate, thereby making the species vulnerable to predators, interference competition, desiccation and the effects of wave action (Zeeman 2016). The competitive ability of *S. algosus* is strongly related to shore height. Due to intolerance to desiccation, it cannot survive on the high shore, but on the low shore its high recruitment rate offsets the low growth rate, and high mortality rate as a result of wave action and predation.

Most of the rocky shores in the southern portion of 554MRC and in the Walviskop project area will be similar to 'typical' shores as described above, although those in the centre of the target beach are expected to show evidence of sand scouring and periodic sand inundation. Such shores will harbour more sand-tolerant and opportunistic foliose algal genera (e.g. *Ulva* spp*.,Grateloupia belangeri, Nothogenia erinacea)* many of which have mechanisms of growth, reproduction and perennation that contribute to their persistence on sand-influenced shores (Daly & Matheison 1977; Airoldi *et al.* 1995; Anderson *et al.* 2008). Of the benthic fauna, the sand-tolerant anemone *Bunodactis reynaudi*, the Cape reef worm *Gunnarea gaimardi*, and the siphonarid *Siphonaria capensis* were prevalent, with the anemone in particular occupying much of the intertidal space.

1.4.2.2 Rocky subtidal Habitat and Kelp Beds

Biological communities of the rocky sublittoral can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora, and an offshore zone below 10 m depth dominated by fauna. This shift in communities is not knife-edge, and rather represents a continuum of species distributions, merely with changing abundances.

From the sublittoral fringe to a depth of between 5 and 10 m, the benthos is largely dominated by algae, in particular two species of kelp. The canopy forming kelp *Ecklonia maxima* extends seawards to a depth of about 10 m. The smaller *Laminaria pallida* forms a sub-canopy to a height of about 2 m underneath *Ecklonia*, but continues its seaward extent to about 30 m depth, although in the northern regions of the west coast, and in the coastal mining licence areas, increasing turbidity limits growth to shallower waters (10-20 m) (Velimirov *et al.* 1977; Jarman & Carter 1981; Branch 2008). *Ecklonia maxima* is the dominant species in the south forming extensive beds from west of Cape Agulhas to north of Cape Columbine, but decreasing in abundance northwards. *Laminaria* becomes the dominant kelp north of Cape Columbine and thus in the project area, extending from Danger Point east of Cape Agulhas to Rocky Point in northern Namibia (Stegenga *et al.* 1997; Rand 2006).

Kelp beds absorb and dissipate much of the typically high wave energy reaching the shore, thereby providing important partially-sheltered habitats for a high diversity of marine flora and fauna, resulting in diverse and typical kelp-forest communities being established. Through a combination of shelter and provision of food, kelp beds support recruitment and complex trophic food webs of numerous species, including commercially important rock lobster stocks (Branch 2008).

Growing beneath the kelp canopy, and epiphytically on the kelps themselves, are a diversity of under storey algae, which provide both food and shelter for predators, grazers and filter-feeders associated with the kelp bed ecosystem. Representative under-storey algae include Botryocarpa prolifera, Neuroglossum binderianum, Botryoglossum platycarpum, Hymenena venosa and Rhodymenia (=Epymenia) obtusa, various coralline algae, as well as subtidal extensions of some algae occurring primarily in the intertidal zones (Bolton 1986). Epiphytic species include *Polysiphonia virgata, Gelidium vittatum* (=Suhria vittata) and Carpoblepharis flaccida. In particular, encrusting coralline algae are important in the under-storey flora as they are known as settlement attractors for a diversity of invertebrate species. The presence of coralline crusts is thought to be a key factor in supporting a rich shallow-water community by providing substrate, refuge, and food to a wide variety of infaunal and epifaunal invertebrates (Chenelot et al. 2008).

The sublittoral invertebrate fauna is dominated by suspension and filter-feeders, such as the mussels Aulacomya ater and *Choromytilus meriodonalis*, and the Cape reef worm *Gunnarea gaimardi*, and a variety of sponges and sea cucumbers. Grazers are less common, with most herbivory being restricted to grazing of juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin *Parechinus angulosus*, with lesser grazing pressure from limpets, the isopod Paridotea reticulata and the amphipod Ampithoe humeralis. The abalone Haliotis midae, an important commercial species present in kelp beds south of Cape Columbine is naturally absent north of Cape Columbine, although attempts at ranching this species along the Namaqualand coast are currently underway. Key predators in the sub-littoral include the commercially important West Coast rock lobster Jasus lalandii and the octopus Octopus vulgaris. The rock lobster acts as a keystone species as it influences community structure via predation on a wide range of benthic organisms (Mayfield et al. 2000). Relatively abundant rock lobsters can lead to a reduction in density, or even elimination, of black mussel *Choromytilus meriodonalis*, the preferred prey of the species, and alter the size structure of populations of ribbed mussels Aulacomya ater, reducing the proportion of selected size-classes (Griffiths & Seiderer 1980). Their role as predator can thus reshape benthic communities, resulting in large reductions in taxa such as black mussels, urchins, whelks and barnacles, and in the dominance of algae (Barkai & Branch 1988; Mayfield 1998).

Of lesser importance as predators, although numerically significant, are various starfish, feather and brittle stars, and gastropods, including the whelks Nucella spp. and Burnupena spp. Fish species commonly found in kelp beds off the West Coast include hottentot Pachymetopon blochii, two tone finger fin *Chirodactylus brachydactylus*, red fingers Cheilodactylus fasciatus, galjoen *Dichistius capensis,* rock suckers Chorisochismus dentex and the catshark *Haploblepharus pictus* (Branch et al. 2010).

There is substantial spatial and temporal variability in the density and biomass of kelp beds, as storms can remove large numbers of plants and recruitment appears to be stochastic and unpredictable (Levitt et al. 2002; Rothman et al. 2006). Some kelp beds are dense, whilst others are less so due to differences in seabed topography, and the presence or absence of sand and grazers.

1.4.2.3 The Water Body

In contrast benthic biota which are associated with the seabed, pelagic species live and feed in the open water column. The pelagic communities are typically divided into plankton and fish, and their main predators, marine mammals (seals, dolphins and whales), seabirds and turtles.

Plankton

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2-m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton.

Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1-1.0 g C/m2, with production increasing north of Cape Columbine (Pillar 1986). Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplanktors (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly.

Zooplankton biomass varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

The project area lies within the influence of the Namaquaupwelling cell, and seasonally high phytoplankton abundance can be expected, providing favourable feeding conditions for micro-, meso- and macrozooplankton, and for ichthyoplankton. Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela (Crawford et al. 1987), and their eggs and larvae form an important contribution to the ichthyoplankton in the region. However, in the Orange River Cone area immediately to the north of the upwelling cell, high turbulence and deep mixing in the water column result in diminished phytoplankton biomassand consequently the area is considered to be an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems. Important pelagic fish species, including anchovy, redeye round herring, horse mackerel and shallow-water hake, are reported as spawning on either side of the Orange River Cone area, but not within it. Ichthyoplankton abundances in the project area are thus expected to be comparatively low.

Pelagic Fish

The structure of the nearshore and surf zone fish community varies greatly with the degree of wave exposure. Species richness and abundance is generally high in sheltered and semi-exposed areas but typically very low off the more exposed beaches (Clark 1997a, 1997b). The surf zone and outer turbulent zone habitats of sandy beaches are considered to be important nursery habitats for marine fishes (Modde 1980; Lasiak 1981; Kinoshita & Fujita 1988; Clark *et al.* 1994). However, the composition and abundance of the individual assemblages seems to be heavily dependent on wave exposure (Blaber & Blaber 1980, Potter *et al.* 1990, Clark 1997a, 1997b). Surf zone fish communities off the South African West Coast have relatively high biomass, but low species diversity. Typical surf zone fish include harders (*Liza richardsonii*), white stumpnose (*Rhabdosargus globiceps*), Cape sole (*Heteromycteris capensis*), Cape gurnard (*Chelidonichthys capensis*), False Bay klipfish (*Clinus latipennis*), sandsharks (*Rhinobatosannulatus*), eagle ray(*Myliobatis aquila*),and smooth-hound (*Mustelus mustelus*) (Clark 1997b).

Fish species commonly found in kelp beds off the West Coast include hottentot *Pachymetopon blochii* , two tone fingerfin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis*, rock suckers *Chorisochismus dentex,* maned blennies *Scartella emarginata* and the catshark *Haploblepharus pictus* (Sauer*et al.*1997; Brouwer *et al.* 1997; Branch *et al.* 2010).

Small pelagic species occurring beyond the surfzone and generally within the 200 m contour include the sardine/pilchard (Sadinops ocellatus), anchovy (Engraulis capensis), chub mackerel (Scomber japonicus), horse mackerel (Trachurus capensis) and round herring (Etrumeus whiteheadi). These species typically occur in mixed shoals of various sizes (Crawford et al. 1987), and exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Recruitment success relies on the interaction of oceanographic events, and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small, short-lived (1-3 years) pelagic fish is highly variable both within and between species.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year.

Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*), and occasionallythe Loggerhead (*Caretta caretta*) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast.

The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa) (Lambardi *et al.* 2008, Elwen & Leeney 2011). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008).

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays *et al.* 2004). Their abundance in the study area is unknown but expected to be low. Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. Leatherback Turtles are listed as “Critically Endangered” worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and Convention on Migratory Species. Loggerhead and green turtles are listed as “Endangered”. As a signatory of the Convention on Migratory Species, South Africa has endorsed and signed an International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

Seabirds

14 species of seabirds breed in southern Africa; Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species. Birds endemic to the region and liable to occur most frequently in the project area include Cape Gannets, Kelp Gulls, African Penguins, African Black Oystercatcher, Bank, Cape and Crowned Cormorants, and Hartlaub’s Gull. Of these the Black oystercatcher and Bank cormorant are rare. The breeding success of African Black Oystercatcher is particularly susceptible to disturbance from off-road vehicles as they nest and breed on beaches between the Eastern Cape and southern Namibia. Caspian and Damara terns are likewise rare and breed in the broader study area,

especially in the wetland and saltpan areas associated with the Orange River and Olifants River estuaries.

Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km), although African Penguins and Cape Gannets are known to forage up to 60 km and 140 km offshore, respectively (Dundee 2003; Ludynia 2007).

There are no seabird breeding sites in the vicinity of the Walviskop project area, other than the RAMSAR site at the Orange River mouth, some 60 km to the north.

Marine Mammals

The marine mammal fauna occurring off the southern African coast includes several species of whales and dolphins and one resident seal species.

Cetaceans (whales and dolphins)

Thirty four species of whales and dolphins are known (based on historic sightings or stranding records) or likely (based on habitat projections of known species parameters) to occur in these waters.

Mysticete (Baleen) whales

The majority of mysticetes whales fall into the family Balaenopeteridae. Those occurring in the area include the fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales. The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters.

Odontocetes (toothed) whales

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales.

Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year round in low densities off western South Africa (Best et al. 2010), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir et al.2010). Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the project area at low levels.

The false killer whale has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1,000 m, but with a few recorded close to shore (Findlay et al. 1992). They usually occur in groups ranging in size from 1-100 animals (Best 2007). The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007).

The common dolphin is known to occur offshore in West Coast waters (Findlay et al. 1992; Best 2007), although the extent to which they occur in the project area is unknown, but likely to be low. Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region (Findlayet al. 1992). They are more frequently seen in the warmer waters offshore and to the north of the country, seasonality is not known.

In water <500m deep, dusky dolphins are likely to be the most frequently encountered small cetacean as they are very “boat friendly” and often approach vessels to bowride. The species is resident year round throughout the Benguela ecosystem in waters from the coast to at least 2,000 m deep (Findlay et al. 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lamberts Bay (Elwenet al.2010a; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlayet al. 1992). A hiatus in sightings (or low density area) is reported between ~27□S and 30□S, associated with the Lüderitz upwelling cell (Findlay et al. 1992). Dusky dolphins are resident year round in the Benguela.

Heaviside’s dolphins are relatively abundant in the Benguela ecosystem region with 10,000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen et al. 2009). This species occupies waters from the coast to at least 200 m depth, (Elwenet al. 2006; Best 2007), and may show a diurnal onshore-offshore movement pattern (Elwen et al. 2010b), but this varies throughout the species range. Heaviside’s dolphins are resident year round and likely to be frequently encountered off the project area.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant (*Mirounga leoninas*), subantarctic fur (*Arctocephalus tropicalis*), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) (David 1989).

There are a number of Cape fur seal colonies within the broader study area: at Kleinzee (incorporating Robeiland), at Bucchu Twins near Alexander Bay, and Strandfontein Point (south of Hondeklipbaai). The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status (M. Meyer, DAFF, pers. comm.). Non-breeding colonies occur south of Hondeklip Bay at Strandfontein Point and on Bird Island at Lamberts Bay, with the McDougall's Bay islands and Wedge Point being haul-out sites only and not permanently occupied by seals. All have important conservation value since they are largely undisturbed at present. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. The timing of the annual breeding cycle is very regular, occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

2. HERITAGE RESOURCES

The area proposed for mining activities is located approximately 20 km north of Port Nolloth along the West Coast of South Africa. The mining method proposed will require heavy piping and equipment on the beach. Local miners who have mined diamonds for many years in the same area are of the opinion that mobility of equipment on the beach is essential so that the equipment can be removed relatively quickly and easily in the event of the sea turning.

Most of the area proposed for sand mining is located below the high water mark within the active surf zone and as such, is unlikely to contain significant archaeological or palaeontological heritage. Archaeological evidence points to occupation of the West Coast region of South Africa, including the Namakwa coast from the Early Stone Age, through to the Middle and Later Stone Age, up until the arrival of early Trekboers in the 18th century (Kaplan 2008, NID 390540). The rocky shoreline attracted hunter-gatherers during the Holocene, in particular, resulting in rich archaeological deposits in the form of shell middens that stretch along the coastline and within the adjacent dune belt. In the past 2 000 years, early herders began arriving in the area, introducing livestock and new material culture (Orton 2012). Unmarked human burials occur, but these are seldom found by archaeologists, and are more commonly unearthed by mining operations (Kaplan 2008). As discussed in Smuts (2017), known heritage resources are predominantly located in undisturbed areas, except where these are structures within towns. The implications of this are twofold. Firstly, this makes it less likely that significant heritage resources will be impacted by the proposed mining, but also that sites are still present in undisturbed areas, and that these areas should therefore be avoided. However, previously, Kaplan (2008) and others (Smuts, 2017) have noted that the majority of significant heritage resources along this coastline exist within 300m of the high-water mark and as such, the areas within 300m of the high water mark have been red-flagged as particularly sensitive for impacts to significant archaeology. Most of the proposed mining activities take place within the high water mark, or just above it and as such, fall directly into this High Sensitivity Area. Previous recommendations required only hand-augering within this sensitive 300m buffer area.

However, this area has been subjected to ongoing mining for almost a century (see attached letter from Hattingh, 2020). Alexkor SOC Limited ("Alexkor") a state-owned diamond mining company has been actively mining diamonds since 1928. During the period 1928 to 2018, diamonds weighing more than 10,2 million carats have been recovered from marine gravel deposits on beaches and marine terraces at the Alexkor Mine. The Walviskop area is no exception and has seen active mining with surf zone mining taking place on an ongoing basis in this area since 2004 by mainly beach based dredging operations and to a lesser extent dredge mining from small boats in the bay itself. Beach mining using heavy earth moving equipment has taken place during at least two mining campaigns since 2013. As such, any significant archaeological resources within the proposed development area are likely to have been extensively disturbed in the past. Therefore the previously recommended hand-augering in this area is unlikely to mitigate impacts to significant archaeological heritage resources.

According to the SAHRIS Palaeosensitivity Map, the area proposed for prospecting is underlain by Geological formations of low significance. The formations of low palaeontological significance include surficial Alluvium including Dune Beach Sand, the Oranjemund FM, the Holgat FM, the Vredefontein FM and Aeolianites. According to the Fossil Heritage Browser on SAHRIS, fossil bone finds during research on the Northern Cape coast mines have enabled age estimations based on correlations with the African vertebrate biochronology. Fossil data associated with the aeolian record overlaps with the presence of hominids at Elandsfontein, Duinefontein and Swartklip archaeological sites, making these very significant findings. In the marine deposits, fossil molluscan seashells, brachiopods, crustaceans (barnacles, crabs, prawns, ostracods), echinoids, polychaete worm tubes, corals, bryozoans and foraminifera are found. Shark teeth are common, and other fish teeth are known to occur, as are the bones of whales, dolphins, seals and seabirds. Pether (2007) and (2013) has written much about the palaeontological sensitivity of this area of the coastline. As such, it is recommended that, while no further palaeontological specialist studies are required, the attached Fossil Finds Procedure (Appendix D3) be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

3. SOCIO-ECONOMIC

The area consists of a sparsely spread population with the Richtersveld municipal area reflecting a density of 1,2 persons/km². This is comparable with the average density for the Namakwa District municipal area of <1 person/km². The majority of approx 64% live in Alexander Bay, Port Nolloth and Mc Dougall's Bay, and indicates that the mining sector is the main economic driver in the region. Such low density implies a scarcity of skills and a low revenue base which seriously limits services delivery capacity. The current trend is on-going out-migration of economically active persons (20-30 year age group), given urbanization trends and limited job opportunities following mine down-scaling or closure.

The broader regional community reflects poor socio-economic prospects, including: - Low literacy levels occurring widespread throughout the rural population - Unemployment due to a decrease in mining activities - Inadequate housing, with rentals largely in arrears - Low affordability levels - Very low level of community health - Poverty within certain communities. The socio-economic conditions within a post-diamond mining economy poses employment sustainability challenges, therefore new mining initiatives of different commodities could proof valuable for job security in the region.

b. Description of the current land uses.

The proposed mining area extends from the high water mark to the edge of the surf zone at approximately -5 m depth. Other users of these areas include Alexkor's marine diamond mining contractors, the commercial and recreational fishing industries and a kelp collection concession.

Diamond Mining

The coastal mining licence areas extend some distance inland, and as a consequence public access to the coast is restricted and recreational activities between Alexander Bay and Hondeklipbaai is limited to the area around Port Nolloth and McDougall's Bay.

The marine diamond mining concession areas are split into four or five zones (Surf zone and (a) to (c) or (d)-concessions), which together extend from the high water mark out to approximately 500 m depth. Shore-based and vessel-based diver-assisted mining is restricted to Alexkor's contractors.

Kelp Collecting

The West Coast is divided into numerous seaweed concession areas. The Whale Head Minerals project area falls within seaweed concession 19 held by Premier Fishing, which extends from just north of Port Nolloth to the Orange River mouth. Access to a seaweed concession is granted by means of a permit from the Fisheries Branch of the Department of Agriculture, Forestry and Fisheries to a single party for a period of five years. The seaweed industry was initially based on sun dried beach-cast seaweed, with harvesting of fresh seaweed occurring in small quantities only (Anderson et al. 1989). The actual level of beach-cast kelp collection varies substantially through the year, being dependent on storm action to loosen kelp from subtidal reefs. Permit holders collect beach casts of the both Ecklonia maxima and Laminaria pallida from the driftline of beaches. The kelp is initially dried just above the high water mark before being transported to drying beds in the foreland dune area. The dried product is ground before being exported for production of alginic acid (alginate). In the areas around abalone hatcheries fresh beach-cast kelp is also collected as food for cultured abalone, although quantities have not been reported to the Department of Agriculture, Forestry and Fisheries (DAFF). There has been no activity in kelp concession 19 over the past decade**.**

Rock Lobster Fishery

The West Coast rock lobster Jasus lalandii is a valuable resource of the South African West Coast and consequently an important income source for West Coast fishermen. Following the collapse of the rock-lobster resource in the early 1990s, fishing has been controlled by a Total Allowable Catch (TAC), a minimum size, restricted gear, a closed season and closed areas (Crawford et al. 1987, Melville-Smith et al. 1995). The fishery is divided into the offshore fishery (30 m to 100 m depth) and the near-shore fishery (< 30 m depth), thereby overlapping with the mining licence areas. Management of the resource is geographically specific, with the TAC annually allocated by Area. The Whale Head Minerals target area falls within Management Area 1 of the commercial rock lobster fishing zones, which extends from the Orange River Mouth to Kleinzee. The fishery operates seasonally, with closed seasons applicable to different zones; Management Areas 1 and 2 operate from 1 October to 30 April.

Commercial catches of rock lobster in Area 1 are confined to shallower water (<30 m) with almost all the catch being taken in <15 m depth, therefore overlapping directly with diver-assisted vessel-based mining operations. Actual rock-lobster fishing, however, takes place only at discrete suitable reef areas along the shore within this broad depth zone. Lobster fishing is conducted from a fleet of small dinghies/bakkies. The majority of these work directly from the shore within a few nautical miles of the harbours, with only 30% of the total numbers of bakkies partaking in the fishery being deployed from larger deck boats. As a result, lobster fishing tends to be concentrated close to the shore within a few nautical miles of Port Nolloth and Hondeklip Bay. Landings of rock lobster recorded within Area 1 have been reported at an average total rock lobster tail weight of 16 tons per year (2008 – 2012). All landings were reported by bakkies, with no landings made by the offshore sector. This amounts to 0.8% of the total landings recorded by the West Coast rock lobster fishery (inclusive of both the near-shore and offshore fisheries) and 4.1% of the total landings recorded by the bakkie fleet.

Rock lobster landings from Area 1 and 2 extends from Kleinzee to the mouth of the Brak River, are provided for comparison.

Recreational Fisheries

Recreational and subsistence fishing on the West Coast is small in scale when compared with the south and east coasts of South Africa. The population density in Namaqualand is low, and poor road infrastructure and ownership of much of the land by diamond companies in the northern parts of the West Coast has historically restricted coastal access to the towns and recreational areas of Port Nolloth, McDougall's Bay, Hondeklipbaai and the Groenrivier mouth.

Recreational line-fishing is confined largely to rock and surf angling in places such as Brand-se-Baai, well to the south of the mining licence areas, and the more accessible coastal stretches in the regions. Boat angling is not common along this section of the coast due to the lack of suitable launch sites and the exposed nature of the coastline. Fishing effort has been estimated at 0.12 angler/km north of Doringbaai. These fishers expended effort of approximately 200,000 angler days/year with a catch-per-unit-effort of 0.94 fish/angler/day (Brouwer et al. 1997; Sauer & Erasmus 1997). Target species consist mostly of hottentot, white stumpnose, kob, steenbras and galjoen, with catches being used for domestic consumption, or are sold.

Recreational rock lobster catches are made primarily by diving or shore-based fishing using baitbags. Hoop-netting for rock lobster from either outboard or rowing boats is not common along this section of the coast (Cockcroft & McKenzie 1997). Most of the recreational catch is made early in the season, with 60% of the annual catch landed by the end of January. The majority of the recreational take of rock lobster (~68%) is made by locals resident in areas close to the resource. Due to the remoteness of the area and the lack of policing, poaching of rock lobsters by the locals, seasonal visitors as well as the shore-based mining units is becoming an increasing problem. Large numbers of rock lobsters are harvested in sheltered bays along the Namaqualand coastline by recreational divers who disregard bag-limits, size-limits or closed seasons. This potentially has serious consequences for the sustainability of the stock in the area.

Mariculture

Although the Northern Cape coast lies beyond the northern-most distribution limit of abalone (*Haliotis midae*) on the West Coast, ranching experiments have been undertaken in the region since 1995(Sweijd et al. 1998, de Waal & Cook 2001, de Waal 2004). As some sites have shown high survival of seeded juveniles, the Department of Agriculture, Forestry and Fisheries (DAFF) published criteria for allocating rights to engage in abalone ranching or stock enhancement (Government Gazette No. 33470, Schedule 2, 20 August 2010) in four areas along the Namaqualand Coast. Ranching in these areas is currently being investigated at the pilot phase. The Whale Head Minerals target area falls within area NC1 held by Turnover Trading. No seeding has as yet commenced in the area and the Department of Agriculture, Forestry and Fisheries are still awaiting the baseline assessment for the area (I. Zimasa Jika, DAFF, pers. comm., March 2020)

Associated with the ranching projects are land-based abalone hatcheries located at North Point near Port Nolloth, at Kleinzee and at Hondeklipbaai. These hatcheries operate on a semi-recirculation system using seawater pumped from the shallow subtidal zone to top-up the holding tanks (Anchor Environmental Consultants 2010).

Conservation Areas and Marine Protected Areas

The only conservation area along the Northern Cape coast in which restrictions apply is the McDougall’s Bay rock lobster sanctuary near Port Nolloth, which is closed to exploitation of rock lobsters. The sanctuary, which extends one nautical mile seawards of the high water mark between the promontory at the northern end of McDougall's Bay, and the promontory at the southern extremity of McDougall's Bay, lies well south of the mining target area.

Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments a systematic biodiversity plan was developed for the West Coast with the objective of identifying coastal and offshore priority focus areas for MPA expansion (Sink et al. 2011; Majiedt et al. 2013).Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. The biodiversity data were used to identify ten focus areas for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas were carried forward during Operation Phakisa, which identified potential MPAs. Those approved MPAs within the broad project area are shown in. The proposed project area does not fall within any of these MPAs, or with any other coastal MPAs, sanctuaries or conservation areas.

As part of a regional Marine Spatial Management and Governance Programme (MARISMA; 2014-2020) the Benguela Current Commission (BCC) and its member states have identified a number of Ecologically or Biologically Significant Areas (EBSAs) both spanning the border between Namibia and South Africa and along the South African West and South Coasts, with the intention of implementing improved conservation and protection measures within these sites. Those areas identified as being of high priority for place-based conservation measures within the broad project area have been proposed and inscribed under the Convention of Biological Diversity (CBD). There is no overlap with the proposed project area and any of these EBSAs.

The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. No specific management actions have been formulated for the various areas at this stage.

4. TERRESTRIAL ENVIRONMENT

The Vegetation Map of South Africa, Lesotho and Swaziland (Mucina, Rutherford & Powrie, 2005; SANBI, 2012) (VEGMAP) shows that 2 vegetation types originally occurred within the immediate study area, Richtersveld Coastal Duneveld and Namaqualand Seashore Vegetation. Both vegetation types found are considered to be 'Least Threatened' (Government Gazette, 2011).

Two main factors are taken into account in determining sensitivity in the project area. The first is the current disturbance regime and the second is the designation of critical biodiversity areas (CBAs). Vegetation within the study area has been heavily disturbed over significant areas within the greater project area. The result is that the remaining vegetation is important not only since it represents particular types but because it is important for functioning of the ecosystem. (One of the most significant benefits of vegetation is the stabilization of the sandy soil. Since active mining has been underway, wind-blown sand and dust have caused major environmental and health and safety issues within the project area). CBAs have been determined for the greater study area (Figure 7) (Mcdonald, 2017).

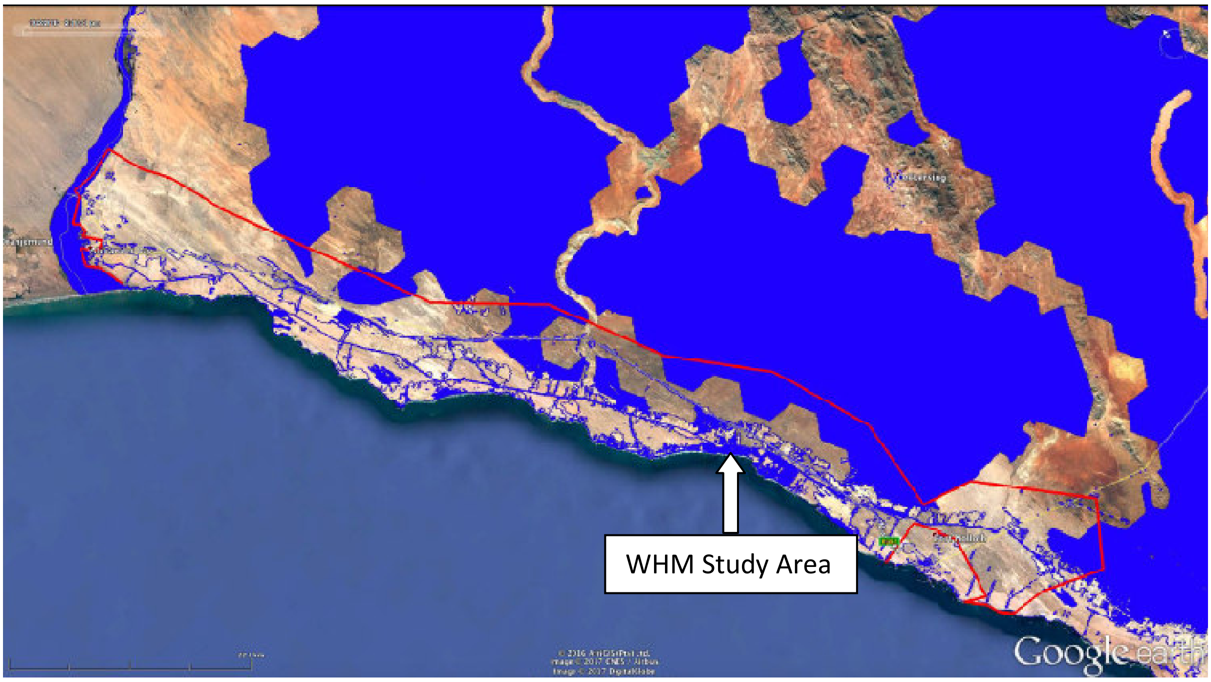

Figure 7: Portion of the Critical Biodiversity Areas (CBAs) map for the Northern Cape Province as it applies to the greater area (Mcdonald,2017).

c. Description of specific environmental features and infrastructure of the site.

Refer to the Baseline Environment section above.

d. Environmental and current land use map.

(show all environmental, and current land use features)

(Refer to Appendix F: Site Plan).

v) Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be mitigated

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated).

Refer to the detailed Impact Assessment (Appendix I).

Summary of potential impacts identified:

1. MARINE ECOLOGY IMPACTS

DIRECT IMPACTS

a. Physical disturbance of benthic habitats

Disturbance and loss of supratidal habitats and associated biota

Impacts associated with the disturbance of supratidal habitats would be of high intensity, but would remain localised around the Walviskop site. Due to the sensitivity of the coastal habitats to disturbance, impacts would persist over the medium- to long term and be only partially reversible. The likelihood of impacts to coastal vegetation and biota is highly probable and any adverse effects on coastal biota are considered of HIGH significance without mitigation and LOW significance with mitigation.

Disturbance and loss of invertebrate macrofauna

Removal and processing of beach sands are an integral part of the mining approach and other than the 'no-go' option, there is no feasible mitigation for these proposed operations. Disturbance of beach habitat adjacent to the mining blocks can, however, be minimised through stringent environmental management and good house-keeping practices. Active rehabilitation involving backfilling of mined out areas and re-structuring of the mining area to resemble the natural beach morphology should be undertaken concurrently with and on completion of mining operations. Significance is MEDIUM without mitigation and VERY LOW with mitigation.

Smothering of benthic biota by discarded tailings

The localised impacts of smothering, burial and loss of intertidal and shallow subtidal benthic communities through tailings discharge and possible beach accretion is considered to be of medium intensity in the tailings discharge area. Impacts are likely to persist over the short-term only as tailings would be redistributed by wave action. Even in the event of localised accretion opposite the discharge point, once discharges have ceased erosion of the accreted beach would occur over the short-term with redistribution of sediments across the length of the beach being facilitated by local rip currents and eddies. Smothering of beach macro fauna by discarded tailings is thus considered to be of LOW significance without mitigation and would be fully reversible. This would reduce to INSIGNIFICANT if tailings are returned to the mined out blocks.

b. Changes in Biophysical Characteristics

On sandy shores, all the sand sources and sinks are linked to one another, thereby forming a coastal sand system that is in a natural state of equilibrium. The removal or addition of sand to such a system can therefore be expected to affects all of the other parts of the system before a new equilibrium is formed. The removal of the heavy mineral component of the sediments at Walviskop is thus highly likely to result in localised changes in the physical characteristics of the impacted beaches, and changes in community structure of invertebrate macro fauna in response to these physical changes can be expected. Such changes are considered to be of medium intensity but limited to the Walviskop beach. Impacts are likely to persist over the short- to medium-term and are thus considered to be of LOW significance without mitigation, reducing to VERY LOW with mitigation.

c. Disturbance of coastal biota by noise

Disturbance and injury to marine biota due to construction noise is thus deemed of medium intensity within the immediate vicinity of the construction sites, with impacts persisting over the very short-term only. Whereas noise impacts on shorebirds are possible, fish and marine mammals in the area are unlikely to be affected. The impact of noise is therefore considered INSIGNIFICANT.

d. Accidents and Emergencies

A highly localised operational spill in the supratidal and intertidal would thus be of medium to high intensity in the short term. Small operational spills onshore are considered highly probably, but in most cases the impacts on biota can be considered of LOW significance before mitigation, reducing to INSIGNIFICANT with mitigation. Should they occur, impacts would be fully reversible.

INDIRECT IMPACTS

d. Increased water turbidity and reduced light penetration

Due to the transient nature of suspended sediment plumes, the potential impacts are considered to be of low intensity, persisting only over the very short term (hours to days), and would be localised (<2 km radius of the mine site). Any possible adverse effects on sessile benthos, or on the feeding, spawning and recruitment of mobile predators, will be fully reversible. The biochemical impact of reduced water quality through increased turbidity can thus confidently be rated as being INSIGNIFICANT without mitigation. Suspended sediment concentrations within plumes are unlikely to exceed maximum levels periodically occurring naturally along the wave-dominated coastline.

e. Hypoxia

The high wave exposure in combination with the comparatively coarse nature of the beach sediments in the project area make it highly unlikely that hypoxic conditions will develop as a consequence of the tailings discharge. The comparatively coarse sediment will ensure penetrability and flushing rates will remain high. Furthermore, the tailings will likely have a low organic content. The likelihood of hypoxic conditions developing in the discharge area is therefore very low. The potential impacts of hypoxia are considered to be of low intensity and as any effects would persist over the short-term only, they are considered to be of INSIGNIFICANT both without and with mitigation.

f. Sediment mobilisation and redistribution

The impacts associated with the mobilisation and redistribution of sediments during mining and as a consequence of tailings discharges are considered to be of medium intensity and as they would not persist beyond the short term, they are considered to be of MEDIUM significance both without and with mitigation.

g. Impacts on higher-order consumers

Due to recovery over the short-term of the invertebrate communities that serve as a food source for higher-order consumers, the potential impacts are considered to be of low intensity and are thus considered to be INSIGNIFICANT.

NO-DEVELOPMENT ALTERNATIVE

The "no-development" alternative implies that the heavy mineral sands beach mining operation does not go ahead. From a marine perspective this is undeniably the preferred alternative, as all impacts associated with beach disturbance, shoreline changes, loss of biota, unplanned pollution events and indirect sedimentation will not be realised. This must, however, be seen in context with existing mining and exploration rights and sustainability of the associated mines, and thus needs to be weighed up against the potential positive socio-economic impacts undoubtedly associated with accessing the potentially rich placer deposits present in the surf zone.

CUMULATIVE IMPACTS

Although the area of Namaqua Mixed Shore targeted for heavy mineral mining amounts to only a fraction of the total habitat type in the region, the cumulative impact of years of mining by an increasing number or contractors applying progressively modern techniques to locate and access deposits must be kept in mind. Considering the vulnerability of the habitat types in the mining licence area and the decades of uncontrolled and environmentally irresponsible operations these cumulative impacts are considered to be of MEDIUM significance. Detailed records of annual and cumulative areas mined should be maintained by Whale Head Minerals, and submitted to the authorities should future informed decisions need to be made regarding disturbance limits to benthic habitat types in the Namaqua Bioregion.

2. FRESHWATER ECOLOGY

No impacts identified because there are no freshwater resources on or next to the site.

3. AIR QUALITY

a. Impaired human health from increased pollutant concentrations, caused by dust fall, associated with construction and mining activities.

Due to the nature of the mining technology, coastal mining in wet conditions and limited construction activities proposed for the site, the significance of impacts on air quality is LOW and VERY LOW after mitigation.

4. SOCIO-ECONOMIC IMPACTS

a. Investment in and contribution to the economy

The procurement of goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible will have a MEDIUM (+) significant impact on economy.

b. Increased employment, income and skills development

By maximising the use of local skills and resources through preferential employment of locals where practicable, the mine will have HIGH (+) significant impact on local employment.

c. Reduced access to the coast

Although access to the coast will be restricted causing a HIGH significant impact, installing appropriate signage and information regarding coastal access will reduce the significance to LOW.

d. Possible decline of tourism

Due to the proximity of the site to the main access route in the area, the significance of the impact before mitigation is LOW. By installing appropriate screening of construction sites in line with the scenic nature of the area, the significance will be reduced to INSIGNIFICANT.

5. HERITAGE IMPACTS

a. Loss of Heritage Resources

Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further paleontological specialist studies are required, the Fossil Finds Procedure (Appendix D3) must be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

6. VISUAL IMPACTS

a. Altered sense of place and visual intrusion caused by construction activities

Due to the proximity of the site to residential areas and scenic routes, the significance of the impact is deemed LOW before mitigation and VERY LOW after.

b. Altered sense of place from increased traffic during mining

Due to the proximity of the site to residential areas and scenic routes, the significance of the impact is deemed LOW before mitigation and VERY LOW after.

7. TRAFFIC IMPACTS

a. Increased nuisance on existing road users and surrounding residents from mining/construction traffic and road widening

The site is an existing mine with roads and established access points, therefore the additional traffic following established network should not have an impact on other traffic in the area. Due to the proximity of the site to residential areas and scenic routes, the significance of the impact is deemed LOW before mitigation and VERY LOW after**.**

8. GEOTECHNICAL IMPACTS

No impacts identified.

9. SOIL AND LAND CAPABILITY

a. Soil erosion caused by operational activities

Mining activities will mostly occur within the beach area. Due to the nature of the mining technology, the significance of the mining activity is LOW before and VERY LOW after mitigation. The impact associated with the widening of the road will have a MEDIUM significance before and LOW significance after mitigation.

b. Soil compaction caused by hauling

The impact associated with hauling will have a MEDIUM significance before and LOW significance after mitigation.

c. Soil chemical pollution from operational activities

The impact associated with pollution will have a MEDIUM significance before and LOW significance after mitigation.

d. Loss of land capability

Due to historic land use (mining) and mining rights associated with the larger study area, the impact associated with land capability will have a LOW significance before and VERY LOW significance after mitigation which entails the rehabilitation of the site.

10. TERRESTRIAL ECOLOGY IMPACTS

The probability is high that mining would affect areas of vegetation that have previously been disturbed (that may or may not have been restored) as well as areas where vegetation might never have been disturbed. Consequently, care is required in all circumstances to limit any negative impacts of mining on the vegetation. The plant communities in these arid ecosystems are fragile and take a long time to restore therefore the impact footprint must be kept to a minimum.

A number of studies concerning rehabilitation have been carried out in the Alexander Bay Mining Complex (Mcdonald, 217) One of the most important principles identified is that maximum retention of natural vegetation is fundamental in any rehabilitation programme.

Owing to the highly arid environment in which the mining project would take place, any disturbance (removal or trampling of vegetation) would take a long time to remedy. This is the principle reason for a precautionary approach whereby the habitat is disturbed as little as possible while still permitting the necessary activities for successful mining.

Apart from possible (probable) removal of vegetation at the mining site the other major anticipated negative impact would be unavoidable compaction of the soil. Taking this and other impacts into account, it is proposed that basic restorative be taken at the site.

There would inevitably be negative impacts on the vegetation at the mining site due to vegetation removal or at least disturbance, trampling and soil-compaction. Where mining activities would occur at highly disturbed or transformed areas, the impacts would be Low Negative. This anticipated Low Negative impact could be mitigated by restorative intervention with the residual impact then being Very Low Negative.

vi) Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks

(Describe how the significance, probability, and duration of the aforesaid identified impacts that were identified through the consultation process was determined in order to decide the extent to which the initial site layout needs revision).

Refer to **Section j** for the detailed methodology used for the assessment of the significance of potential environmental impacts in the EIA. This methodology allows for the identified potential impacts to be analysed in a systematic manner, with significance rating (from insignificant to very high) assigned to each potential impact. The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The criteria used to determine impact consequence include extent, intensity and duration of the impact and are presented in the attachment.

vii) The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected.

(Provide a discussion in terms of advantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties).

Refer to Section v above.

viii) The possible mitigation measures that could be applied and the level of risk.

(With regard to the issues and concerns raised by affected parties provide a list of the issues raised and an assessment/discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered)

Refer to Appendix I for detailed description of proposed mitigation measures.

ix) Motivation where no alternative sites were considered

Diamonds have been actively mined in the Alexkor Licence Areas since 1928. Historical mining areas associated with the marine Mining Rights and future targets show that the Walviskop area has been actively mined on an ongoing basis since 2004. During the amendment process of the Alexkor Environmental Management Programmes for Mining Rights 554MRC, 10025MRC, 512MRC and 513MRC (SLR 2018), the Walviskop pocket beach, was identified as a future mining target and was included as part of Alexkors Mining Works Plan.

The Walviskop target falls within Alexkor's Mining Right 554MRC. Mining operations at Walviskop have focused on the surf zone using primarily shore-based diver-assisted dredge pumps (walpompe) and to a lesser extent vessel-based diver-assisted dredge pumping in slightly deeper water. Beach mining using heavy earth-moving equipment has taken place during at least two mining campaigns since 2013.

The proposed site was selected based on extensive research and also following on information from previous prospecting activities in the area. This area has been extensively mined for diamonds during the past 90 years by Alexkor and its predecessor the State Alluvial Diggings. This development resulted directly in the establishment of good infrastructure with two large well serviced towns accommodating some 15 000 inhabitants. Many of these inhabitant are directly dependant on the jobs provided by the mine or service industries to the mine.

x) Statement motivating the alternative development location within the overall site.

(Provide a statement motivating the final site layout that is proposed)

No alternative location within the site has been assessed.

i) Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan)) through the life of the activity.

(including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (ii) an assessment of the significance of each issue and risks and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.)

Refer to Section j below.

j) Assessment of each identified potentially significant impact and risk

A . IMPACT ASSESSMENT METHODOLOGY:

Rating	Definition of Rating
***Intensity** – establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment*	
Zero to Very Low	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected.
Low	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable.
Medium	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way.
High	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease.
***Duration** – the time frame over which the impact will be experienced*	
Short-term	<5 years
Medium-term	5 – 15 years
Long-term	>15 years, but where the impact will eventually cease either because of natural processes or by human intervention

Rating	Definition of Rating
Permanent	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient
***Extent** – defines the physical extent or spatial scale of the impact*	
Local	Extending only as far as the activity, limited to the site and its immediate surroundings
Regional	Impacts are confined to the region; e.g. coast, basin, etc
National	Impact is confined to the country as a whole.
International	Impact extends beyond the national scale.
***Reversibility –** defines the potential for recovery to pre-impact conditions*	
Irreversible	Where the impact is permanent
Partially Reversible	Where the impact can be partially reversed
Fully Reversible	Where the impact can be completely reversed
***Probability** – the likelihood of the impact occurring*	
Improbable	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
Possible	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
Probable	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
Definite	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
***Degree of confidence in predictions** – in terms of basing the assessment on available information and specialist knowledge*	
Low	Less than 35 % sure of impact prediction.
Medium	Between 35 % and 70 % sure of impact prediction.
High	Greater than 70 % sure of impact prediction

Using the core criteria above, the consequence of the impact is determined:

***Consequence**– attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*	
VERY HIGH	Impacts could be EITHER: of high intensity at a regional level and endure in the long term; OR of high intensity at a national level in the medium term; OR of medium intensity at a national level in the long term.
HIGH	Impacts could be EITHER: of high intensity at a regional level enduring in the medium term; OR of high intensity at a national level in the short term; OR of medium intensity at a national level in the medium term; OR of low intensity at a national level in the long term; OR of high intensity at a local level in the long term; OR of medium intensity at a regional level in the long term.

***Consequence**– attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*	
MEDIUM	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a national level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a national level in the medium term; OR of low intensity at a regional level in the long term.
LOW	Impacts could be EITHER of low intensity at a regional level, enduring in the medium term; OR of low intensity at a national level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level, enduring in the medium term.
VERY LOW	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low to medium intensity at a local level, enduring in the short term; OR Zero to very low intensity with any combination of extent and duration.
UNKNOWN	Where it is not possible to determine the significance of an impact.

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	**POSSIBLE**	**PROBABLE**	**DEFINITE**
CONSEQUENCE	**VERY LOW**	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

***Nature of the Impact** – describes whether the impact would have a negative, positive or zero effect on the affected environment*	
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect

Type of impacts assessed:

Type of impacts assessed	
Direct (Primary)	Impacts that result from a direct interaction between a proposed project activity and the receiving environment.
Secondary	Impacts that follow on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway.
Cumulative	*Additive*: impacts that may result from the combined or incremental effects of future activities (i.e. those developments currently in planning and not included as part of the baseline); and
	In-combination: impacts where individual project-related impacts are likely to affect the same environmental features. For example, a sensitive receptor being affected by both noise and drill cutting during drilling operations could potentially experience a combined effect greater than the individual impacts in isolation.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance of residual impacts after Mitigation - *considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures*	
Very Low; Low	Activity could be authorised with little risk of environmental degradation.
Medium	Activity could be authorised with conditions and inspections.
High	Activity could be authorised but with strict conditions and high levels of compliance and enforcement.
Very High	Potential fatal flaw

B – IMPACT ASSESSMENT

1. IMPACTS ON MARINE ECOLOGY

Beaches are highly attractive to a wide variety of human use, ranging from recreational pedestrian traffic, through large-scale beachfront developments to intensive seawall mining as practiced in southern Namibia. All of these activities, as well as storm events and other natural processes, can alter the physical characteristics of the beaches resulting in temporary or permanent alterations in faunal communities inhabiting them (McLachlan *et al.* 1994; Defeo & Alava 1995; Alonso *et al.* 2002; Borges *et al.* 2002; Brown & McLachlan 2002; Gomez-Pina *et al.* 2002). Such changes may alter the manner in which beaches function as an interface between the marine and terrestrial environments, either in terms of their physical behaviour or their role in nutrient cycling. The magnitude of the impact depends on an interactive balance between the relative sensitivity of particular beaches to physical disturbance and the degree of anthropogenic disturbance imposed.

The most sensitive part of the littoral active zone is the fore-dune area, which is the beach/dune interface (Brown & McLachlan 2002). Fore or primary dunes (the small sparsely vegetated dunes just above the drift line), as well as the stabilised, large secondary dunes, are a transition zone between the physically and biologically different terrestrial habitats, and surf-zone processes. As this specialist report focuses on the intertidal beach area below the high water mark, the dune/cliff area falls outside of the scope of this study.

Certain beaches are comparatively sheltered and naturally undisturbed, and their faunal communities are typically sensitive to anthropogenic physical disturbance. In contrast, other beaches are exposed to substantial natural environmental disturbance (wind, wave and tidal impacts), and they and their faunal communities are robust to such disturbance (Brown & McLachlan 2002). Sandy beaches facing open oceans are highly dynamic and their associated faunal communities naturally variable, particularly over short to medium time frames (tidal cycles, storm events, seasons or inter-annual weather changes) (McLachlan 1980; Souza & Gianuca 1994; Calliari *et al.* 1996). On such dynamic beaches, it is often difficult to identify trends in beach faunal community structure over and above natural variation, particularly those due to anthropogenic disturbance.

A number of environmental issues of concern have been raised around the mining of coastal heavy mineral deposits both in South Africa (Biccard *et al.* 2018) and in other parts of the world (Saravanan & Chandrasekar 2010; Chandrasekar *et al.* 2014; Van Gosen et al 2014; Sengupta & Ghosal 2017). These include:

- alteration of coastal topographical features;
- effects on hydrogeology, particularly the depth to the water table;
- effects on indigenous flora and fauna species due to vegetation removal in habitat and wildlife corridors, respectively;
- fragmentation of habitats and alteration of ecological processes;
- crushing and trampling of flora and fauna by heavy vehicle traffic, excavation of sands and stockpiling of plant feed, tailings and/or concentrate;
- effects on soil biota and the seed bank through topsoil stripping;
- effects of tailings disposal onto beaches, into estuaries or wetlands or into mining voids;
- increased turbidity in rivers, estuaries and the marine environment through erosion of sediments in the mining area;
- effects of noise and light pollution, dust, increased heavy transport traffic, disruption of and increased burden on the local infrastructure, air quality; and spread of alien invasive species.

Many of these environmental issues, however, apply primarily to large-scale operations such as Richard's Bay Minerals, Tormin and Namakwa Sands and are not relevant to a much smaller-scale, localised operation such as that proposed by Whale Head Minerals.

Nonetheless, the proposed mining of heavy mineral sands at Walviskop may potentially result in a number of direct and indirect impacts on the marine biota of the beach itself, as well as those in adjacent marine habitats. More specifically, these include:

- Disturbance and alteration of supra-tidal habitats and loss of associated dune and coastal vegetation and biota through crushing and compacting by vehicles and heavy equipment, trampling by personnel and loss of terrestrial resources through illegal plant collection;
- Crushing of invertebrate beach macro-fauna through heavy vehicle traffic, plant infrastructure and pipelines;
- Disturbance or loss of invertebrate beach macro-fauna through excavation and processing of sands;
- Changes in the sediment particle size distribution on the beach with concomitant changes in beach profile and morpho-dynamic state;
- Changes in invertebrate macro-faunal community composition in response to physical changes in the beach;
- Smothering of invertebrate beach macro-fauna as a consequence of tailings discharges;
- Increased turbidity in the surf-zone opposite the mining site through suspension of sediments and overspill of processing runoff water with potential effects on phytoplankton production and foraging efficiency of higher order consumers;
- Potential indirect impacts on adjacent rocky shores through mobilisation and re-deposition of sediments;
- Habitat deterioration through littering, pollution and accidental spills; and
- Effects on other users of the marine environment as a result of mining operations on the beach.

These potential impacts were evaluated in the light of information from studies on beach mining conducted in southern Namibia, and on the Namaqualand and Western Cape coasts, and from the scientific literature, and in the context of the short-and long-term natural disturbances characterising the near-shore marine environment in the Benguela region.

Marine Ecology Impact Assessment:

a) Destruction and loss of coastal vegetation and biota		
	Without Mitigation	**Assuming Mitigation**
Intensity	High	Medium
Duration	Medium- to Long-term	Medium-term
Extent	Local: limited to the Walviskop area	Local
Consequence	High	Low
Probability	Probable	Probable
Significance	High	Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Partially reversible	
Loss of resources	Medium	
Mitigation potential	Low	
Recommended Mitigation Measures	• Prepare a site- and project-specific Environmental Code of Practice (ECOP) for the Walviskop operation. The ECOP should include specific details for the following aspects: – Environmental considerations (i.e. identification of sensitive receptors) and establishment of no-go areas – Access route(s) to the allocated beach – Extent of mining block and demarcation of the facilities and processing area(s), and refuelling / maintenance areas – Housing keeping: > Use of drip trays under stationary plant and for refuelling and maintenance activities > Use and maintenance of toilet facilities > Bunding of fuel stores > Demarcation of refuelling and maintenance areas	

	– Waste management, including the removal of all facilities, waste and other features established during mining activities – Rehabilitation specification (if necessary), e.g. topsoil management, reshaping, netting, etc. – Establishment of a rehabilitation fund – Monitoring • Use only established tracks and roads to access the allocated pocket beach in order to avoid the creation of new tracks. • Identify and map the required existing tracks and develop a maintenance and rehabilitation program that ensures that necessary tracks are maintained. Permitted tracks are to be marked as such and all duplicate tracks leading to mining site should be closed and rehabilitated. • Avoid the establishment of processing areas within 100 m of the edge of a river channel or estuary mouth. • Locate processing areas as far as possible in previously disturbed areas or areas of least sensitivity. • Limit the processing area and office facilities to the minimum reasonably required and to that which will cause least disturbance to the vegetation and natural environment. The extent of the site should be clearly demarcated (e.g. with droppers). • Do not collect any plants within or around the mining area. • Undertake Environmental Awareness Training to ensure mining personnel are appropriately informed of the purpose and requirements of the EMPr and ECOP. • Before the commencement of any work on site, the contractor's site staff must attend an environmental awareness-training course presented by Environmental Manager/Officer. The contractor must keep records of all environmental training sessions, including names of attendees, dates of their attendance and the information presented to them. • Prior to leaving the mining site, the area must be audited by Environmental Manager/Officer. Only once the Environmental Manager/Officer is satisfied that the area has been suitably cleaned and rehabilitated should the rehabilitations funds be paid back to the contractor.

b) Destruction and loss of intertidal and shallow sub-tidal macro-fauna in unconsolidated sediments		
	Without Mitigation	**Assuming Mitigation**
Intensity	High	Medium
Duration	Short- to Medium-term	Short-term
Extent	Local: limited to the Walviskop beach	Local

Consequence	Medium	Very Low
Probability	Probable	Probable
Significance	Medium	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Medium	
Mitigation potential	Low	
Recommended Mitigation Measures	Removal and processing of beach sands are an integral part of the mining approach and other than the 'no-go' option, there is no feasible mitigation for these proposed operations. Disturbance of beach habitat adjacent to the mining blocks can, however, be minimised through stringent environmental management and good house-keeping practices. Active rehabilitation involving backfilling of mined out areas and re-structuring of the mining area to resemble the natural beach morphology should be undertaken concurrently with and on completion of mining operations. Further recommendations for mitigation include: • Mine target blocks sequentially from the south to north along the beach, rehabilitating mined-out blocks immediately on cessation of mining in that block; • Avoid re-mining of blocks, and the target beach as a whole in the medium to long term; • Designate and actively manage specific access, storage and operations areas; • Remove all equipment on completion of activities; and • Flatten all remaining tailings heaps on completion of operations.	

c) Smothering of benthic biota by discarded tailings		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Low

Duration	Short-term	Short-term
Extent	Local: limited to the discharge area	Local
Consequence	Very Low	Low
Probability	Probable	Possible
Significance	Low	Insignificant
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	High	
Recommended Mitigation Measures	As far as practicable, return tailings to the mined out blocks to 1) reduce impacts on beach macro-fauna in as yet undisturbed sections of the beach, 2) avoid potential accretion opposite the discharge point, and 3) facilitate rehabilitation of mined out voids.	

d) Changes in community structure in response to alterations in the biophysical characteristics of the beach		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	No mitigation is feasible
Duration	Medium-term	
Extent	Local: limited to the project area	
Consequence	Very Low	
Probability	Probable	
Significance	Low	
Status	Negative	

Confidence	High	
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	None	
Recommended Mitigation Measures	Removal and processing of heavy mineral beach sands and discharge of tailings are all an integral part of the mining approach and other than the 'no-go' option, there is no feasible mitigation for these proposed operations.	

e) Disturbance of coastal biota by noise		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	No mitigation is feasible
Duration	Short-term	
Extent	Local: limited to the project area	
Consequence	Very Low	
Probability	Improbable - Possible	
Significance	Insignificant	
Status	Negative	
Confidence	High	
Nature of Cumulative impact	Due to the remoteness of the area cumulative noise impacts are unlikely	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Low	
Recommended Mitigation Measures	As the noise associated with construction is unavoidable, no direct mitigation measures, other than the no-project	

	alternative, are possible. Impacts can however be kept to a minimum through responsible construction practices.

f) Impacts of an operational spill on intertidal and sub-tidal benthic macro-fauna		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium to High	Very Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Probable	Possible
Significance	Low	Insignificant
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Medium	
Recommended Mitigation Measures	• Seek to reduce the probabilities of accidental and/or operational spills through enforcement of stringent oil spill management systems. These should incorporate plans for emergencies and Environmental Awareness and Spill Training to ensure the contractor and their staff are appropriately informed of how to deal with spills. • Ensure good housekeeping practices are in place. This should include : – Place drip trays under all stationary machinery, – Bunding of all fuel storage areas, – Restrict vehicle maintenance to the maintenance yard area, except in emergencies when the beach area may be used if absolutely necessary – Maintain mining equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled • Refuelling must occur under controlled conditions only.	

g) Impacts of suspended sediments on water column and bottom-water biochemistry (turbidity and light)		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	No mitigation is proposed
Duration	Short-term	
Extent	Local: limited to immediate vicinity of the mining area	
Consequence	Very Low	
Probability	Improbable	
Significance	Insignificant	
Status	Negative	
Confidence	High	
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	None	
Recommended Mitigation Measures	No mitigation measures other than the 'no-go' alternative are possible or deemed necessary for the re-suspension of seabed sediments and the generation of turbid water plumes.	

h) Development of hypoxic sediments		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	No mitigation is proposed
Duration	Short-term: although hypoxic conditions would be transient, their effects on infaunal communities would extend over the short-term	

Extent	Local: limited to area of accretion	
Consequence	Very Low	
Probability	Possible	
Significance	Insignificant	
Status	Neutral: unlikely to vary beyond natural oxygen concentrations	
Confidence	High	
Nature of Cumulative impact	Biota in the Benguela ecosystem have behavioural and physiological mechanisms for coping with this feature of their habitat so cumulative impacts are unlikely	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	None	
Recommended Mitigation Measures	No mitigation measures are possible or deemed necessary.	

i) Sedimentation of intertidal and shallow sub-tidal reefs		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	No mitigation is proposed
Duration	Short term: sediments in the near shore will be continuously re-suspended by wave action, Erosion of accreted sediments on rocky shores on the open coast will occur over the short term	
Extent	Local: extending beyond the boundary of the immediate mining target	
Consequence	Very Low	
Probability	Probable	
Significance	Very Low	
Status	Negative	

Confidence	High	
Nature of Cumulative impact	Cumulative impacts are possible during the life-of-mine	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	None	
Recommended Mitigation Measures	No mitigation is feasible other than the 'no-go' option	

j) Indirect effects on higher-order consumers		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	No mitigation is proposed
Duration	Short-term: as recovery of invertebrate communities that serve as food sources occurs within 2-5 years	
Extent	Local: limited to mining area	
Consequence	Very Low	
Probability	Improbable	
Significance	Insignificant	
Status	Negative	
Confidence	High	
Nature of Cumulative impact	Cumulative impacts are unlikely as being highly mobile, affected species can move to adjacent available feeding grounds	
Reversibility	The impact is fully reversible	
Loss of resources	Low	
Mitigation potential	None	
Recommended Mitigation Measures	No mitigation is feasible other than the 'no-go' option.	

2. IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

k) Visual Impacts - Altered sense of place and visual intrusion caused by mining activities		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Very Low
Duration	Medium-term	Medium-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Probable	Possible
Significance	Low	Insignificant
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	High	
Recommended Mitigation Measures	• Avoid handling and transport of materials which may generate dust under high wind conditions. • Keep site tidy and all activities, material and machinery contained within an area that is as small as possible. • Rehabilitate disturbed areas incrementally and as soon as possible. • Minimise the use of night-lighting. No high mast or spot-light security lighting or up-lighting allowed.	

l) Investment in and contribution to the local economy		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Medium

Duration	Medium-term	Medium-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Possible
Significance	Medium (+)	High (+)
Status	Positive	Positive
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area positive cumulative impacts from heavy minerals mining can be expected	
Reversibility	-	
Loss of resources	-	
Mitigation potential	Medium	
Recommended Mitigation Measures	Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers. If mining continues in the area the economy remains stimulated.	

m) Increased employment, income and skills development		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Medium
Duration	Medium-term	Medium-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Possible
Significance	Medium (+)	High (+)
Status	Positive	Positive
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area positive cumulative impacts from heavy minerals mining can be expected	

Reversibility	-
Loss of resources	-
Mitigation potential	Medium
Recommended Mitigation Measures	• Maximise use of local skills and resources through preferential employment of locals where practicable. • Provide ancillary training to workers on maximising the use of income and training to further future economic prospects, potentially through projects initiated as part of a social upliftment programme. • Due to decline in the diamond mining industry new kinds of mineral mining will help sustain the mining industry in area.

n) Reduced access to the coast		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Possible
Significance	Low	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to the nature of the land use along the coast, insignificant cumulative impacts are expected.	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Low	
Recommended Mitigation Measures	• Install appropriate signage and information regarding coastal access. • Restrict mining activities to the mining footprint. • Install appropriate screening of construction sites (access road expansion) in line with the scenic nature of the area.	

o) Possible decline of tourism		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Possible
Significance	Low	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to the nature of the land use along the coast, insignificant cumulative impacts are expected.	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Low	
Recommended Mitigation Measures	• Install appropriate signage and information regarding coastal access. • Restrict construction activities to the development footprint. • Install appropriate screening of construction sites in line with the scenic nature of the area. • Site is in existing mine area and not part of tourism area.	

p) Traffic Impacts - Increased nuisance on existing road users and surrounding residents from construction traffic and road widening		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Low
Probability	Probable	Possible

Significance	Low	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Medium	
Recommended Mitigation Measures	• Restrict deliveries (if any) to Mondays to Saturdays between the hours of 08h00 and 17h00. • Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc. at the various access points where necessary to inform other road users of construction activities. • Maintain and repair roads damaged by vehicles, in consultation with relevant road authorities. • Schedule road widening of the existing access road during “off season” (low visitor) periods.	

q) Air Quality Impacts - Impaired human health from increased pollutant concentrations associated with mining and processing activities		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Low
Probability	Possible	Possible
Significance	Low	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	

Mitigation potential	Medium
Recommended Mitigation Measures	• Reduce airborne dust through dampening access road with water, where required. • Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes. • Schedule road widening of the existing access road during "off season" (low visitor) periods.

3. IMPACTS ON HERITAGE RESOURCES

Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further paleontological specialist studies are required, the attached Fossil Finds Procedure be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

r) Possible impact on Heritage Resources		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Possible	Possible
Significance	Low	Very Low
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area, minor cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	

Mitigation potential	Medium
Recommended Mitigation Measures	Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further paleontological specialist studies are required, the Fossil Finds Procedure (Appendix D-3) be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

4. IMPACTS ON SOIL AND LAND CAPABILITY

s) Soil erosion caused by road widening		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Possible	Possible
Significance	Low	Insignificant
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Medium	
Recommended Mitigation Measures	• Implement drainage control measures and culverts to manage the natural flow of surface runoff around the infrastructure / plant expansion area.	

t) Loss of land capability (activities above HWM)		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Very Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Probable	Possible
Significance	Low	Insignificant
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Medium	
Recommended Mitigation Measures	Undertake concurrent rehabilitation.	

5. IMPACTS ON TERRESTRIAL ECOLOGY

u) Impact on terrestrial habitat		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Low	Very Low
Probability	Probable	Possible
Significance	Low	Very low

Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Due to decades of coastal mining in the area cumulative impacts from heavy minerals mining can be expected	
Reversibility	Fully reversible	
Loss of resources	Low	
Mitigation potential	Medium	
Recommended Mitigation Measures	• Wherever possible existing roads and tracks should be used. • Designated 'holding areas' or 'storage areas' for equipment should be established in areas where there have been historical high levels of disturbance. No undisturbed or rehabilitated sites should be chosen for this purpose. • Mining area must be cordoned off where possible and work should only take place within the approved mining area. • No access, particularly vehicle access, should be allowed outside designated mining area. • Where possible, plants should not be removed at mining area since they can recover more quickly if not uprooted. • No habitat, undisturbed or rehabilitated, outside designated mining area should be disturbed in any way. • Compaction of the substrate should be avoided as far as possible by keeping within minimum mining activities areas. • Dust control should be exercised.	

6. GEOTECHNICAL IMPACTS

No impacts identified.

7. IMPACTS ON FRESHWATER ECOLOGY

No impacts identified.

8. IMPACT SUMMARY TABLE

Impact	Significance (before mitigation)	Significance (after mitigation)
1. IMPACTS ON MARINE ECOLOGY		
v. Destruction and loss of supra-tidal habitats and associated biota	High	Low
w. Disturbance and loss of intertidal and shallow sub-tidal sandy beach macro-fauna	Medium	Very Low
x. Smothering of benthic biota by discarded tailings	Low	Insignificant
y. Changes in community structure in response to alterations in the biophysical characteristics of the beach	Low	Low
z. Impacts of noise from mining operations on coastal biota	Insignificant	Insignificant
aa. Impacts of an operational spill on intertidal and sub-tidal benthic macro-fauna	Low	Insignificant
bb. Impacts of tailings discharge on water column and bottom-water biochemistry (turbidity and light)	Insignificant	Insignificant
cc. Indirect Impacts of tailings discharges: development of anoxic sediments	Insignificant	Insignificant
dd. Sedimentation of intertidal and shallow sub-tidal reefs	Very Low	Very Low
ee. Impacts of mining operations on higher-order consumers	Insignificant	Insignificant
2. IMPACT ON SOCIO-ECONOMIC ENVIRONMENT		
ff. Visual Impacts - Altered sense of place and visual intrusion caused by mining activities	Low	Very Low
gg. Investment in and contribution to the local economy	Medium (+)	High (+)
hh. Increased employment, income and skills development	Medium (+)	High (+)
ii. Reduced access to the coast	Low	Very Low
jj. Possible decline of tourism	Low	Very Low

kk. Traffic Impacts - Increased nuisance on existing road users and surrounding residents from construction traffic and road widening	Low	Very Low
ll. Air Quality Impacts - Impaired human health from increased pollutant concentrations associated with mining and processing activities	Low	Very Low
3. IMPACT ON HERITAGE RESOURCES		
mm. Possible impact on Heritage Resources	Low	Very Low
4. IMPACTS ON SOIL AND LAND CAPABILITY		
nn. Soil erosion caused by mining activities	Low	Very Low
oo. Loss of land capability	Low	Very Low
5. IMPACTS ON TERRESTRIAL ECOLOGY		
pp. Impact on terrestrial habitat	Low	Very Low
5. GEOTECHNICAL IMPACTS		
No impacts identified.		
6. IMPACTS ON FRESHWATER ECOLOGY		
No impacts identified.		

k) Summary of specialist reports

(This summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form)

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATION THAT HAVE BEEN INCLUDED IN THE EIA REPORT (MARK WITH AN X WHERE APPLICABLE)	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED
Marine Ecology Impact Assessment	Environmental management actions for implementation in Whale Head Minerals's Environmental Management Plan should focus on the following aspects to be considered prior to, during and on cessation of mining activities in an area: • 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. • 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. • To prevent degradation of the sensitive high-shore beach areas, all activities must be managed according to a strictly enforced Environmental Management Plan. High safety standards and good house-keeping must form an integral part of any operations on the shore from start-up, including, but not limited to: – drip trays and bunding under all vehicles and equipment on the shore where losses are	**x**	**Refer to Section B of this report.**

	likely to occur; – no vehicle maintenance or refuelling on shore; – accidental diesel and hydrocarbon spills to be cleaned up accordingly; and – collect and dispose polluted soil at appropriate bio-remediation sites. • To avoid unnecessary disturbance of communities and destruction of habitats, heavy vehicle traffic in the high- and mid-shore must be limited to the minimum required, and must be restricted to clearly demarcated access routes and operational areas only. The operational footprint of the mining site should be minimised as far as practicable. • Initiate restoration and rehabilitation as soon as mining is complete in an area. This should involve back-filling excavations using tailings and discards and restoring the beach profile to that resembling the pre-mining situation. No accumulations of tailings should be left above the high water mark. • On cessation of operations, all mining equipment, artificial constructions or beach modifications created during mining must be removed from above and within the intertidal zone. • Possible ways of minimising the risk of cumulative impacts are provided below, but the feasibility of these is uncertain and should be weighed up against the apparent robustness of the beach macro-faunal communities to large-scale and long-term disturbance: – Compile the mine plan in close collaboration with Alexkor so that areas are mined concurrently rather than in succession; – Areas previously mined by Alexkor should not be re-mining for heavy mineral sands within 5 years of Alexkor's operations ceasing in that section of the beach; or – The 'no-development' option.		
Heritage Screener	Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact	**x**	**Refer to Section B of this report.**

	significant archaeological heritage. Furthermore it is recommended that, while no further palaeontological specialist studies are required, the Fossil Finds Procedure be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.		
Terrestrial Ecology (desktop study, Mcdonald, 2017)	Wherever possible existing roads and tracks should be used. Designated 'holding areas' or 'storage areas' for equipment should be established in areas where there have been historical high levels of disturbance. No undisturbed or rehabilitated sites should be chosen for this purpose. Mining area must be cordoned off where possible and work should only take place within the approved mining area. No access, particularly vehicle access, should be allowed outside designated mining area. Where possible, plants should not be removed at mining area since they can recover more quickly if not uprooted. No habitat, undisturbed or rehabilitated, outside designated mining area should be disturbed in any way. Compaction of the substrate should be avoided as far as possible by keeping within minimum mining activities areas. Dust control should be exercised.		

Attach copies of Specialist Reports as appendices

Refer to Appendix D for all specialist reports.

l) Environmental impact statement

(i) Summary of the key findings of the environmental impact assessment

The main marine impacts associated with the proposed mining activities are related to disturbance and loss of sandy and rocky habitats and their associated benthic flora and fauna in the mining footprint. From the results of past studies, it is now well established that mining in the intertidal zone of sandy beaches severely influences the diversity and community structure of the invertebrate macrofauna of the beach itself, and potentially the benthic biota of adjacent rocky intertidal and shallow sub tidal habitats as well. However, as removal and treatment of beach sediments are an unavoidable consequence of the proposed mining, there can be no direct mitigation for their impacts on marine biological communities. Other than the 'no go' option, the impacts to the intertidal and shallow sub tidal marine biota are thus unavoidable should mining go ahead. As mining operations have been ongoing along this section of the coast for decades, however, the proposed mining target cannot be considered particularly 'pristine'. Nonetheless, from a marine perspective the 'no go' option is undeniably the preferred alternative, as all impacts associated with the disturbance of beach and rocky habitats would no longer be an issue.

The highly localised, yet significant impacts of heavy minerals mining in the Walviskop pocket beach will endure over the short- to medium term, and these impacts thus need to be weighed up against the benefits of the mining project. Provided the impacts are meticulously managed and pro-active rehabilitation is undertaken as far as is feasible in the coastal environment, there is no reason why the proposed mining of the heavy mineral sands at Walviskop should not go ahead.

The potential environmental impacts associated with the proposed WHM Mine project considered in the BAR process include soil and land capability, air quality, noise, groundwater, marine ecology, freshwater ecology, terrestrial ecology, socio-economic, heritage, visual, traffic and geotechnical impacts. Assuming that the recommended mitigation measures will be effectively implemented, the proposed mine is not projected to have unacceptably significant adverse impacts, while socio-economic benefits are noteworthy.

The impacts associated with the WHM Mine are considered to be acceptable.

A number of mitigation and monitoring measures have been identified to avoid, minimise and manage potential environmental impacts associated with the proposed mine. These are further laid out in the EMPr.

Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further palaeontological specialist studies are required, the Fossil Finds Procedure be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

(ii) Final Site Map

Refer to Appendix H**.**

(iii) Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives

Refer to Section j.

m) Proposed impact management objectives and the impact management outcomes for inclusion in the EMPr

Based on the assessment and where applicable the recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as condition of authorisation

n) Aspects for inclusion as conditions of authorisation

Any aspects which must be made conditions of the Environmental Authorisation

All identified management and mitigation measures have been included in the EMPr.

o) Description of any assumptions, uncertainties and gaps in knowledge

(Which relate to the assessment and mitigation measures proposed)

It is assumed that the description of the proposed project, provided by the applicant is sufficient for providing the authorities with the right information for understanding the proposed project.

It is assumed that the public consultation process to be undertaken as part of the Environmental Impact Assessment (EIA) will suffice and that the application will be soldiered objectively based on stakeholders' response to the proposed activities.

p) Reasoned opinion as to whether the proposed activity should or should not be authorised

i) Reasons why the activity should be authorised or not

This draft BAR Report has identified and assessed the potential biophysical and socio-economic impacts associated with the WHM Mine project.

In terms of Section 31 (n) of NEMA, the EAP is required to provide an opinion as to whether the activity should or should not be authorised. In this section, a qualified opinion is ventured, and in this regard PHS believes that sufficient information is available for DMR to take a decision.

The WHM Mine project will result in unavoidable environmental impacts. None of these impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures. In addition, the project will directly and indirectly benefit the local and regional economy. The site is located where previous mining took place as such it will sustain the mining industry in the area.

Working on the assumption that WHM is committed to ensuring that beach mining and the associated processing activities are undertaken to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, PHS believes and the EIA Report demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts of this project can be reduced to levels compliant with national standards or guidelines.

The fundamental decision is whether to allow the development, which brings economic benefits and is generally consistent with development policies for the area, but which may have limited biophysical impacts.

PHS believes that the specialist studies have shown that the WHM Mine extension project is generally acceptable. The BAR has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion PHS is of the opinion that on purely ‘environmental’ grounds (i.e. the project’s potential socio-economic and biophysical implications) the application as it is currently articulated should be approved, provided the essential mitigation measures are implemented. Ultimately, however, the DMR will need to consider whether the project benefits outweigh the potential impacts.

ii) Conditions that must be included in the authorisation

Key recommendations, which are considered essential, are:

- Implement the EMPr to guide construction, operations and closure activities and to provide a framework for the ongoing assessment of environmental performance;

- Appoint an Environmental Control Officer (ECO) to oversee the implementation of the EMPr;
- Implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use existing roads to access this stretch of coast;
- Actively backfill mined beaches and profile the mining area to resemble the natural beach profile;
- Implement the Rehabilitation Plan (**Refer to Appendix J**); and
- Obtain other permits and authorisations as may be required.

q) Period for which the Environmental Authorisation is required

- All non-operational activities (i.e. construction activities (road expansion/platform) will be completed within one (1) year.
- The LoM is anticipated to be ~ 5 years.
- Closure activities will be completed within 1 year.

r) Undertaking

Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic Assessment Report and the EMPr.

An undertaking is provided at the end of this report.

s) Financial Provision

State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.

i) Explain how the aforesaid amount was derived.

A financial provision of approximately, R 665 848.77, which includes rehabilitation activities has been made by Whale Head Minerals. A breakdown of these costs is presented in Appendix J.

ii) Confirm that this amount can be provided for from operating expenditure

(Confirm that the amount is anticipated to be an operating cost and is provided for as such in the Mining work programme. Financial and Technical Competence Report or Prospecting Work Programme as the case may be)

Refer to the MWP (Appendix G) indicating the budget for the mining operation.

t) Specific Information Required by the Competent Authority

Compliance with the provisions of sections 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the NEMA, 1998. The EIA report must include the:

(1) Impact on the socio-economic conditions of any directly affected person.

(Provide the results of investigation, assessment and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as an Appendix).

A full consultation process will be implemented during the environmental authorisation process. The purpose of the consultation is to provide affected persons the opportunity to raise any potential concerns. Concerns raised will be captured and addressed within the public participation section of this report.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

(Provide the results of investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2)(i)(vi) and (vii) of the Act, attach the investigation report as Appendix 2.19.2 and confirm that the applicable mitigation is reflected in 2.5.3: 2.11.6 and 2.12 herein)

Based on the information available, it is unlikely that significant intact archaeological resources remain on the site and as such, it is unlikely that the proposed mining activities will impact significant archaeological heritage. Furthermore it is recommended that, while no further palaeontological specialist studies are required, the attached Fossil Finds Procedure be implemented for the proposed mining activities due to the sensitivity of the fossils that may be impacted by this proposed mining activity.

u) Other matters required in terms of section 24(4)(a) and (b) of the Act.

(The EAP managing the application must provide the competent authority with detailed written proof of an investigation as required by section 24 (4)(b)(i)of the Act and motivation as Appendix 4).

Alternatives have been discussed for this project, as listed above in Section 2 (h)(i). Where alternatives have not be considered for assessment, reasons have been provided in Section 2 (h)(i).

PART B
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1) Draft environmental management programme.

a) Details of the EAP

(Confirm that the requirement for the provision of the details and expertise of the EAP are already included in Part A Section 1(a) herein required.

It is confirmed that the requirements for the provision of the details and expertise of the EAP are already included in PART B, section (1)(h).

b) Description of the Aspects of the Activity

(Confirm that the requirement to describe the aspects of the activity that are covered by the draft EMPr is already included in PART A, Section (1)(h) herein as required).

It is confirmed that the requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in PART B, section (1)(h)

c) Composite Map

(Provide a map (Attached as an Appendix) at an appropriate scale which superimposes the proposed activity, its associated structures on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers).

Please refer to Appendix F for the Composite Map.

d) Description of Impact management objectives including management statements

i) Determination of closure objectives.

(Ensure that the closure objectives are informed by type of environment described)

After mining is completed at the site, it will be rehabilitated to be safe, stable, non-polluting, non-eroded and in a state that is suitable for agreed post-closure land use. A follow-up rehabilitation inspection will follow 3 months after initial work. The site should be monitored over a two-year period for success or otherwise of revegetation (where required). If initially unsuccessful, a second attempt should be carried out.

ii) Volumes and rate of water use required for the operation

Not Applicable. Sea water is used.

iii) Has a water use license has been applied for?

Not Applicable.

iv) Impacts to be mitigated in their respective phases
Measures to rehabilitate the environment affected by the undertaking of any listed activity

ACTIVITIES (E.g. For prospecting – drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc.. E.g. For mining – excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, bers, roads, pipelines, power lines, conveyors, etc…	**PHASE** (of operation in which activity will take place. State; Planning and design, pre-Construction, Construction, Operational, Rehabilitation, Closure, Post closure).	**SIZE AND SCALE** (volumes, tonnages and hectares or m^2)	**MITIGATION MEASURES** (description how each of the recommendations in herein will remedy the cause of pollution or degradation and migration of pollutants)	**COMPLIANCE WITH STANDARDS** (A description of how each of the recommendations herein will comply with any prescribed environmental management standards or practices that have been identified by competent Authorities)	**TIME PERIOD FOR IMPLEMENTATION** Describe the time period when the measures in the EMPr must be implemented. Measures must be implemented when required. With regard to Rehabilitation specifically this must take place at the earliest opportunity, With regard to Rehabilitation, therefore state either:- .. Upon cessation of the individual activity Or. Upon the cessation of mining, bulk sampling or alluvial diamond prospecting as the case may be.
PHASE 1: PLANT AREA AND INFRASTRUCTURE					
Road Works	Planning/construction/operation/closure	200m x7m	Prepare a site- and project-specific Environmental Code of Practice (ECOP) for the Walviskop operation. The ECOP should include specific details for the following aspects: – Environmental considerations (i.e. identification of sensitive receptors) and establishment of no-go areas – Access route(s) to the allocated beach – Extent of mining block and	NEM:BA& ICMA / GN R. 827 (NEM:AQA) / SANS 10103 guideline	Prior to and during mining activity.
Plant Area/ placing of equipment	Planning/construction/operation/closure	$250m^2$			
Above ground seawater pipeline	Planning/construction/operation/closure	250mm diameter			

			demarcation of the facilities and processing area(s), and refuelling / maintenance areas – Housing keeping: > Use of drip trays under stationary plant and for refuelling and maintenance activities > Use and maintenance of toilet facilities > Bunding of fuel stores > Demarcation of refuelling and maintenance areas – Waste management, including the removalof all facilities, waste and other features established during mining activities – Rehabilitation specification (if necessary), e.g. topsoil management, reshaping, netting, etc. – Establishment of a rehabilitation fund – Monitoring Use only established tracks and roads to access the allocated pocket beach in order to avoid the creation of new tracks.		

			Operational and decommissioning activities will be limited to daylight hours on Mondays to Saturdays and no activities on Sundays and public holidays. Identify and map the required existing tracks and develop a maintenance and rehabilitation program that ensures that necessary tracks are maintained. Permitted tracks are to be marked as such and all duplicate tracks leading to mining site should be closed and rehabilitated. Locate processing areas as far as possible in previously disturbed areas or areas of least sensitivity. Limit the processing area and office facilities to the minimum reasonably required and to that which will cause least disturbance to the vegetation and natural environment. The extent of the site should be clearly demarcated (e.g. with droppers). Do not collect any plants within or around the mining area.		

			Undertake Environmental Awareness Training to ensure mining personnel are appropriately informed of the purpose and requirements of the EMPr and ECOP. Before the commencement of any work on site, the contractor's site staff must attend an environmental awareness-training course presented by Environmental Manager/Officer. The contractor must keep records of all environmental training sessions, including names of attendees, dates of their attendance and the information presented to them. Prior to leaving the mining site, the area must be audited by Environmental Manager/Officer. Only once the Environmental Manager/Officer is satisfied that the area has been suitably cleaned and rehabilitated should the rehabilitations funds be paid back to the contractor. Seek to reduce the probabilities of accidental and/or operational spills through enforcement of stringent oil spill management systems. These should		

			incorporate plans for emergencies and Environmental Awareness and Spill Training to ensure the contractor and their staff are appropriately informed of how to deal with spills. • Ensure good housekeeping practices are in place. This should include : – Place drip trays under all stationary machinery, – Bunding of all fuel storage areas, – Restrict vehicle maintenance to the maintenance yard area, except in emergencies when the beach area may be used if absolutely necessary – Maintain mining equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled • Refuelling must occur under controlled conditions only.		
PHASE 2: Mining Operation					
Beach material pumped	Planning/construction/operation/closure	5ha	Mine target blocks sequentially from the south to north along the beach, rehabilitating mined-out blocks immediately on cessation of mining in that block. Avoid re-mining of blocks, and the target	NEMA ICMA	During mining operation

			beach as a whole in the medium to long term. Designate and actively manage specific access, storage and operations areas. Remove all equipment on completion of activities. Flatten all remaining tailings heaps on completion of operations. Noise levels to be minimised by responsible mining practices.		
PHASE 3: Processing					
Wet Concentrator Plant	Planning/construction/operation/closure	260t/h	See Phase 1.		Operation
PHASE 4: Waste Disposal					
Sand and oversize gravel fraction tailings from the WCP is considered waste returned to the surf zone by means of gravity flow	Operation	Approximately 26 t/h (90% of sediment received at WCP)	As far as practicable, return tailings to the mined out blocks to 1) reduce impacts on beach macro-fauna in as yet undisturbed sections of the beach, 2) avoid potential accretion opposite the discharge point, and 3) facilitate rehabilitation of mined out voids.		Operation
Phase 5: Stockpile and removal of heavy minerals					
Heavy Mineral stockpile	Operation	35 000t with a frequency of removal	Restrict vehicle movements to haul roads.		Operation

		of 4 x 34t loads daily.	Place drip trays under all stationary vehicles. Bunding of all fuel storage areas. Restrict vehicle maintenance to the maintenance yard area, except in emergencies when the beach area may be used if absolutely necessary.		
Phase 6: Closure					
Rehabilitation	Closure	5ha	In accordance with closure plan.	MPRDA/NEMA	Closure

e) Impact Management Outcomes

(A description of impact management outcomes, identifying the standard of impact management for the aspects contemplated in paragraph):

ACTIVITY (whether listed or not listed) E.g. Excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc..)	**POTENTIAL IMPACT** (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc…)	**ASPECTS AFFECTED**	**PHASE** In which impact is anticipated (e.g. Construction, commissioning, operational, decommissioning, closure, post-closure)	**MITIGATION TYPE** (modify, remedy, control, or stop) through (e.g. noise control measures, storm water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc.) E.g. 1. Modify through alternative method 2. Control through noise control 3. Control through management and monitoring 4. Remedy through rehabilitation	**STANDARD TO BE ACHIEVED** (Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc.)
PHASE 1: Plant area and infrastructure	Cultural and Heritage	Destruction or loss of Cultural and Heritage Resources	Construction	A Fossil Finds Procedure to be implemented.	Avoid impact and ensure very low levels of impact
	Noise	Noise causing nuisance	Construction/Operation	Activities will be limited to daylight hours on Mondays to Saturdays and no activities on Sundays and public holidays.	Minimise intensity of impact
	Visual; Traffic & Dust	Increased activity on site/ increased traffic and dust	Construction/Operation	Respect landowner/operators needs to avoid visual intrusion and stay within the mine area; Obey traffic signs around the site; Vehicles to adhere to local speed	Avoid and minimise impacts and disturbance. The operation will be in mine area only therefore mine rules apply.

				limits as far as possible when driving in and around site	
	Soil/Fauna/Flora	Soil erosion/destruction or disturbance of fauna and flora habitat	Construction/Operation	Soil & vegetation disturbance and clearance of vegetation at mine areas will be limited to the absolute minimum required; Avoid surface vegetation clearance to leave the roots intact so that vegetation can coppice and re-grow; Use existing tracks as far as possible; No driving on the beach outside mine area and access road; If any animals are encountered they must not be killed or injured, but should rather be removed or chased away from the site; Implement rehabilitation plan (Appendix J).	NEM:BA& ICMA; avoid sensitive feature
	Social	Conflict with landowners and	Construction /operation	All mining personnel will be made aware of the local conditions and	Avoid impacts

		mine operators	/closure	sensitivities in the mine area.	
	Marine	Impact on marine ecology	Construction /operation /closure	Prepare a site- and project-specific Environmental Code of Practice (ECOP) for the Walviskop operation. Use only established tracks and roads to access the allocated pocket beach in order to avoid the creation of new tracks.	Avoid and minimise impacts.
PHASE 2: Mining Operation Pumping of beach material	Marine	Impact on Marine ecology	Operation	Mine target blocks sequentially from the south to north along the beach, rehabilitating mined-out blocks immediately on cessation of mining in that block. Avoid re-mining of blocks, and the target beach as a whole in the medium to long term. Designate and actively manage	Avoid and minimise impacts

				specific access, storage and operations areas. Remove all equipment on completion of activities. Flatten all remaining tailings heaps on completion of operations. Noise levels to be minimised by responsible mining practices.	
PHASE 3: Processing	Refer to phase one above.				
PHASE 4: Waste Disposal	Marine	Impact on Marine Ecology	Operation	As far as practicable, return tailings to the mined out blocks to 1) reduce impacts on beach macro-fauna in as yet undisturbed sections of the beach, 2) avoid potential accretion opposite the discharge point, and 3) facilitate	Avoid and minimise impacts

				rehabilitation of mined out voids.	
PHASE 5: Stockpile and removal of heavy minerals	Marine	Impact on Marine Ecology	Operation	Restrict vehicle movements to haul roads. Place drip trays under all stationary vehicles. Bunding of all fuel storage areas. Restrict vehicle maintenance to the maintenance yard area, except in emergencies when the beach area may be used if absolutely necessary.	Avoid and minimise impacts
PHASE 6: Closure	Refer to Phase 1 Impacts.				

f) Impact Management Outcomes

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

ACTIVITY (whether listed or not listed) E.g. Excavations, blasting, stockpiles, discard dumps or dams, loading, hauling and transport, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc..)	**POTENTIAL IMPACT** (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc…)	**MITIGATION TYPE** modify, remedy, control, or stop) through (e.g. noise control measures, storm water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc.) E.g. 1. Modify through alternative method 2. Control through noise control 3. Control through management and monitoring 4. Remedy through rehabilitation	**TIME PERIOD FOR IMPLEMENTATION** Describe the time period when the measures in the environmental management programme must be implemented. Measures must be implemented when required. With regard to Rehabilitation specifically this must take place at the earliest opportunity. With regard to rehabilitation, therefore state either: - Upon cessation of the individual activity or Upon the cessation of mining, bulk sampling or alluvial diamond prospecting as the case may be.	**COMPLIANCE WITH STANDARDS** (A description of how each of the recommendations in 2.11.6 read with 2.12 and 2.15.2 herein will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
PHASE 1: Plant area and infrastructure	Cultural and Heritage	A Fossil Finds Procedure to be implemented.	Construction/Operation	Adhere to the Heritage Act and the recommendations from Heritage Specialist.

	Noise Impact	Activities will be limited to daylight hours on Mondays to Saturdays and no activities on Sundays and public holidays.	Construction/Operation	SANS 10103 guideline and acceptable for the mine operations
	Visual; Traffic & Dust	Respect landowner/operators needs to avoid visual intrusion and stay within the mine area; Obey traffic signs around the site; Vehicles to adhere to local speed limits as far as possible when driving in and around site	Construction/Operation	Mine rules and acceptable to the mine operators
	Soil/Fauna/Flora	Soil & vegetation disturbance and clearance of vegetation at mine areas will be limited to the absolute minimum required; Avoid surface vegetation clearance to leave the roots intact so that vegetation can coppice and re-grow; Use existing tracks as far as possible; No driving on the beach outside mine area and access road; If any animals are encountered they must not be killed or injured, but should rather be removed or chased away from the site; Implement rehabilitation plan (Appendix J).	Construction/Operation	NEM:BA & ICMA, limit new disturbance try stay within existing disturbed mine footprint.
	Social	All mining personnel will be made aware of the local conditions and sensitivities in the mine area	Construction /Operation /Closure	Mine rules
	Marine	Prepare a site- and project-specific Environmental Code of Practice (ECOP) for the Walviskop operation. Use only established tracks and roads to access the allocated pocket beach in order to avoid the creation of new tracks.	Construction /Operation /Closure	ICMA, adhere to Marine Ecologist recommendations.

PHASE 2: Mining Operation Pumping of beach material	Marine	Mine target blocks sequentially from the south to north along the beach, rehabilitating mined-out blocks immediately on cessation of mining in that block. Avoid re-mining of blocks, and the target beach as a whole in the medium to long term. Designate and actively manage specific access, storage and operations areas. Remove all equipment on completion of activities. Flatten all remaining tailings heaps on completion of operations. Noise levels to be minimised by responsible mining practices.	Operation	ICMA, adhere to Marine Ecologist recommendations.
PHASE 3: Processing	Refer to phase one above.			
PHASE 4: Waste Disposal	Marine	As far as practicable, return tailings to the mined out blocks to 1) reduce impacts on beach macro-fauna in as yet undisturbed sections of the beach, 2) avoid potential accretion opposite the discharge point, and 3) facilitate rehabilitation of mined out voids.	Operation	ICMA, adhere to Marine Ecologist recommendations.
PHASE 5: Stockpile and removal of heavy minerals	Marine	Restrict vehicle movements to haul roads. Place drip trays under all stationary vehicles. Bunding of all fuel storage areas. Restrict vehicle maintenance to the maintenance yard area, except in emergencies when the beach area may be used if absolutely necessary.	Operation	ICMA, adhere to Marine Ecologist recommendations.

i) Financial Provision

(1) Determination of the amount of Financial Provision

(a) Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under the Regulation.

The closure objectives are to record and communicate the results of the mining programme to the participating stakeholders, and to receive an effective closure certificate should the prospect indicate that the resource(s) would not support a sustainable mining operation.

(b) Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties.

Minimise the area to be disturbed and to ensure that the areas disturbed during the mining activities are rehabilitated and stable, as per the commitments made in the EMPr. Sustain the pre-mining land use, and return the site the state it was found in.

(c) Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure.

After mining has been completed in one area, the mining company will ensure the site is reverted back to its original state by implementing mitigation measures (Refer to Appendix J).

(d) Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.

The Company is required to make the prescribed financial provision for the rehabilitation or management of negative environmental impacts. If the Company fails to rehabilitate or manage any negative impact on the environment, the DMR may, upon written notice to the Company, use all or part of the financial provision to rehabilitate or manage the negative environmental impact in question. The Company will specify that the mining contractor is required to comply with all the environmental measures specified in the EMPr. This will include avoiding unnecessary disturbance of natural vegetation and the rehabilitation of mining site, immediately after mining has been completed. All tracks to the mining site must be rehabilitated at the end of use. The closure objective is to leave the site as it was found. The financial provision provides for the final checking of the site before closure.

(e) Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.

The quantum of the financial provision required is R 665 848.77 The Company must annually update and review the quantum of the financial provision (as per Regulation 54 (2) of the MPRDA). The financial Quantum Calculation is found under Appendix J.

(f) Confirm that the financial provision will be provided as determined.

Please refer to Appendix J for more details on the financial provision for the proposed activity.

Mechanisms for monitoring compliance with and performance assessment against the EMPr and reporting thereon, including

g) **Monitoring of Impact Management Actions**
h) **Monitoring and reporting frequency**
i) **Responsible persons**
j) **Time period for implementing impact management actions**
k) **Mechanism for monitoring compliance**

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY AND TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
PHASE 1: Plant area and infrastructure	Heritage Noise Dust fall Visual Soil & vegetation Social Housekeeping & maintenance Waste management	Weekly inspections will cover the following: - Implementation of effective waste management. - Establish and implement a stakeholder compliant register on-site and ensure that all complaints are responded to promptly. - Ensure that an oil spill kit is readily available. - Ensure that all chemicals and hydrocarbons are stored within bund walls. - Have drip trays on site to avoid soil contamination. - Control and minimise the development of new access tracks.	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO
PHASE 2: Mining Operation	Marine Ecology	Weekly monitoring	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO

PHASE 3: Processing	Housekeeping & maintenance Waste management Noise	Weekly monitoring	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO
PHASE 4: Waste Disposal	Marine Ecology	Weekly monitoring	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO
PHASE 5: Stockpile and removal of heavy minerals	Marine and Terrestrial ecology Dust Noise Traffic	Weekly monitoring	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO
PHASE 6: Closure	Noise Dust fall Visual Soil & vegetation Social Housekeeping & maintenance Waste management	Weekly inspections will cover the following: Establish and implement a stakeholder compliant register on-site and ensure that all complaints are responded to promptly. Ensure that an oil spill kit is readily available. Ensure that all chemicals and hydrocarbons are stored within bund walls. Have drip trays on site to avoid soil contamination. Control and minimise the development of new access tracks.	On-site ECO/ EAP	Weekly inspection and monthly internal reporting to EAP/ECO

l) Indicate the frequency of the submission of the performance assessment/environmental audit report.

Regular monitoring of all the environmental management procedures and mitigation measures shall be carried out by the Company in order to ensure that the provisions of this EMPr are adhered to. Internal monthly reporting will take place and a follow-up report 3 months after rehabilitation. Formal monitoring and performance assessment of the EMPr will be undertaken annually. Site photographs taken before mining commences and after the site has been rehabilitated must be included in the monthly internal report and the performance assessment reports.

m) Environmental awareness Plan

(1) Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.

Environmental awareness training courses will be provided to all personnel on site by the independent EAP/ECO.

The environmental training courses will include, amongst others, aspects such as:

- Awareness training for contractors and employees
- Job specific training – training for personnel performing tasks which could cause potentially significant environmental impacts;
- Comprehensive training – on emergency response, spill management, etc;
- Specialised skills for engagement with mine operations;
- Mine rules and security protocol
- Training verification and record keeping.
- Environmental issues on site;
- Roles and responsibilities;
- The operational environmental management measures;
- Cultural awareness; and
- Heritage discovery procedures (Appendix D-3).

All attendees shall remain for the duration of the course and, on completion, sign an attendance register that clearly indicates participants' names. A copy of the register shall be kept on record.

(2) Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.

All employees must be provided with environmental awareness training to inform them of any environmental risks and security protocols which may result from their work and the manner in which the risks must be dealt with in order to avoid pollution or the degradation of the environment. This should be in conjunction with the implementation of the EMPr.

n) Specific information required by the Competent Authority

(Among others, confirm that the financial provision will be reviewed annually).

Not applicable at this stage but as part of the annual audit the financial provision will be reviewed.

2) UNDERTAKING

The EAP herewith confirms

a) the correctness of the information provided in the reports ☒

b) the inclusion of comments and inputs from stakeholders and I&APs ;☒

c) the inclusion of inputs and recommendations from the specialist reports where relevant;☒and

d) that the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected. parties are correctly reflected herein.☒

Signature of the environmental assessment practitioner

PHS Consulting

May 2020

Date:

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