Extension of Tormin Mine, West Coast, South Africa

Scoping Report

Report Prepared for

Mineral Sands Resources (Pty) Ltd

Report Number 507228/1A

Report Prepared by

srk consulting

April 2018

Extension of Tormin Mine, West Coast, South Africa

Scoping Report

Mineral Sands Resources (Pty) Ltd

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SRK Project Number 507228

April 2018

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Note:

In January 2017, MSR applied for Environmental Authorisation (EA) for the proposed extension of Tormin Mine through an Environmental Impact Assessment (EIA) process, as required in terms of the National Environmental Management Act 107 of 1998 (NEMA). SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed to undertake the EIA process (DMR Reference Number: WC 30/5/1/2/2 MR).

A draft Scoping Report (SRK Report No. 507228/2, dated April 2017) was released for stakeholder comment in April 2017 and updated at the end of the comment period to produce a Final Scoping Report, which was submitted to the Department of Mineral Resources (DMR) in June 2017. On 22 November 2017, DMR refused the EA at the Scoping Phase, citing the undertaking of a section 24G (s24G) process in terms of NEMA for the rectification of unlawful activities.

MSR appointed SRK to undertake the s24G application process (to rectify the unlawful activities), in terms of NEMA and Regulations 698 of 2017. The unlawful activities requiring rectification were identified in an EMPr Performance Assessment of Tormin Mine conducted by Jomela Consulting (Pty) Ltd in January/February 2018, as follows:

- *Clearing of an additional 3.9 ha area adjacent to and inland of the processing (plant) facilities, to be (and now) used for stockpiling; and*
- *Construction of a 2.2 ha dam south-east of the processing facilities, with total associated vegetation clearance (including the dam) of 4.1 ha (of which 1.9 ha is under rehabilitation).*

In response to the preliminary advertisement notifying stakeholders of the s24G application, some stakeholders allege that other activities commenced unlawfully; however, the EMPr Performance Assessment only identifies two activities, which are the subject of the s24G application that has been submitted to DMR.

A new application for EA for the proposed extension of Tormin Mine has now been submitted. ***This Scoping Report****, which forms part of the new EIA process,* ***is largely the same as the Scoping Report dated April 2017 and previously released for stakeholder comment.***

Updates to this Scoping Report (vis-a-vis the April 2017 Scoping Report) are based on and/or incorporate certain:

- *Stakeholder comments;*
- *Preliminary findings of draft specialist studies (specialist studies will be provided in the EIA Report); and*
- *Refinements to the project description since April 2017,*

Changes are indicated in italics and underlined font for easier reference.

EXECUTIVE SUMMARY: SCOPING REPORT

EXTENSION OF TORMIN MINE, WEST COAST, SOUTH AFRICA

NOTE:

In January 2017, MSR applied for Environmental Authorisation (EA) for the proposed extension of Tormin Mine through an Environmental Impact Assessment (EIA) process, as required in terms of the National Environmental Management Act 107 of 1998 (NEMA). SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed to undertake the EIA process (DMR Reference Number: WC 30/5/1/2/2 MR). On 22 November 2017, the Department of Mineral Resources (DMR) refused the EA at the Scoping Phase, citing the undertaking of a section 24G (s24G) process in terms of NEMA for the rectification of unlawful activities. MSR appointed SRK to undertake the s24G application process, which was initiated in March 2018.

A new application for EA for the proposed extension of Tormin Mine has now been submitted. This Scoping Report, which forms part of the new EIA process, is largely the same as the Scoping Report dated April 2017 and previously released for stakeholder comment. Changes are indicated in italics and underlined font for easier reference.

1 INTRODUCTION

Mineral Sand Resources (Pty) Ltd (MSR) owns and operates the Tormin Mineral Sands Mine (Tormin Mine) on the West Coast of South Africa, near Lutzville. The mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, and an approved Environmental Management Programme (EMPr) to mine Valuable Heavy Minerals (VHM) on beaches below the high-water mark adjacent to Farm Geelwal Karoo 262.

MSR proposes to extend mining operations at Tormin Mine in terms of Section 102 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA), into the following areas (the "project") (Figure 2, Figure 3 and Figure 4):

- Ten beaches adjacent to Remainder of Graauw Duinen 152, and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline north of Tormin Mine comprising 43.7 ha mining and 2.1 ha beach access road widening;
- Inland *"Strandline"* mining area on the Farm Geelwal Karoo 262, *inland of the existing Processing Plant*, comprising 75 ha mining; and
- An infrastructure */ plant* expansion area of ~*64* ha adjacent to the existing Processing Plant *to accommodate additional processing plants, stockpile areas, process water dams, industrial yards, parking and laydown areas*.

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by MSR to undertake the Scoping and Environmental Impact Reporting (S&EIR, also referred to as an EIA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA). The EIA process is being undertaken in accordance with Section 21 of the EIA Regulations, 2014. Current mining activities at Tormin Mine are not assessed in the EIA.

See page 10 for details on how you can participate in the process.

2 GOVERNANCE FRAMEWORK

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an EA issued by the competent authority, in this case, the DMR. The EIA Regulations, 2014 (Government Notice (GN) R982)[1], promulgated in terms of NEMA, govern the process, methodologies and requirements for the undertaking of EIAs in support of EA applications. The EIA Regulations are accompanied by Listing Notices (LN) 1-3 that list activities that require EA.

The EIA Regulations, 2014, lays out two alternative authorisation processes. Depending on the type of activity that is proposed, either a Basic Assessment (BA) process or an S&EIR process is required to obtain EA. LN 1 lists activities that require a BA process, while LN 2 lists activities that require S&EIR. LN 3 lists activities in certain sensitive geographic areas that require a BA.

SRK has determined that the proposed project triggers activities listed in terms of LN 1, LN 2 and LN 3 of the EIA Regulations, 2014, requiring an EIA. The equivalent activities in terms of the EIA Regulations, 2014, are included in Table 1.

Table 1: Listed activities triggered by the project

No	Description
LN1 (requiring BA)	
9	Development of infrastructure exceeding 1 000 m in length for bulk transportation of water

[1] As amended by GN R327, GN R325 and GN R324 on 7 April 2017.

No	Description
10	Development of infrastructure exceeding 1 000 m in length for bulk transportation of effluent, process water or slimes
12	*The development of dams, infrastructure or structures with a physical footprint of more than 100 square metres within 32 metres of a watercourse*
13	*The development of facilities or infrastructure for the off-stream storage of water with a combined capacity of 50 000 cubic metres or more*
14	*The development and related operation of facilities or infrastructure for the storage and handling of a dangerous good in containers with a combined capacity of 80 cubic metres or more*
16	Development of a desalination plant producing more than 100 m^3 of treated water per day
17	*Development in the sea or littoral active zone in respect of embankments, rock revetments or stabilising structures*
19	Depositing or excavating of material from a watercourse
19A	Depositing or excavating of material from the seashore or the littoral active zone
20	*Any activity that requires a prospecting right*
24	*Development of a road wider than 8 m.*
25	*The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput of more than 2000 but less than 15 000 cubic metres*
28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or game farming on or after 01 April 1998 and where such development will occur outside an urban area and the land to be developed is bigger than 1 hectare*
LN2 (requiring S&EIR)	
6	Any activity requiring a licence or permit for release of emissions or pollution
14	Development of a structure on or along the sea bed
15	Clearance of more than 20 ha of indigenous vegetation
16	The development of a dam with the wall higher than 5 m or surface area of 10 ha or more
17	*Any activity that requires a mining right*
19	*The removal and disposal of minerals contemplated in terms of section 20 of the MPRDA*
26	*Development in the sea or littoral active zone*
LN3 (requiring BA in the sensitive areas)	
4	*Development of a road wider than 4 m in areas containing indigenous vegetation.*
12	Clearance of more than 300 m^2 of indigenous vegetation in sensitive areas

Consequently, the proponent is obliged to apply for EA for the project. Since activities listed under Regulation GN R984 apply to the project, an S&EIR process is required.

In addition to EA, various other key authorisations, permits or licences might be required before the project may proceed (see Table 2).

Table 2: Key authorisations, permits and licences

Application	Authority
Waste Management Licence	DMR
Heritage Application	Heritage Western Cape
Water Use Authorisation	Department of Water and Sanitation
Coastal Waters Discharge Permit; and Dumping Permit	National Department of Environmental Affairs: Oceans and Coasts

3 ENVIRONMENTAL PROCESS

The EIA Regulations, 2014, define the detailed approach to the S&EIR process, which consists of two phases: the Scoping Phase (the current phase) and the Impact Assessment Phase (see Figure 1).

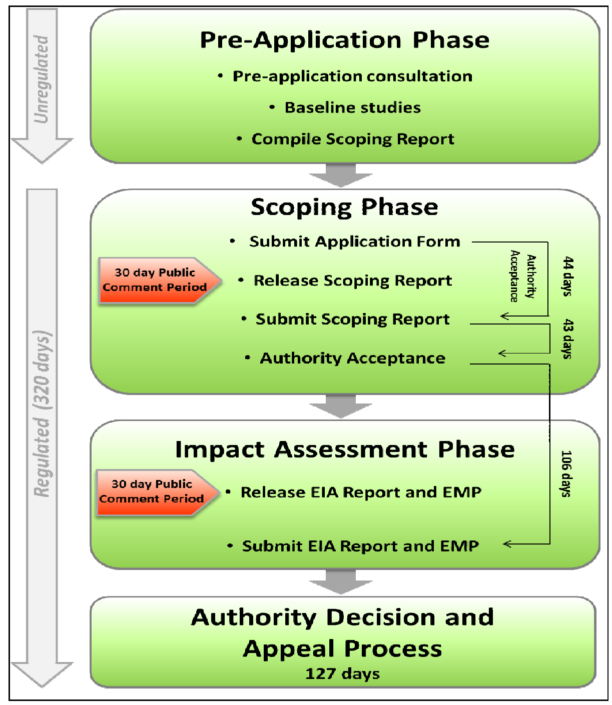

Figure 1: S&EIR Process

***Note:** *EMP = Environmental Management Programme*

The objectives of the Scoping Phase are to:

- Identify stakeholders and inform them of the proposed activity, feasible alternatives and the S&EIR process;
- Describe the affected environment and potential environmental issues and benefits arising from the proposed project that may require further investigation in the Impact Assessment Phase;
- Develop terms of reference for specialist studies to be undertaken in the Impact Assessment Phase;
- Provide stakeholders with the opportunity to participate in the process and identify any issues or concerns; and
- Produce a Scoping Report for submission to the relevant authorities.

Once the Scoping Phase has been completed, the Impact Assessment Phase will commence, in which the significance of potential impacts will be assessed and measures to avoid and /or mitigate negative impacts and enhance benefits will be determined.

Figure 2: Locality Map

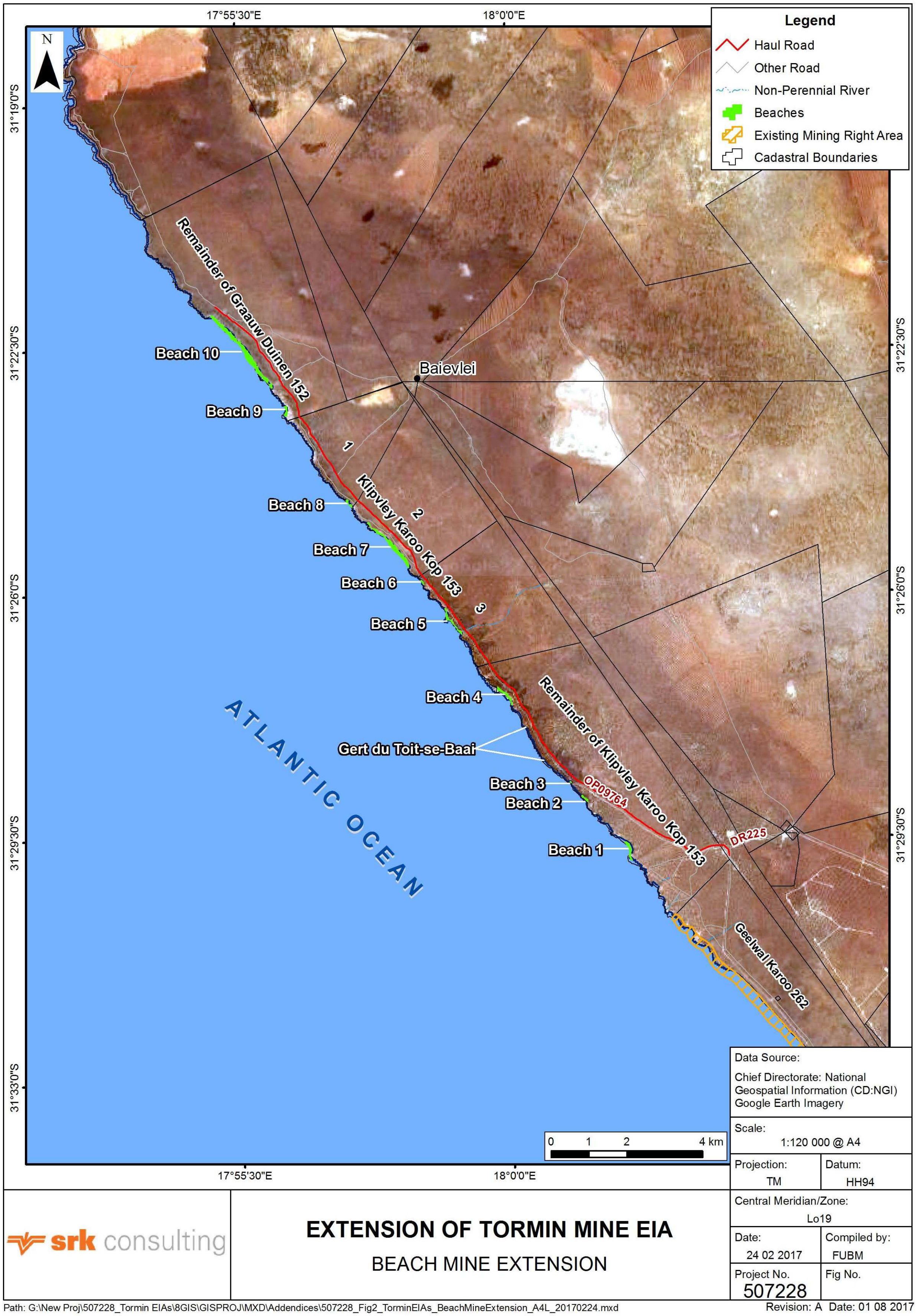

Figure 3: Beach mine extension

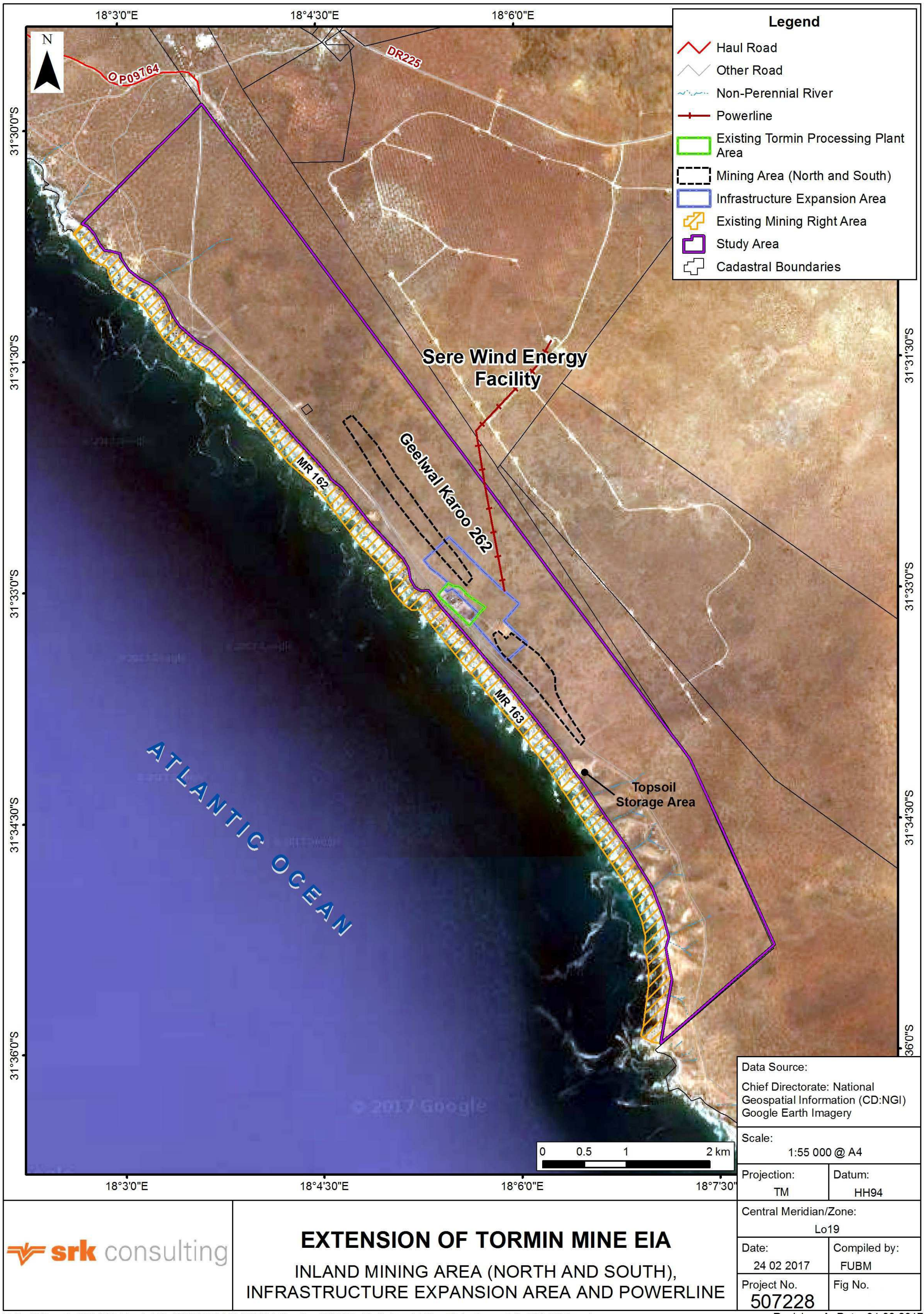

Figure 4: Inland mining and infrastructure / plant expansion area

4 DESCRIPTION OF THE SITE AND ENVIRONMENT

Tormin Mine is located on Farm Geelwal Karoo 262 on the West Coast of South Africa, north of the Olifants River Estuary and approximately 25 km west of Lutzville. Eskom's Sere wind energy facility is located on the ridgeline inland of Tormin Mine.

Access to the Mine is from Koekenaap via Robeiland and De Punt, or from Koekenaap via Kommandokraal and Schaapvlei (DR225). The gravel road extending the length of Farm Geelwal Karoo 262 is maintained by the Mine and provides access to the processing plant. The public (gravel) road OP09764 (see Figure 2) provides access to the coastline north of Tormin Mine. This road is used by farmers and visitors to the coastline. The coastline is used by campers and other recreational users.

The coastline of Farm Geelwal Karoo 262 consists of wide beaches separated by rugged rocky promontories. Steep dunes and rocky cliffs (between 30 and 50 m above mean sea level) are a feature of the area. The coastal platform is almost flat before rising to a ridgeline along the western boundary of Farm Geelwal Karoo 262.

The coastline to the north of Tormin Mine is characterised by a rocky shoreline with isolated beaches in small bays. The character of the coastline changes further north, as longer beaches and primary dune systems become more prominent. The vertical change from the high-water mark to the inland zone is less abrupt: the topography rises gently to a ridgeline ~ 5 km inland.

Areas along the coast have been disturbed from historical and current mining and/or prospecting activities, as well as by people accessing the coastline on a network of informal beach access roads.

The predominant vegetation type of the region is Namaqualand Strandveld (Figure 5). Plant diversity of this vegetation type is relatively low but has a rich component of annual and perennial flora. Namaqualand Seashore vegetation occurs along the coast on slightly sloping beaches and coastal rocky formations (Figure 6). The vegetation of the area consists of low coastal shrub up to 1 m high, typical of much of the West Coast.

Figure 5: Namaqualand Strandveld vegetation on the coastal platform

Figure 6: Namaqualand Seashore vegetation along the coast

The majority of the area under application falls within Critical Biodiversity Areas (CBAs). These areas have been designated as CBAs to promote coastal resource protection and to maintain ecological processes associated with the coastal strip, especially the ability of fauna to move along the coast. Although CBAs confer no rights and have no official conservation status in law, they provide an indication of ecological status (biodiversity).

The beaches are used by shoreline birds for foraging, rest or breeding as well as by mammals such as seals, the Cape Clawless Otter and Black-Backed Jackal. The dunes and rocky formations / cliffs are important reptile habitats and several relatively rare species - restricted to the West Coast - occur within this habitat. The coastal plain is an important habitat for a wide range of faunal species.

The study area lies in the Olifants-Doorn Water Management Area. With the exception of the Olifants River, ~19 km south-east of Tormin Mine and beyond the study area, all of the rivers and wetlands in the area are minor ephemeral systems. Wetlands in the area comprise mainly pans or "depressions".

The bulk of archaeological sites (mainly Later Stone Age middens) lie within 500 m of the coast. Inland of the coast, archaeological sites are quite scarce, limited to scatters in deflation hollows. Evidence of historic occupation is prolific in areas of rocky outcrops with shelters or overhangs or any place with potential for providing a water source.

5 PROJECT AND PROCESS DESCRIPTION

MSR proposes to extend mining operations to ensure the ongoing operation of Tormin Mine. The proposed project consists of the following key activities (see Figures 2 to 4):

- **Mine VHM deposits on ten *discrete* beaches** (Figure 3 and Figure 7) along a stretch of coastline north of Tormin Mine:
  - Mining will be undertaken using hydraulic excavators, slurry pumps and other ancillary equipment (e.g. graders, watercart, dozer) *to feed the ore into a mobile Primary Beach Concentrator*

(PBC). The concentrate will be loaded into ~40 ton dump trucks and hauled up the beach access road to the haul road and then onward to the Run-of-Mine (ROM) stockpiles at the processing plant for further processing;

- *Beach mining will be conducted along the beaches between the low-water mark of the sea and the toe of the dunes / cliffs with a 10 m buffer.* Mining will proceed along each beach depending on tides and mine schedule grade requirements; and
- VHM deposits will be mined to an average depth of 6 m. Where the VHM deposit is shallow or poorly developed, mining will take place *where tides allow*. Where thick VHM deposits are found near the low water mark, a sand berm, wave breaker (*ditch in the sand*), or similar will be constructed on the seaward side of the deposit, providing temporary safety protection from the incoming tide whilst ensuring the mining process is efficient and minimising the need to return to the same area following tide retreat. Once the deposit has been mined, wave action will quickly return the beach to its former condition *in a short period of time* (and partly replenish VHM deposits). In some instances, a bulldozer will reshape the beach to the original profile *where mining occurs above the high-water mark*;

Figure 7: Target Beach 6

- MSR proposes to utilise existing gravel roads from the Tormin Mine entrance (off the DR2225) to the beaches to serve as haul roads for dump trucks. This includes public road OP9764 adjacent to the coast and informal beach access roads. MSR will **widen and grade the beach access roads** as required;
- **Mine *a 75 ha* inland VHM deposit** *in an area 100 – 300 m wide and ~4.8 km long* inland (east) of the existing processing plant, but seaward of the Sere wind energy facility (Figure 4 and Figure 8). Strip mining of the inland strand line will be undertaken progressively:
    - Vegetation and topsoil (to a depth of approximately 50 cm) will be stripped by bulldozers and stored in stockpiles in *designated* areas or - where mine sequencing allows - placed directly over tailings backfilled to the preceding mine void. Topsoil from the initial box cut will be stored in the existing topsoil storage area;
    - *Overburden will be removed to a depth of 2-25 m (depending on resource depth) and will immediately be backfilled into an adjacent previously mined-out area or temporarily stored in the designated overflow areas*;
    - A 15 m wide haul road on the western side of the proposed *mining areas*, and ramps, will provide access into the pit for mining vehicles and plant / equipment. *The haul roads between the mining areas and the infrastructure / plant expansion area will be located within the proposed mining areas or infrastructure / plant expansion area footprints*;
    - Excavators will mine the mineralised sand layer *up to a maximum depth of* 30 m (average of 10 m). The sand and ore will be loaded into dump trucks and transported to the existing ROM stockpiles at the processing plant *or the new ROM stockpile area in the infrastructure / plant expansion area*;
    - Tailings will be returned (pumped) to the mine void as backfill *and then covered with stockpiled overburden and topsoil material*;
    - Rehabilitation will be undertaken as soon as the mining path allows. *Once an area has been mined and backfilled, the backfilled material will be re-profiled to create the desired landform.* The backfill material will be reseeded (if required) and the final rehabilitated area demarcated as a No-Go area;
- **Process water dams** will be constructed *in the infrastructure / plant expansion area* to store process water to ensure there is adequate water supply for the processing plant to accommodate increased water consumption rates for strand line mining. The process water dams will be lined (HDPE) and will have a combined storage capacity of less than 50 000 m^3;

Figure 8: View across the inland strand line

- **Construct a Mineral Separation Plant (MSP)** in the infrastructure / plant expansion area east of the existing processing plant *to further beneficiate the concentrates produced and increase overall mineral recovery*;
- **Install a Reverse Osmosis (RO) Plant** in the infrastructure expansion / plant area with capacity to provide ~24 m^3/hour of fresh (potable) water for processing and domestic purposes. A new fresh water dam (75 m x 35 m x 6 m, 10 000 m^3) will be constructed adjacent to the RO Plant; and
- Install a **powerline** (22 kv) from the Sere wind energy facility to the Mine.

6 ALTERNATIVES

Appendix 2 Section 2 (h)(i) of the EIA Regulations, 2014, requires that all S&EIR processes must identify and describe feasible and reasonable alternatives. Alternatives considered during screening phases of the project, include:

Location Alternatives for Mine Areas: The locations of the VHM beach deposits and inland deposits are fixed, which dictates possible mining locations. Location alternatives will not be considered in the Impact Assessment Phase. *However, specialists will consider the location of new mining and infrastructure footprints within the extension areas, taking into account environmental constraints identified during their site visits. The specialists did not identify any specific areas of high sensitivity within the proposed mining and infrastructure footprints that should be designated as "exclusion zones" (specialist studies will be provided in the EIA Report).*

Location Alternatives for the MSP: Based on capital costs, operating costs and hauling costs, MSR identified Tormin Mine as the most feasible location for the MSP and no location alternatives are considered for the MSP.

Alternatives for Transporting Ore to the Processing Plant: MSR does not consider conveyors and pipelines to be feasible, as these alternatives will require significant capital outlay and the infrastructure will significantly increase the disturbance footprint. The use of dump trucks is considered to be the only feasible alternative.

Layout Alternatives for the Infrastructure / Plant Expansion Area: *MSR proposed a layout design for the infrastructure / plant expansion area that extended close to the eastern boundary of Farm Geelwal Karoo 262. Under advice of the terrestrial ecology specialist, MSR revised the layout of the infrastructure / plant expansion area to increase the ecological corridor between the infrastructure / plant expansion area and the eastern fenceline. This layout design has been selected for assessment and no other design alternatives will be assessed.*

Technology Alternatives Enabling Beach Mining: MSR considered the use of dredging techniques and machinery; or geofabric socks to enable beach mining. The high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators during *lower* tides.

Power Supply Alternatives: MSR considered installing additional generator sets or photovoltaic panels to generate the required electricity on site. However, a connection to the *Eskom network* is MSR's preferred alternative.

Fresh Water Supply Alternatives: MSR considers seawater desalination as the only viable option, as trucking of water is not considered to be feasible due to cost and the Lower Olifants River Water User Association canal has insufficient unallocated water available for Tormin Mine.

Brine Discharge Alternatives: *Brine will be discharged from a single effluent discharge point (outfall). The beach void disposal and rocky shore disposal options were screened out because of potential negative environmental impacts identified by the marine ecology specialist. The marine ecology specialist will assess three outfall location alternatives along MSR's existing seawater intake pipeline – two offshore locations beyond the surf-zone and one near-shore location within the surf zone.*

Various **process and design alternatives** are also being investigated.

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-Go alternative will have major implications for the sustainability of Tormin Mine and will probably entail the closure of the Mine.

7 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is a key component of the S&EIR process and is being undertaken in accordance with Chapter 6 of the EIA Regulations, 2014. The stakeholder engagement activities related to the Scoping Phase are summarised in Table 3 below.

Relevant local, provincial and national authorities, conservation bodies, local forums and surrounding landowners and occupants have been directly notified of the S&EIR process and the release of the Scoping Report for comment.

Table 3: Stakeholder Engagement during Scoping

Activity	Date
Release Scoping Report to the Public	*6 April 2018*
Public Comment Period	*7 April – 8 May 2018*
Compile Issues and Responses Summary and finalise Scoping Report	*May 2018*

8 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

The impacts of a project are mostly linked to the sensitivity of the receiving environment and proximity of receptors, the extent or footprint and nature of the development, expected discharges and stakeholders' perceptions.

Based on the above considerations as well as the professional experience of the Environmental Assessment Practitioners and input from specialists, the following key environmental issues – potential negative impacts and potential benefits of the project in its proposed setting – have been identified.

Soil and land capability – potential impact on soil and loss of land use and land capability;

Air quality – potential increase in atmospheric emissions from the MSP and dust generated by mining and on haul roads;

Hydrology – potential impact on watercourses;

Hydrogeology – Potential impact on groundwater;

Marine and coastal ecology – disturbance to the coastal environment during mining and loss of marine biota and resources due to discharge of brine;

Terrestrial ecology – potential loss of vegetation and habitat and disturbance to sensitive or protected species and habitats;

Socio-economic – benefits of sustained and increased employment and investment in the local and regional economy;

Heritage – potential impacts on sites of archaeological or palaeontological significance;

Visual aspects – deterioration of sense of place and aesthetic value along the currently undeveloped stretch of coast; and

Traffic – potential impact on existing road users and surrounding residents.

Certain impacts, while important, are considered likely to be less significant, including air quality, noise, socio-economic, traffic and visual (or sense of place) aspects.

9 PLAN OF STUDY FOR THE IMPACT ASSESSMENT

To address the potential issues and impacts identified thus far, the following **specialist studies** are proposed:

- Soil and Land Capability Impact Assessment;
- Air Quality Impact Assessment;
- Groundwater Impact Assessment;
- Marine Ecology Impact Assessment;
- Freshwater Ecology Impact Assessment;
- Terrestrial Ecology Impact Assessment;
- Heritage Impact Assessment; and
- Traffic Impact Assessment.

Specialist input, rather than a full specialist study, is recommended for noise, *visual* and socio-economic aspects.

Specialists will be required to provide detailed baseline information and to identify and assess the potential impacts of the proposed project within their particular field of study. In addition, specialists will be required to identify practicable mitigation and optimisation measures to avoid or minimise potential negative impact and/or enhance any benefits. SRK's standard impact rating methodology will be employed in the assessment of impacts.

Once specialist studies have been completed, the results will be collated into an EIA Report and EMP. The EIA Report and EMP will be released for public comment through notifications to registered Interested and Affected Parties (IAPs). Key authorities will also be consulted as part of the process.

All comments received will be incorporated into an Issues and Responses Summary which will be appended to the EIA Report. The EIA Report and EMPr will then be submitted to the DMR for their consideration in decision-making.

HOW YOU CAN YOU PARTICIPATE IN THE EIA PROCESS

The Scoping Report is not a final report and can be amended based on comments received from stakeholders. *As this Scoping Report is substantially similar to the Scoping Report dated April 2017 and previously released for stakeholder comment during the prior EIA process, all comments previously submitted in response to the April 2017 Scoping Report are included and will be responded to in the Issues and Responses summary that will accompany the Final Scoping Report and draft EIA Report. Additional comments can be submitted as part of the current EIA process.*

REVIEW THE REPORT

Copies of the complete report are available for public review at the following locations:

- Lutzville Public Library;
- Vredendal Public Library;
- SRK's Cape Town office; and
- SRK's website: www.srk.co.za – click on the 'Library' and 'Public Documents' links.

REGISTER OR PROVIDE YOUR COMMENT

Register or send written comment to:

Jessica du Toit

SRK Consulting

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Email: jedutoit@srk.co.za

Tel: + 27 21 659 3060

Fax: +27 86 530 7003

Issues and concerns identified in the Scoping Study will assist in focussing the EIA and will be used to refine the terms of reference for specialist investigations. Stakeholders are therefore urged to participate. IAPs are invited to comment, and/or to register on the project database. IAPs must provide their comments together with their name, contact details (preferred method of notification, e.g. email), and an indication of any direct business, financial, personal or other interest which they have in the application, to the contact person below, by ***8 May 2018***.

Relevant Organs of State have been automatically registered as stakeholders. According to the EIA Regulations, 2014, all other **persons must request in writing to be placed on the register, submit written comments or attend meetings in order to be registered as stakeholders** and be included in future communication for the project. ***Stakeholders who were registered on the prior EIA database will be automatically registered on the new EIA database.***

Profile and Expertise of EAPs

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Mineral Sands Resources (Pty) Ltd (MSR) to undertake the Environmental Impact Assessment (EIA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA).

SRK Consulting comprises over 1 300 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town environmental department has a distinguished track record of managing large environmental and engineering projects, extending back to 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

As required by NEMA, the qualifications and experience of the key independent Environmental Assessment Practitioners (EAPs) undertaking the EIA are detailed below and Curriculum Vitae provided in Appendix 1 and Appendix 2.

Project Director: Christopher Dalgliesh, BBusSc (Hons), MPhil (EnvSci)
Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)
Chris Dalgliesh is a Partner and Principal Environmental Consultant with over 24 years' experience, primarily in South Africa, Southern Africa, West Africa and South America (Suriname). Chris has worked on a wide range of projects, notably in the natural resources, Oil & Gas, waste, infrastructure (including rail and ports) and industrial sectors. He has directed and managed numerous Environmental and Social Impact Assessments (ESIAs) and associated management plans, in accordance with international standards. He regularly provides high level review of ESIAs, frequently directs Environmental and Social Due Diligence studies for lenders, and also has a depth of experience in Strategic Environmental Assessment (SEA), State of Environment Reporting and Resource Economics. He holds a BBusSci (Hons) and M Phil (Env) and is a Certified Environmental Practitioner of South Africa (CEAPSA).

Project Manager: Sue Reuther, BSc (Hons) (Econ); MPhil (Enviro. Man)
CEAPSA
Sue Reuther has more than 14 years of experience researching and working on issues in the environmental assessment sector. She has been involved in a variety of ESIAs as well as strategic State of Environment Reporting, the development of Environmental Management Frameworks (EMF) and the compilation of Environmental Management Programmes (EMP). Her experience also includes due diligence reviews and gap analysis studies against IFC and World Bank Standards. Sue also undertakes socio-economic and resource economic specialist assessments.
She holds a BSc (Hons) in Economics and MPhil in Environmental Management and is a Certified Environmental Practitioner of South Africa (CEAPSA).

Project Manager: Scott Masson, BSc (Hons) (EnvMan); MLA (L.Arch.)
CEAPSA and Professionally Registered with the South African Council for the Landscape Architecture Profession
Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 9 years. His expertise includes Visual Impact Assessment, ESIAs, EMPs, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies. Scott holds a BSc (Hons) in Environmental Management, a MLA in Landscape Architecture, is a Certified Environmental Practitioner of South Africa and is a registered Professional Landscape Architect with the South African Council of the Landscape Architecture Profession.

Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

Disclaimer

The opinions expressed in this report have been based on the information supplied to SRK by MSR. SRK has exercised all due care in reviewing the supplied information, but conclusions from the review are reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Tormin Mine Extension: EAP Affirmation

Section 16 (1) (b) (iv), Appendix 1 Section 3 (1) (r), Appendix 2 Sections 2 (j) and (k) and Appendix 3 Section 3 (s) of the EIA Regulations, 2014 (promulgated in terms of NEMA), require an undertaking under oath or affirmation by the EAPs in relation to:

- The correctness of the information provided in the report;
- The inclusion of comments and inputs from stakeholders and interested and affected parties;
- Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties; and
- The level of agreement between the EAP and interested and affected parties on the Plan of Study for undertaking the environmental impact assessment.

SRK and the EAPs managing this project hereby affirm that:

- To the best of our knowledge the information provided in the report is correct, and no attempt has been made to manipulate information to achieve a particular outcome. Some information, especially pertaining to the project description, was provided by the applicant and/or their sub-contractors. In this respect, SRK's standard disclaimer (inserted in this report) pertaining to information provided by third parties applies.
- To the best of our knowledge all comments and inputs from stakeholders and interested and affected parties have been captured in the report and no attempt has been made to manipulate such comment or input to achieve a particular outcome. Written submissions are appended to the report while other comments are recorded within the report. For the sake of brevity, not all comments are recorded verbatim and are mostly captured as issues, and in instances where many stakeholders have similar issues, they are grouped together.
- Information and responses provided by the EAP to interested and affected parties are clearly presented in the report. Where responses are provided by the applicant (not the EAP), these are clearly indicated.
- With respect to EIA Reports, SRK will take account of interested and affected parties' comments on the Plan of Study and, insofar as comments are relevant and practicable, accommodate these during the Impact Assessment Phase of the EIA process.

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Appendices

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Acronyms and Abbreviations

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
amsl	Above mean sea level
BA	Basic Assessment
BPEO	Best Practicable E nvironmental Option
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CBA	Critical Biodiversity Area
CIA	Cumulative Impact Assessment
Cl	Chlorine
CO_2	Carbon Dioxide
CWDP	Coastal Waters Discharge Permit
DEA	National Department of Environmental Affairs
DEA&DP	(Western Cape) Department of Environmental Affairs and Development Planning
DEA: O&C	Department of Environmental Affairs: Oceans and Coasts
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
ESA	Ecological Support Area
EStA	Early Stone Age
GDP	Gross Domestic Product
GDPR	Regional Gross Domestic Product
GGP	Gross Geographic Product
GN	Government Notice
GSP	Garnet Stripping Plant
GVA-R	Regional Gross Value Added
H_2SO_4	Sulphuric Acid
ha	Hectares
HCl	Hydrochloric Acid
HDPE	High Density Polyethylene
HIA	Heritage Impact Assessment
HWC	Heritage Western Cape
IAPs	Interested and Affected Parties
IDP	Integrated Development Plan
IEM	Integrated Environmental Management

IUCN	International Union for Conservation of Nature and Natural Resources
km	Kilometres
km^2	Square kilometres
kVA	Kilo Volt-Amperes
LED	Local Economic Development
LM	Local Municipality
LoM	Life of Mine
LN	Listing Notice
L/s	Litres per second
LSA	Late Stone Age
m^3/h	Cubic metres per hour
mamsl	Meters above mean sea level
mbgl	Meters below ground level
mg/L	Milligrams per litre
Ml/d	Million litres per day
mm/a	Millimetres per annum
mS/m	Millisiemens per meter
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MSA	Middle Stone Age
MSDS	Material Safety Data Sheet
MSR	Mineral Sands Resources (Pty) Ltd
Mt	Million tonnes
MWP	Mining Work Programme
NEMA	National Environmental Management Act 107 of 1998 as amended
NEM:AQA	National Environmental Management: Air Quality Act 39 of 2004
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act 24 of 2008
NEM:WA	National Environmental Management: Waste Act 59 of 1998
NFEPA	National Freshwater Ecosystem Priority Area
NH_3	Ammonium Hydroxide
NHRA	National Heritage Resources Act 25 of 1999
NID	Heritage Notification of Intent to Develop
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NWA	National Water Act 36 of 1998
O_3	Ozone
PES	Present Ecological State
PM	Particulate matter
PM_{10}	Particulate matter with diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with diameter of less than 2.5 µm
RDL	Red Data List

RO	Reverse Osmosis
ROM	Run of Mine
S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African National Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SCC	Species of Conservation Concern
SCP	Secondary Concentration Plant
SDF	Spatial Development Framework
SLP	Social and Labour Plan
SO_2	Sulfur dioxide
SoW	Scope of Work
SRK	SRK Consulting (South Africa) (Pty) Ltd
StatsSA	Statistics South Africa
TDS	Total Dissolved Solids
THG	Trans Hex Group
tpa	Tonnes per annum
tph	Tonnes per hour
TSP	Tailings Scavenger Plant
ToR	Terms of Reference
VAC	Visual Absorption Capacity
WMA	Water Management Area
WML	Waste Management Licence
WUL	Water Use Licence
WWTW	Waste Water Treatment Works
µ	micro

Glossary

Acidic	A condition where pH is below 7
Aquifer	An underground body of permeable rock or unconsolidated materials (gravel, sand or silt) which can contain or transmit groundwater.
Avifauna	The collective birds of a given region.
Baseline	Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.
Benguela Current	The broad, northward flowing ocean current that forms the eastern portion of the South Atlantic Ocean.
Biodiversity	The diversity, or variety, of plants, animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity
Borehole	Includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer
Community	Those people who may be impacted upon by the construction and operation of the project. This includes neighbouring landowners, local communities and other occasional users of the area
Construction Phase	The stage of project development comprising site preparation as well as all construction activities associated with the development.
Consultation	A process for the exchange of views, concerns and proposals about a project through meaningful discussions and the open sharing of information.
Critical Biodiversity Area	Areas of the landscape that must be conserved in a natural or near-natural state in order for the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.
Cumulative Impacts	Direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors.
Electrical Conductivity (in water)	Reflects the capacity of water to conduct electrical current, and is directly related to the concentration of salts dissolved in water.
Ecology	The study of the interrelationships of organisms with and within their physical surroundings
Ecosystem	The interconnected assemblage of all living organisms that occupy a given area and the physical environment with which they interact.
Endemic / Endemism	Species unique (native or restricted) to a defined geographic location, i.e. ecological state of a species being unique to a defined geographic location.
Environment	The external circumstances, conditions and objects that affect the existence of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Environmental Authorisation	Permission granted by the competent authority for the applicant to undertake listed activities in terms of the NEMA EIA Regulations, 2014.

Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.
Environmental Impact Assessment Report	The report produced to relay the information gathered and assessments undertaken during the Environmental Impact Assessment.
Environmental Management Programme	A description of the means (the environmental specification) to achieve environmental objectives and targets during all stages of a specific proposed activity.
Ephemeral	A water body that does not flow or contain water year-round, in response to seasonal rainfall and run-off.
Fauna	The collective animals of a particular region, habitat or geological period.
Feasibility study	The determination of the technical and financial viability of a proposed project.
Fine Tailings	Tailings below the average grain size found in the resource.
Fossil	Rare objects that are preserved due to unusual circumstances.
Flora	The collective plants of a particular region, habitat or geological period.
Geohydrology	The study of the character, source and mode of occurrence of groundwater.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Heritage Resources	Refers to something tangible or intangible, e.g. a building, an area, a ritual, etc. that forms part of a community's cultural legacy or tradition and is passed down from preceding generations and has cultural significance.
Heuweltjies	Slightly raised, rounded termite mounds up to 10 m in diameter.
High shore	The section of the intertidal zone reaching from the extreme high water spring tide to the mean high water neap tide.
High-water mark	*The highest line reached by coastal waters, but excluding any line reached as a result of exceptional or abnormal weather or sea conditions.*
Hydrology	(The study of) surface water flow.
Hydraulic Conductivity	Measure of the ease with which water will pass through earth material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Independent EAP	An independent person with the appropriate qualifications and experience appointed by the Applicant to manage the Environmental Impact Assessment process on behalf of the Applicant.
Integrated Environmental Management	The practice of incorporating environmental management into all stages of a project's life cycle, namely planning, design, implementation, management and review.
Intertidal zone	The section of the marine environment that lies exposed at low tide and submerged at high tide.

Littoral active zone	*Any land forming part of, or adjacent to, the seashore that is unstable and dynamic as a result of natural processes and characterised by dunes, beaches, sand bars and other landforms composed of unconsolidated sand, pebbles or other such material which is either unvegetated or only partially vegetated.*
Low shore	The section of the intertidal zone reaching from the mean low water neap tide to the extreme low water spring tide.
Low-water mark	*The lowest line to which coastal waters recede during spring tides.*
Midden	A mound or deposit containing shells, animal bones, and other refuse that indicates the site of a human settlement.
Mineral Resource	The concentration or occurrence of material of intrinsic economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction.
Mining Right	A right to enter upon and occupy a specific piece of ground (in South Africa) for the purpose of working it for the extraction or collection of minerals.
Mitigation measures	Design or management measures that are intended to avoid and / or minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
Operational Phase	The stage of the works following the Construction Phase, during which the development will function or be used as anticipated in the Environmental Authorisation.
Ore	The economically mineable part of a measured and/or indicated mineral resource, including diluting materials, allowances for losses that may occur when the material is mined, and the consideration of modifying factors.
Palaeo	*Older or ancient, especially relating to the geological past.*
Peneplain	A more or less level land surface produced by erosion over a long period.
Perennial river	A river that flows year-round.
Red Data List	Species of plants and animals that because of their rarity and/or level of endemism are included on a Red Data List (usually compiled by the IUCN) which provides an indication of their threat of extinction and recommendations for their protection.
Seashore	*The area between the low-water mark and the high-water mark.*
Scoping	A procedure to consult with stakeholders to determine issues and concerns and for determining the extent of and approach to an EIA (one of the phases in an EIA). This process results in the development of a scope of work for the EIA and specialist studies.
Sense of Place	The unique quality or character of a place, whether natural, rural or urban. Relates to uniqueness, distinctiveness or strong identity. Sometimes referred to as genius loci meaning 'spirit of the place' (Oberholzer, 2005).
Slimes	Waste material containing clay and other fine minerals not able to be economically extracted.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Stakeholders	All parties affected by and/or able to influence a project, often those in a position of authority and/or representing others.
Strand line	*An ancient beach line located inland of the current seashore.*
Subtidal	The marine habitat that lies below the level of mean low water for spring tides.

Supratidal	The area above the spring high tide mark that is not submerged by seawater. Seawater penetrates these elevated areas only at high tide during storms.
Sustainable development	Sustainable development is generally defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. NEMA defines sustainable development as the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.
Tailings	Tailings are the materials left over after the process of separating the valuable fraction from the uneconomic fraction of an ore. Tailings are distinct from overburden, which is the waste rock or materials overlying an ore or mineral body that are displaced during mining without being processed.
Tidal level	*The level of the coastal waters.*
Visibility	The area from which the project components would actually be visible and depends upon topography, vegetation cover, built structures and distance.
Visual Character	The elements that make up the landscape including geology, vegetation and land-use of the area.
Visual Quality	The experience of the environment with its particular natural and cultural attributes.
Visual Receptors	Individuals, groups or communities who are subject to the visual influence of a particular project (Oberholzer, 2005).

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

SCOPING REPORT

FOR LISTED ACTIVITIES ASSOCIATED WITH THE EXTENSION OF TORMIN MINE, WEST COAST, SOUTH AFRICA

Section 102 Application

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: Mineral Sand Resources (Pty) Ltd
TEL NO: +27 87 150 4010
FAX NO: +27 21 525 1902
POSTAL ADDRESS: PO Box 139, Lutzville, 8165
PHYSICAL ADDRESS: Tormin Mine, Schaapvlei Road, Lutzville
FILE REFERENCE NUMBER SAMRAD: WC 30/5/1/2/2 MR

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 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.

OBJECTIVE OF THE SCOPING PROCESS

1) The objective of the scoping process is to, through a consultative process—

(a) identify the relevant policies and legislation relevant to the activity;

(b) motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;

(c) identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;

(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;

(e) identify the key issues to be addressed in the assessment phase;

(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and

(g) identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

SCOPING REPORT

2) Contact Person and correspondence address

a) Details of:

i) The EAP who prepared the report

Name of The Practitioner: Scott Masson and Sue Reuther

Tel No: 021 659 3060
Fax No: 086 530 7003 or 021 685 7105
e-mail address: smasson@srk.co.za; sreuther@srk.co.za

ii) Expertise of the EAP.

(1) The qualifications of the EAP

*(With evidence attached as **Appendix 1**).*

Sue Reuther	
Profession:	Principal Environmental Consultant
Education:	MPhil (Environmental Management), University of Cape Town, 2004 BSc (Hons), (Economics), University College London, 2001
Registrations / Affiliations:	Certified Environmental Assessment Practitioner of South Africa (CEAPSA) Member, IAIAsa
Scott Masson	
Profession:	Senior Environmental Consultant
Education:	MLA (Landscape Architecture), University of Cape Town, 2008 BSc (Hons), (Environmental Management), University of Cape Town, 2004
Registrations / Affiliations:	CEAPSA Professionally Registered Landscape Architect Member of National Association for Clean Air

(2) Summary of the EAP's past experience.

*(Attach the EAP's curriculum vitae as **Appendix 2**)*

Sue Reuther, BSc (Hons) (Econ); MPhil (Enviro. Man)

CEAPSA

Sue Reuther has more than 15 years of experience researching and working on issues in the environmental assessment sector. She has been involved in a variety of Environmental Impact Assessments (EIAs) as well as strategic State of Environment Reporting, the development of Environmental Management Frameworks (EMF) and the compilation of Environmental Management Programmes (EMPr's). Her experience also includes due diligence reviews and gap analysis studies against IFC and World Bank Standards. Sue also undertakes socio-economic and resource economic specialist assessments.

She holds a BSc (Hons) in Economics and an MPhil in Environmental Management and is a CEAPSA.

Scott Masson, BSc (Hons) (EnvMan); MLA (L.Arch.)

CEAPSA and Professionally Registered with the South African Council for the Landscape Architecture Profession (SACLAP)

Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 9 years. His expertise includes Visual Impact Assessment, EIAs, EMPr's, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies. Scott holds a BSc (Hons) in Environmental Management, a MLA in Landscape Architecture, is a CEAPSA and is a registered Professional Landscape Architect with SACLAP.

b) Description of the property.

Table 1: Description of properties

Farm Name:	Geelwal Karoo 262/RE C07800000000026200000 Klipvley Karoo 153/RE C07800000000015300000 Klipvley Karoo 153/4 C07800000000015300004 Klipvley Karoo 153/5 C07800000000015300005 Klipvley Karoo 153/6 C07800000000015300006 Klipvley Karoo 153/7 C07800000000015300007 Perseel Weskus 191 C07800000000019100000 Perseel Weskus 192 C07800000000019200000 Perseel Weskus 196 C07800000000019600000 Perseel Weskus 197 C07800000000019700000 Perseel Weskus 198 C07800000000019800000 Perseel Weskus 199 C07800000000019900000 Perseel Weskus 200 C07800000000020000000 Perseel Weskus 201 C07800000000020100000 Perseel Weskus 202 C07800000000020200000 Perseel Weskus 203 C07800000000020300000 Perseel Weskus 204 C07800000000020400000 Perseel Weskus 205 C07800000000020500000 Perseel Weskus 206 C07800000000020600000 Graauwduinen 152/3 C07800000000015200003
Application area (Ha)	• *Ten* beaches *adjacent to Remainder of Graauw Duinen 152 and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline* north of Tormin Mine comprising 43.7 ha mining and 2.1 ha beach access road widening; • Inland *"Strandline"* mining area on the Farm Geelwal Karoo 262*, inland of the existing Processing Plant,* comprising 75 ha mining; and • An infrastructure */ plant* expansion area of ~*64 ha* adjacent to the existing Processing Plant *to accommodate additional processing plants, stockpile areas, process water dams, industrial yards, parking and laydown areas.* Current mining activities at Tormin Mine are not assessed in this EIA.
Magisterial district:	West Coast District Municipality
Distance and direction from nearest town	Koekenaap is located ~ 19 km east of Tormin Mine.

21 digit Surveyor General Code for each farm portion	See above

c) Locality map

*(show nearest town, scale not smaller than 1:250000 attached as **Appendix 3).***

See Appendix 3.

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

i) Listed and specified activities

*Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site and attach as **Appendix 5***

Table 2: Listed activities

NAME OF ACTIVITY (All activities including activities 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.)	**Aerial extent of the Activity Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** (***GNR 983, GNR 984 or GNR 985)/ NOT LISTED***[1])	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**
Beach Mining	43.7 ha			
Mine Valuable Heavy Mineral (VHM) deposit on beaches		X	GN R983 (19A), *(20)* *GN R984 (19), (26)*	
Primary processing in Mobile primary beach concentrator			Not listed	
Load *concentrate* into dump trucks			Not listed	
Haul *concentrate* to Run-of-Mine (ROM) stockpile at existing Processing Plant			Not listed	
Widening of Beach Access Roads	2.1 ha	X	GN R983 (19), (19A) GN R984 (15) GN R985 (12)	
Inland Mining	75 ha			
Remove topsoil and stockpile		X	GN R984 (15) GN R985 (12)	
Mine VHM deposit		*X*	*GN R984 (20)* *GN R984 (17), (19)*	
Load ore into dump trucks			Not listed	
Haul ore along haul road to ROM stockpile at existing Processing Plant		X	GN R983 (24) GN R985 (4)	

[1] As amended by GN R327, GN R325 and GN R324 on 7 April 2017.

NAME OF ACTIVITY (All activities including activities 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.)	**Aerial extent of the Activity Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** (***GNR 983, GNR 984 or GNR 985)/ NOT LISTED***[1])	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**
Return tailings to mine void *and decant excess water* and return water to Processing Plant		X	GN R983 (10), *(25)*	GN R921, Category B (7), (10), (11)
Rehabilitate inland mining area			Not listed	
Infrastructure Expansion Area	*64 ha*			
Stockpile Areas			*GN R983 (14), (28)* GN R984 (15) GN R985 (12)	
Strand *Line Haul* Roads		X	GN R984 (15) GN R985 (4), (12)	
Mineral Separation Plant		X	*GN R983 (14), (28)* GN R984 (6), (15) GN R985 (12)	
Reverse Osmosis Plant		X	GN R983 (9), *(14)*, (16), *(17), (28)* GN R984 (6), (14), (15), *(26)* GN R985 (12)	
Primary Concentration Circuit Improvements		*X*	*GN R983 (14), (28)* *GN R984 (15)* *GN R985 (12)*	
Fresh Water Dam		X	*GN 983 (28)* GN R984 (15), (16) GN R985 (12)	
Process Water Dams		*X*	*GN R983 (12), (13), (25), (28)* *GN R984 (15), (16)* *GN R985 (12)*	
22 kV powerline		X	GN R984 (15)	

Note: The above list is exhaustive based on the project information currently available. The listed activities applied for will be confirmed in the Impact Assessment Phase.

ii) Description of the activities to be undertaken

(Describe Methodology or technology to be employed, and for a linear activity, a description of the route of the activity

1 Introduction: Project Description

1.1 Heavy Mineral Sands

This section provides a general overview of heavy mineral sands and the sector.

The term "mineral sands" normally refers to concentrations of heavy minerals in an alluvial (old beach or river system) environment. Most mineral sands deposits (sometimes also referred to as ore in this report) are found in unconsolidated fossil shorelines several hundreds of metres to tens of kilometres and occasionally hundreds of kilometres inland from the present coastline. Repeated storm erosion and reworking over centuries or millennia may progressively enrich a mineral sand deposit. This can be observed within individual deposits being mined today and can result in enrichment of heavy mineral within a deposit (Jones, 2009).

Deposit preservation occurs over geologically longer periods through subsidence of coastal sediments, changing sea levels caused by ice ages or isostatic adjustment of continental margins. This may cause shorelines to migrate inland (marine transgression), potentially resulting in reworking older heavy mineral accumulations into larger deposits. Alternatively migration seaward (marine regression) can occur leaving reworked deposits preserved inland (Jones, 2009).

The principal valuable minerals include ilmenite, leucoxene, rutile, zircon and monazite. Smaller volumes of garnet and staurolite are sold as niche products for specialised use.

The mineral sands sector generates two principal product streams (Jones, 2009):

- Titanium dioxide minerals – in the form of rutile, ilmenite and leucoxene. Titanium dioxide minerals are used mainly as feedstock for the world's titanium dioxide (TiO_2) pigment industry commonly used in architectural and automotive paints, plastics, paper, textiles and inks. Rutile, synthetic rutile and titanium slag can be used to produce titanium metal; and
- Zircon - The most important application for zircon is in the ceramics industry in the production of opacifiers used in surface glazes and pigments. Due to its high melting point (2 200°C), zircon is used as a foundry sand in moulds, and as a milled "flour", particularly in higher temperature applications where maintaining the quality of the surface of the casting is important (Jones, 2009). Zircon is also used for the production of zirconia, zirconium metal and zirconium chemicals. These are high value and growing applications resulting in increased demand for zircon (Jones, 2009).

The US Geological Survey (2018) estimated global titanium minerals (ilmenite and rutile) production in 2017 of 7.2 Million tonnes (Mt), of which South Africa accounted for 19%. Zircon production was estimated at 1.6 Mt, with South Africa accounting for 25%.

Garnet production was estimated at 1.1 Mt, with South Africa producing 300 kt – 27% of global production (US Geological Survey, 2018). Garnet is mainly used for abrasive blasting (sandblasting) where it has less environmental impacts than coal or metalliferous slags, and also does not have the health and safety risks associated with sand blasting using silica sands.

South Africa is the leading producer of titanium minerals and the second largest producer of zircon and garnet.

1.2 Existing Tormin Mine and Current Mining Method Overview

Mineral Sand Resources (Pty) Ltd (MSR) owns and operates the Tormin Mineral Sands Mine (Tormin Mine) on the West Coast of South Africa (Appendix 3). Tormin Mine is located on and adjacent to Farm Geelwal Karoo 262, approximately 18 km north of the Olifants River Estuary and 25 km west of Lutzville. Eskom's Sere wind energy facility is located on the ridgeline inland of Tormin Mine.

The Mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, with an approved Environmental Management Programme (EMPr) to mine VHM below the high-water mark adjacent to Farm

Geelwal Karoo 262 (Appendix 3). Tormin Mine is a 24 hours a day, 7 days a week operation and has been in operation since 2013. The Mine employs more than 200 people.

The Trans Hex Group (THG) has been operating in the area since the 1960's. THG has the right to mine the beaches for diamondiferous gravel below the VHM deposit. MSR coordinates mining activities with THG to ensure efficient, often concurrent mining of the VHM deposit and the diamondiferous gravel.

The Tormin Mine operation includes:

- Mining on the beach;
- Access roads;
- Processing plant and associated infrastructure area;
- Water supply; and
- Power supply.

These are described further below.

1.2.1 Beach Mining

MSR currently uses hydraulic excavators to mine VHM beach deposits: beach sand is excavated to an average depth of 6 m, along a ~75 m wide[2] and ~12 km long stretch of beach, with a 10 m setback from the toe of the cliff.

The excavated sand (ore) is loaded into dump trucks. The dump trucks haul the ore to the Run-of-Mine (ROM) stockpile located at the processing plant on the elevated coastal plain (Appendix 5, Figure 1).

1.2.2 Access and Haul Roads

Access to Tormin Mine is from Koekenaap via Robeiland and De Punt, or from Koekenaap via Kommandokraal and Schaapvlei. The gravel road extending the length of Farm Geelwal Karoo 262 is maintained by the Mine and provides access to the processing plant.

Five existing gravel tracks down to the beach were upgraded by MSR. These roads are used as haul roads / ramps to transport ore from the beach to the processing plant, where it is delivered to the ROM stockpile.

1.2.3 Processing

The processing plant and associated infrastructure are located on the elevated coastal plain on Farm Geelwal Karoo 262, occupying an area of approximately 10 ha (Appendix 5, Figure 1).

A front-end loader feeds the ore from the ROM stockpile into a feed hopper and conveyor system, which conveys the material to a trommel (mechanical screening machine) where seawater is introduced to form a slurry. The slurry from the slurry tank is pumped to the Primary Beach Concentrators (PBCs) (Figure 1) where the heavy and light particles are separated by means of gravity separation.

The light particles (quartz and silica [beach sand]) are retreated in the Tailings Scavenger Plant (TSP) modules to increase recovery of valuable minerals. The residual light particles (tailings) are combined with the tailings from the Secondary Concentration Plant (SCP) at the Tailings Disposal Plant. The tailings then report to the Tailings Disposal Hoppers for disposal onto the beach below the processing plant as a slurry by pipeline (Appendix 5, Figure 1) or via dump truck where the natural wave action levels the beach.

The heavy particles are stockpiled as a heavy mineral concentrate prior to processing at the SCP (Figure 1) at a throughput of ~110 tons per hour (tph). The SCP includes trash screen, spirals, magnetic separators and

[2] The centreline of the mining area along the beach moves with tidal fluctuations and is midway between the high-water mark and low-water mark of the sea at the time of mining.

screens to produce a:

- Non-magnetic concentrate rich in zircon and rutile;
- Garnet concentrate; and
- Magnetic concentrate containing ilmenite.

A Garnet Stripping Plant (GSP) was installed and commissioned in 2016 to improve production efficiency. The GSP removes garnet and low density silicates from the feed to the SCP using gravity and magnetic separation, thereby increasing the non-magnetic / ilmenite feed grade to the SCP.

Tormin Mine has an annual production capacity of ~570 000 tonnes per annum (tpa). The finished ilmenite and garnet concentrate is transported to the Port of Saldanha via Vredendal, Leipoldtville, Elandsbaai, Velddrif and Vredenburg for *bulk* export. The non-magnetic zircon / *rutile* concentrate is *bagged and* transported to Cape Town for export *in containers*. At present (2017) there are ~ 36 truck trips per day from Tormin Mine to the Port of Saldanha (1 210 monthly in one direction; 2 420 trips in both directions). *Currently ~ 200,000 tpa of garnet concentrate is exported in bulk under an off-take agreement with an international company. Excess production is stockpiled on-site for later transport as required.*

There are three process (sea) water dams at the SCP (Figure 1). The process water dams are lined and have a combined storage capacity of ~49 000 m³.

Prefabricated containers provide offices, workshops and stores in the processing plant area.

Figure 1: The PBCs (left) and the SCP and process water dams (right)

1.2.4 Water Supply

MSR utilises water from two sources, namely seawater for processing activities from the seawater intake located on the coast and fresh water for domestic purposes, the latter transported by truck to site from Lutzville. The current daily seawater intake rate is approximately 7.2 Ml/d. Seawater is pumped to two process water dams at the SCP (Appendix 5, Figure 1). Process water from the SCP and GSP is discharged into the secondary process water dam for settling. The water is then recirculated back to the main process water storage dam for further use in processing. Excess process water is returned to the beach with the tailings as a slurry.

1.2.5 Power Supply

Diesel powered generator sets (gensets) are currently used at Tormin Mine to provide power to the Mine. Power is generated by 4 x 1250kVA gensets with an installed power capacity of 3.8kVA. The gensets are containerised and located adjacent to the SCP and GSP processing plant.

1.3 Geology of the Deposits

The VHM deposit in the Tormin area occurs in a present-day beach environment and in an older palaeo-beach strand line found 300 – 500 m inland.

The coastal zone adjacent to Tormin Mine consists of alternating coastal dunes and cliffs. Cliffs have formed from the more resistant basement rocks creating small outcrops and headlands whilst dunes have developed over the softer shales and schists (basement rock). The coastline is in a natural regressive state eroding and undercutting cliffs and palaeo-beach deposits which, together with the northerly current transporting mineralised marine sediments, function as a replenishment source for heavy minerals along the coast.

The dune coast north of Tormin Mine is characterized by alternating poorly developed bays and headlands. On headlands the coastal plain often extends seawards onto the headland, and a foredune is absent. A broader dune structure is associated with embayments, comprising poorly developed hummock dune zones which blend into constantly rising foreland dune slopes, with a well-defined transition into the coastal plain approximately 20 m above mean sea level (amsl). Lower angled slopes (at approximately 45º) covered in uniform brown sandy loam, occur above the cliff face and extend upwards to an elevation of approximately 50 m amsl.

The area under application has been investigated and mined for VHM deposits as far back as the 1930s (Haughton, 1931). Subsequent geological surveys and exploration programmes investigated the distribution, mineralogy and economic potential of the VHM deposits along the coastline of Geelwal Karoo (Toerien & Groeneveld 1957, Abele 1989, Swart 1990, Barnes 1998).

The accumulation of heavy minerals in the beach sands of the coastal zone in this region is not related to the inland geology of the area, but more to ongoing erosion of elevated historic beach terraces, and subsequent marine transport of released minerals.

Heavy minerals concentrated in the coastal bays have formed enriched zones of ilmenite, garnet, rutile and zircon. This material has been deposited unconformably over the basement rock - micaceous schist. The beach sand is up to 6 m thick in places and consists of a basal conglomerate pebble unit which fills in the unconformities in the bedrock and is overlain by marine sands that contain the VHM deposit. The conglomerate pebble material contains the diamondiferous material which the THG and numerous other groups and contractors (e.g. Namakwa Diamond Company) have been mining since the 1960s[3].

The beach environment on the West Coast is extremely dynamic with large volumes of sand displaced between tides and across seasons (Figure 2). However, broad trends in the heavy mineral distribution are evident as described:

- A low tide lower grade zone consisting of high grade garnet, low grade ilmenite and zircon. The material is not well sorted because of a constant mixing action in this zone. This zone contains a higher percentage of lighter minerals such as quartz;
- The intertidal mixed zone consisting of lower grade garnet and zircon with a moderate grade ilmenite. This zone reflects better sorting and has local high grade garnet lenses; and
- The high tide zone consisting of high grade zircon, garnet and ilmenite. This area represents sediments that have been extensively reworked and preferentially sorted. Lighter minerals have been washed away leaving only the heavy minerals.

Heavy mineral enriched mega-ripples and longshore bars in the sub-tidal area indicate the existence of a reserve in the offshore zone, which acts as a replenishment source for the VHM beach deposits. The heavy minerals are constantly replenished by the transport of new sediment from deeper waters, much of which

[3] *MSR advises that THG has active Mining Rights to mine diamonds from the beaches north and south of Tormin Mine and THG are currently mining these beaches. The Namakwa Diamond Company mined the adjacent inland areas between 2004 and 2006.*

have been derived from erosion of deposits accumulated in the elevated historic beach terraces onto the present beach.

The inland palaeo strand line, known as the 35 m[4] strand line and also the subject of this application, is one of three strand lines on Geelwal Karoo 262 that form part of an inland VHM deposit (Figure 3). The 50 m strand line is located east of the 35 m strand line and the 25 m strand line is currently being eroded on the cliffs.

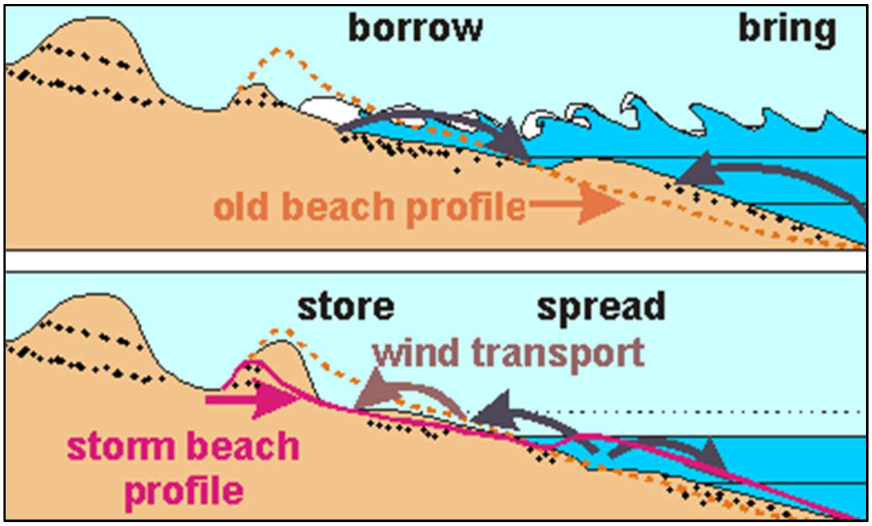


Figure 2: The heavy mineral sand beach depositional cycle

Source: MSR, 2017

[4] Named for its approximate elevation above sea level.

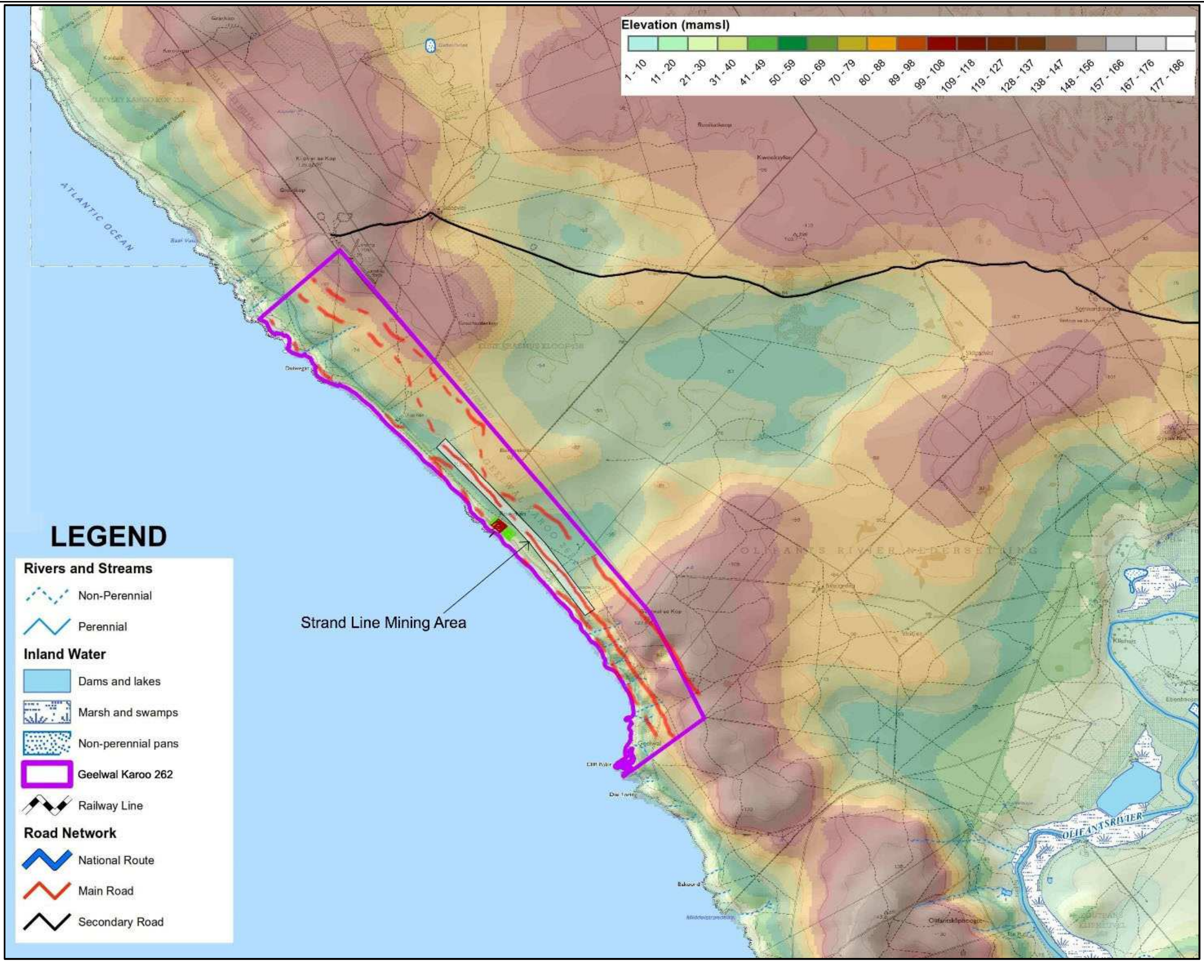


Figure 3: Inland strand lines (dashed red lines) on Geelwal Karoo 262

Source: MSR, 2017

1.4 Exploration Results

THG completed a resource assessment of the VHM deposits of the northern beaches as part of an overall economic assessment to mine the diamondiferous gravels. Exploration consisted of:

- *Hand held auger drilling in 1989;*
- *Reverse Circulation drilling in 1990 and 1991; and*
- *One metre diameter bulk sample drilling in 1991.*

A total of 572 holes were drilled and analysed by THG. The feasibility study compiled by THG in 1992 included a defined mineral resource.

During 1999, THG conducted inland drilling and identified the raised beach deposits. The inland strand lines were defined based on bulk sample information, drilling logs and geophysical surveys undertaken by MSR (airborne magnetics and radiometric survey).

Addition resource information was obtained from historical exploration and mining work by Namakwa Diamond Company in 2003 and 2004, Goliath Gold in 2012 and 2013 and numerous published research and sampling work by Philander, Rozendaal and Elferink.

MSR conducted regional aeromagnetic and radiometric surveys (Xcalibur) in 2014 to confirm the above results and HMS trends.

A total base resource of 15.4 Mt (beach and inland strand line) has been identified by MSR, excluding potential beach replenishment.

2 Proponent's Project Motivation

MSR has been mining the VHM beach deposits at Tormin Mine since 2013 and has seen continual decline in grade. This decline in grade is *anticipated and understood*. The resource is partly replenished by erosion and marine transport; ultimately the *heavy minerals* at a given location will be depleted if mining continues at the current *rate*. A period of reduced mining will allow the beaches in the current Mining Right area to replenish, thereby ensuring the long-term operation of the Mine.

It is likely that mining operations will need to be scaled down or closed for care and maintenance should resource grades remain low. If mining operations are scaled down without a prospect of mining additional resources (as described in this report), approximately 216 full term employees (11% of the local workforce) and more than 80 contractors and suppliers are likely to be retrenched. The closure of Tormin Mine will cease the ~ R 500 million annualised average contribution to the South African economy.

The extension of Tormin Mine will extend the Life of Mine (LoM) thereby securing long-term employment at the Mine and contribution to the local and regional economy. Approximately 80 additional employment opportunities will be created by the proposed Mine extension, predominantly at the proposed Mineral Separation Plant (MSP) and Reverse Osmosis (RO) Plant. The project will require an expected R 500 million capital investment and will contribute approximately R 1 billion per annum to the South African economy for up to the next 20 years.

The project if approved will contribute enormously to the local economy, the province infrastructure, and the national taxable revenue dollar (R1.5bn per annum).

MSR proposes to construct a MSP at Tormin Mine *to further beneficiate the concentrates produced* and increase overall mineral recovery. It is expected that the establishment of the MSP will result in the following benefits to MSR:

- Increase revenue by increasing mineral recovery to saleable products and production of higher value products;
- Reduce shipping costs as waste minerals will be rejected prior to export;
- Reduce processing costs than at alternative locations (e.g. USA, Australia);
- Reduce sale agreement risk between MSR and off-take customers as MSR will control mineral recovery and product quality via the MSP; and
- Upgrade the low grade ilmenite concentrate making it more marketable.

3 Proposed Mine Operations Expansion

MSR proposes to extend mining operations to ensure the ongoing operation of Tormin Mine. The proposed project consists of the following key activities which are described in further detail in the sections below *(refer to Appendix 5, Figures 1 to Figure 12):*

- *Ten beaches adjacent to Remainder of Graauw Duinen 152 and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline north of Tormin Mine comprising 43.7 ha mining and 2.1 ha beach access road widening (MSR advises that THG has active Mining Rights on these beaches for diamonds);*
- *Inland "Strand line" mining area on the Farm Geelwal Karoo 262, inland of the existing processing plant comprising 75 ha mining; and*
- *An infrastructure / plant expansion area of 64 ha adjacent to the existing processing plant to accommodate additional processing infrastructure, an MSP, an RO Plant, stockpile areas, process water dams, industrial yards, parking and laydown areas.*

3.1 Beach Mining

MSR proposes to mine VHM deposits on ten *discrete* beaches (identified as Beach 1 to Beach 10 *in Appendix 5, Figure 2*) along a stretch of coastline north of Tormin Mine. The proposed beach mining area is 43.7 ha while 2.1 ha will be disturbed for the widening and upgrade of beach access roads (Appendix 5, Figure 2 *to Figure 10*).

The VHM deposits in the beach extension area contain garnet, ilmenite, zircon and rutile. The mineral composition of the beach VHM deposits is presented in Table 3-1.

Table 3: Heavy mineral composition – beach VHM resource excluding replenishment

Mining Area	Total Resource (Mt)	Total HM %	Zircon % of resource	Ilmenite % of resource	Rutile % of resource	Garnets % of resource
Beach 1 - 10	2.03	22.65	0.68	3.62	0.47	16.71

Source: MSR, 2017

Beach mining will be conducted along the beaches between the *low-water mark of the sea and the toe of the dunes / cliffs with a 10 m buffer zone between the cliffs and the proposed beach mining area (refer to Appendix 5, Figure 3 to Figure 10)*. Mining will proceed along each beach depending on tides and mine schedule grade requirements.

VHM deposits will be mined to an average depth of 6 m. Where the VHM deposit is shallow or poorly developed, mining will take place where tides allow. Where thick VHM deposits are found near the low water mark, a sand berm, wave breaker (ditch *in the sand*), or similar will be constructed on the seaward side of the deposit, providing temporary safety protection from the incoming tide whilst ensuring the mining process is efficient and minimising the need to return to the same area following tide retreat.

Mining will be undertaken using hydraulic excavators, slurry pumps and other ancillary equipment (e.g. graders, watercart, dozer) to feed the ore into a mobile PBC. Considering the number of trucks required to transport material to the processing plant at Tormin Mine, it would be more efficient and have less impact to concentrate the material on the beaches and transport the concentrate to the processing plant. This will also reduce the number of truck trips along OP9764 between the beaches and the processing plant. The ore will be processed (primary processing) on the beaches using two mobile PBCs at 120 tph to extract the heavy mineral concentrate (about 20-40% of the ore will concentrated by the PBCs). The concentrate will be loaded into ~40 ton dump trucks and hauled up the beach access road to the haul road and then onward to the ROM stockpiles at the processing plant for further processing.

Once the deposit has been mined, wave action will quickly return the beach to its former condition *in a short period of time* (and partly replenish VHM deposits). In some instances, a bulldozer will reshape the beach to the original profile *where mining occurs above the high-water mark*.

MSR will coordinate beach mining activities with THG, which has the right to mine diamondiferous gravel on the beaches, to ensure efficient mining of the VHM deposit and the diamondiferous gravel.

Figure 4: Beach 5 (left) and Beach 6 (right)

3.2 Inland Strand Line Mining

MSR is proposing to mine a 75 ha inland VHM deposit in an area *100 - 300 m wide and ~4.8 km* long inland (east) of the existing processing plant, but seaward of the Sere wind energy facility (Figure 5*). The inland mining area will consist of a north inland mining area and a south inland mining area on either side of the proposed infrastructure / plant expansion area (Appendix 5, Figure 11).*

Figure 5: View across the inland strand line with the existing processing plant right of photograph

A total of ~ 13.5 Mt of material will be mined at the inland strand line. The mineral composition of the inland VHM deposit is presented in Table 3-2.

Table 4: Heavy mineral composition – inland VHM deposit

Mining Area	% of Mining Area	Total VHM		Zircon		Ilmenite		Rutile		Garnet	
		%	tons	%	tons	%	tons	%	tons	%	tons
Upper Ore	68	15.9	1,451,990	1.5	136,980	8.9	812,749	0.6	54,792	2.6	237,432
Lower Ore	32	30.4	1,327,716	3.0	131,025	17.63	755,575	0.7	30,572	4.8	209,639

Source: Synergy Mining, 2017

Strip mining of the inland strand line will be undertaken progressively as discussed below (refer to the typical mine layout, Figure 6):

- Vegetation and topsoil (to a depth of approximately 50 cm) will be stripped by bulldozers and scrapers *just before mining activities occur*, and stored in stockpiles in *designated* areas or - where mine sequencing allows - placed directly over tailings backfilled to the preceding mine void. *This has the advantage of ensuring that vegetative material (including the seedbank) is returned to or very close to the area from which it was removed.* Topsoil from the initial box cut will be stored in the existing topsoil storage area (Appendix 5, *Figure 11) because an area readied for rehabilitation will not be immediately available*;

- *Overburden*[5] *will be removed to a depth of 2-25 m (depending on resource depth) and will immediately be backfilled into an adjacent, previously mined-out area or temporarily stored in the designated overflow areas (north and south) located in the infrastructure / plant expansion area (Appendix 5, Figure 12. Long-term storage of overburden will only be required when mining in a new discrete area commences, i.e. when overburden is removed for the first time and no proximate mined-out area is available for backfilling;*
- A 15 m wide haul road on the western side of the proposed *mining areas*, and ramps, will provide access into the pit for mining vehicles and plant / equipment. The haul roads *between the mining areas and the infrastructure / plant expansion area* will be located within the proposed mining *areas or infrastructure / plant expansion area footprints*;
- Excavators will mine the mineralised sand layer *up to a maximum depth of* 30 m (average of 10 m). The sand and ore will be loaded into dump trucks and transported to the existing ROM stockpiles at the processing plant *or the new ROM stockpile area in the infrastructure / plant expansion area (Appendix 5, Figure 12). The ore extraction process is entirely mechanical and no chemical compounds will be used other than fuel and lubricants to power equipment and machinery*;
- Tailings will be returned (pumped) to the mine void as backfill (see Section 3.5, "Tailings Management") *and then covered with stockpiled overburden and topsoil material*; and
- Rehabilitation will be undertaken as soon as the mining path allows. *Once an area has been mined and backfilled, the backfilled material will be re-profiled to create the desired landform. Re-profiling will aim to mimic the pre-mining topography as far as possible, but the final land surface will be lower than the original landform due to the removal of the ore.* The backfill material will be reseeded (if required) and the final rehabilitated area demarcated as a No-Go area.

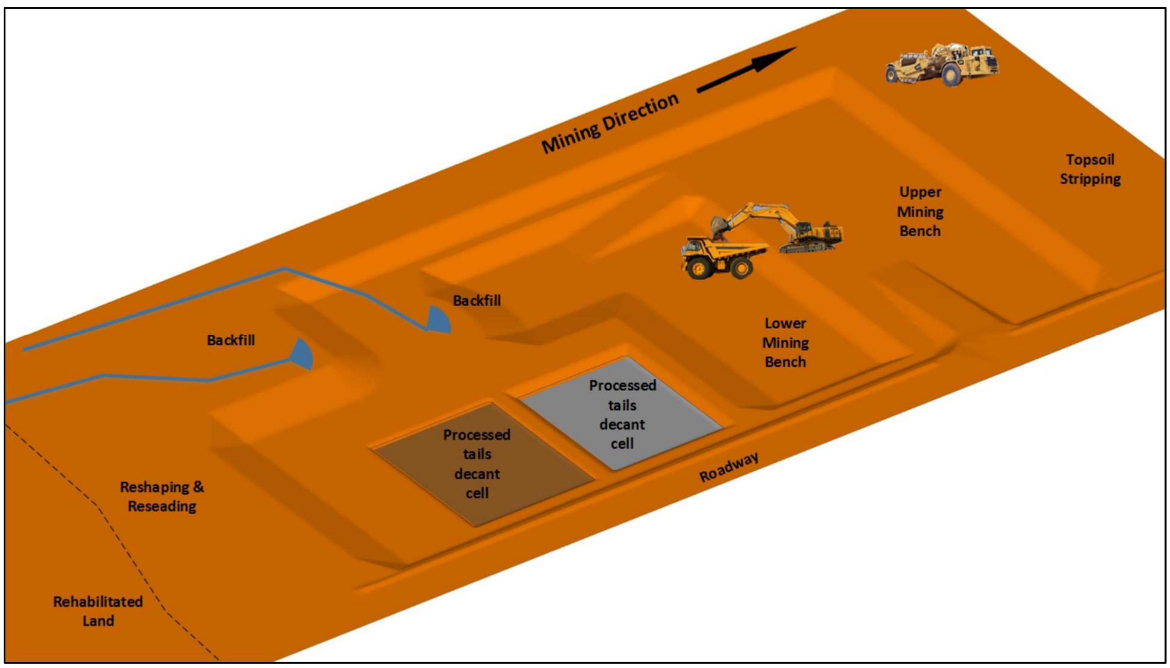


Figure 6: Typical mine layout

Source: Synergy Mining, 2017

3.3 Ore Transport and Storage Areas

3.3.1 Beach Mining

MSR proposes to utilise existing gravel roads from the Tormin Mine entrance (off the DR2225) to the beaches

[5] *Overburden is the material that lies above the area of economic interest, i.e. the soil that lies above the VHM deposit.*

to serve as haul roads for dump trucks (Figure 7). This includes public road OP9764 adjacent to the coast (Appendix 5, Figure 2) and informal beach access roads *currently* used by THG and, previously, by Namakwa Diamond Company and De Beers *(Appendix 5, Figure 3 to Figure 10) for their mining operations in the same area*.

Beach 1 and Beach 10 are located approximately 2.5 km and 19 km from the Tormin Mine entrance, respectively. The access roads from OP9764 to the beaches will be via existing gravel roads which range between 150 m and 2.2 km in length with an average of about 500 m.

Existing beach access roads will be widened by a maximum of 4 m *to achieve a road width of 7 – 8.75 m. An area of ~ 2.1 ha will be disturbed by road widening (Table 3-3). The cross-fall of the beach access roads will be between 3-6% to ensure adequate drainage and reduce erosion potential. Where stormwater run-off is expected, cut-off berms will be constructed on the road edge[6]. A typical cross-section through a beach access road, with stormwater protection at the toe of the slope is provided in Figure 3-5.*

MSR will grade the roads as required. A suitable quality wearing course will be used which may need to be replenished (due to gravel loss). The thickness and type of the wearing course layer will depend upon in-situ testing to assess if the material is suitable for compaction, or whether additional structural layers are required. The quality of material is expected to be at least a G7 material.

Table 5: Beach access road widening

Beach	**~ Length (m)**	**~ Average width (m)**	**Proposed widening (m)**	**Proposed width (m)**	**Disturbed area (m^2)**
Beach 1	2 240	5	3.75	8.75	8 400
Beach 2	550	4	4	8	2 200
Beach 3	250	4	4	8	1 000
Beach 4	350	3	4	7	1 400
Beach 5	220	4	4	8	880
Beach 6	150	3.5	4	7.5	600
Beach 7	340	7	1.75	8.75	595
Beach 8	450	3.5	4	7.5	1 800
Beach 9	280	4	4	8	1 120
Beach 10a	290	3	4	7	1 160
Beach 10b	400	4	4	8	1 600
Total disturbed area (m^2)					20 755
Total disturbed area (ha)					**2.0755**

Dump trucks, with a payload of ~ 40t will transport *approximately 800 tonnes of concentrate per day* from the beaches to the processing plant. *Approximately 20 truck return trips per day are planned between the beaches and the processing plant.* The haul roads will also be used by light vehicles to transport staff, fuel, water and equipment to the beaches.

In consultation with the relevant roads authority, MSR will implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use OP9764 to access this stretch of coast.

[6] *Any stormwater protection measures will be installed within the maximum road widening width of 4 m.*

Figure 7: Example of a dump truck MSR intends using to haul ore from the beaches to the plant

Source: IVECO, 2017

Excavators *and mobile PBCs (Figure 8)* will be walked slowly to the beach or transported on a *low-loader*, depending on access road conditions and distance. *The mobile PBCs may be moved onto the beach access ramps during high tide. No other infrastructure or laydown areas are proposed for beach mining activities.*

No additional ore storage areas are required for beach mining activities.

Figure 8: Example of a mobile PBC potentially to be used by MSR on the beaches

Source: MSR, 2017

3.3.2 Inland Mining

A 15 m wide haul road *on the western side of the proposed mining areas, and temporary access ramps (at ~8 degrees), will provide access into the pit for mining vehicles and plant / equipment. The haul roads between the mining areas and the infrastructure / plant expansion area will be located within the proposed mining areas or infrastructure / plant expansion area footprints.*

MSR will either utilise existing ROM stockpile areas at the processing plant or new ROM stockpile areas in the infrastructure / plant expansion area (Appendix 5, Figure 12).

Overburden and topsoil will either be stockpiled in the previous mining area or in the designated overflow areas (north and south) located in the infrastructure / plant expansion area (Appendix 5, Figure 12). Topsoil from the first boxcut will be stored in the existing topsoil stockpile area at the Mine for rehabilitation (Appendix

5, Figure 11).

An additional product stockpile area is included in the infrastructure / plant expansion area (Appendix 5, Figure 12).

All stockpile areas in the infrastructure / plant expansion area will be lined and any seepage from the stockpiles will be decanted into sumps and returned (pumped) to the process water dams. MSR estimates that the moisture content of the ROM stockpiles will be ~4%, the concentrate and process stockpiles will be ~10% and the product stockpiles will be ~1%.

3.4 Transport of Product to Saldanha and Cape Town

Transport of product to the Port of Saldanha (*for bulk export*) and Port of Cape Town (*for bagged product export in containers*) will be on public roads, using 40 t road trucks (B Doubles). Assuming annual production of saleable product of *~750 000 tpa* there will be 20 - 50 truck movements per day. Approximately *689 000 tpa* of total annual production is expected to be transported to Port of Saldanha and approximately *61 000 tpa* is expected to be transported to Port of Cape Town.

MSR are currently exploring the option of carting material via rail networks and are discussing this option with Transnet and various service providers[7].

3.5 Tailings Management

3.5.1 Beach Mining

A front-end loader or excavator will load the ore into the PBC where the heavy and light particles will be separated by means of gravity separation, with seawater added via a slurry pump (Figure 9). Tailings (mainly quartz *[beach sand]*) from the mobile PBC will be discharged onto the beach (above the tide level) and, because of the *low solids content of the slurry and the energy of the waves*, will disperse quickly on the beach.

Approximately 1-2% of beach mine tailings will be discharged via the existing tailings discharge pipeline from the processing plant onto the beaches adjacent to Farm Geelwal Karoo 262 (Appendix 5, Figure 12).

Figure 9: Example of an excavator and slurry pump potentially to be used by MSR on the beaches

Source: MSR, 2017

[7] *As an agreement between MSR and Transnet has not yet been finalised, the traffic specialist will assess the worst case scenario for the number of truck movements per day between the Mine and the Port of Saldanha and Port of Cape Town.*

3.5.2 Inland Mining

The average tailings production is approximately 80% of ROM. Total anticipated tailings from inland mining will be approximately 10.8 Mt. Tailings will have a (seawater) *water* content of ~ 65% with the aim of extracting 100 % of free-flowing (decant) water after settlement.

Tailings will be hauled or pumped as a slurry from the processing plant and backfilled in the mine void[g], with a portion used to construct containment cells within the mine void. Tailings, including fine tailings, from the processing plant will be conveyed by pipeline and deposited in the containment cells. The fine tailings and slimes (estimated to be ~1% by volume) will be allowed to settle in the containment cells. Water in the fine tailings and slimes will either be pumped from the containment cells via a decant pipeline or will drain through the containment (sand) walls and pumped to the *process water dams* for reuse in processing *(Figure 3-8)*.

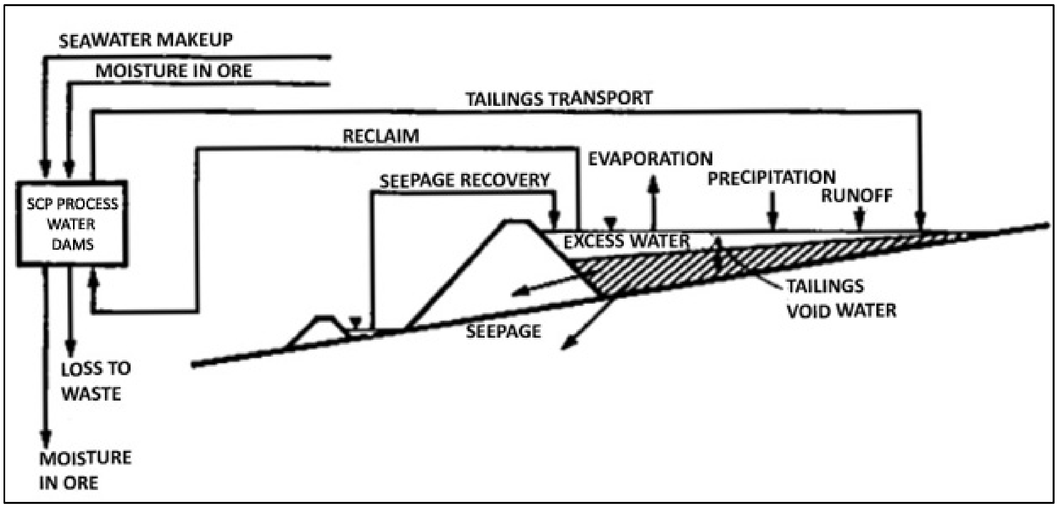


Figure 10: Conceptual diagram of the tailings water balance

Source: Adapted from AEMCO, 2017

Backfilled tailings *and overburden* will be profiled to mimic original topography as closely as possible before topsoil is replaced for rehabilitation following reseeding, where required.

Residue Characterisation

The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits (GN 632 of 2015) specify requirements for managing mine residue deposits based on the type of the residue. In accordance with section 7 of the Regulations, the design of residue stockpiles and residue deposits must take cognizance of the residue characterisation.

The National Norms and Standards for the Disposal of Waste to Landfill (GN636 - promulgated in terms of the National Environmental Management Waste Act 59 of 2008 [NEM:WA]) specify design requirements for residue deposits (in this case the mine void) based on the type of the residue (in this case tailings and fine tailings). Waste type is determined based on chemical characterisation. The Regulations specify the class of residue disposal facility required for each waste type.

The residue characterisation study by AEMCO analysed the chemistry of the residue material and the chemistry of the receiving environment at Tormin Mine. Based on the chemical analysis (Table 3-4), no acid forming minerals (e.g. sulphides) were identified. The calcrete horizons and host layers of the area have a high alkalinity level (high pH) as indicated in Table 3-4 thereby providing a natural buffer to any potential acid mine drainage. Based on samples taken, AEMCO considers the tailings at Tormin Mine to be inert and chemically stable without the potential to form a leachate, even with the use of seawater in processing.

The use of seawater in processing will introduce additional salts into the receiving environment. These salts are highly soluble and can be easily mobilised by groundwater or rainwater and leach into the surrounding environment.

The salt load introduced into the mine void is comparable to the salinity levels of the receiving environment (Table 3-5). The bedrock clayey sand-schist layer and the strand line material is brackish to highly brackish. This is because the receiving material is the product of marine erosion and deposition and was exposed to seawater during formation. The material with the lowest salt load is the near surface material (topsoil) with a salt load of 1785 mg/kg (Table 3-5). This is still considered by AEMCO to be brackish alkaline material.

Table 6: Chemical analysis of residue material at Tormin Mine

			Sea Water	Plant return wate	Inland Strandline					Basement	
		Units		S/P (Slimes)	T/S (Topsoil)	C/S (Clayey Sand)	A/S (Aeolian Sand)	M/L (Strandline)	P/L (Pebbly Layer)	C/C (Clayey Sand/ Channel Clay)	S/T (Schist)
Chemistry Parameters	Alkalinity-Total as $CaCO_3$	(mg/kg as $CaCO_3$)	141	69.6	119	523	28.8	110	167	75.9	19.8
	pH @25°C	pH units	7.5	9.34	8.09	8.66	7.07	8.23	8.5	8.24	7.06
Physical Parameters	Electrical Conductivity @25°C	mS/m	5300	2148	255	807	864	389	429	708	1410
	Total Dissolved Solids @105°	mg/kg	**37100**	**15036**	**1785**	**5649**	**6048**	**2723**	**3003**	**4956**	**9870**
Cations and Anions	Calcium as Ca	mg/kg	426	693	7.11	25.2	16.1	2.51	4.65	29.9	66.1
	Sodium as Na	mg/kg	11300	3860	465	1720	1670	777	863	1390	2830
	Magnesium as Mg	mg/kg	1100	68.8	4.93	5.79	16.6	2.17	5.29	20.2	80.8
	Potassium as K	mg/kg	603	217	53.4	96.6	178	36.1	54.9	88.2	191
	Chloride as Cl^-	mg/kg	20400	6540	570	1950	2340	1002	1104	2280	3840
	Fluoride as F^-	mg/kg	1.07	2.73	0.57	3.33	<0.3	1.44	2.85	0.66	0.84
	Sulphate as $SO4^{2-}$	mg/kg	2740	1080	195	451	569	184	249	328	719
	Nitrate as N	mg/kg	<0.5	1.8	1.8	2.1	<1.5	<1.5	3	1.8	1.5
	Bromine as Br_2	mg/kg	<0.1	4.38	12.8	20.4	0.78	11.8	11.9	1.8	2.25
		Total Soluble Salts cations & anions (mg/kg	**36,570**	**12,468**	**1,311**	**4,274**	**4,790**	**2,017**	**2,299**	**4,141**	**7,731**
		Ranking (Soluble Salts/ Electrical Conductiv	1	2	9	5	4	8	7	6	3

Source: AEMCO, 2017

Table 7: Chemical analysis of receiving material at Tormin Mine

			Sea Water	Plant return water	Inland Strandline					Basement		Tails	
		Units		S/P (Slimes)	T/S (Topsoil)	C/S (Clayey Sand)	A/S (Aeolian Sand)	M/L (Strandline)	P/L (Pebbly Layer)	C/C (Clayey Sand/ Channel Clay)	S/T (Schist)	T/SW (Wet Tails)	T/SD (Dry Tails)
Chemistry Parameters	Alkalinity-Total as	(mg/kg a	141	69.6	119	523	28.8	110	167	75.9	19.8	143	92.1
	pH @25°C	pH units	7.5	9.34	8.09	8.66	7.07	8.23	8.5	8.24	7.06	8.27	9.11
Physical Parameters	Electrical Conductivity @25°C	mS/m	5300	2148	255	807	864	389	429	708	1410	5270	1641
	Total Dissolved Solids @105°C	mg/kg	37100	15036	1785	5649	6048	2723	3003	4956	9870	36890	11487
Cations and Anions	Calcium as Ca	mg/kg	426	693	7.11	25.2	16.1	2.51	4.65	29.9	66.1	715	510
	Sodium as Na	mg/kg	11300	3860	465	1720	1670	777	863	1390	2830	12900	2610
	Magnesium as Mg	mg/kg	1100	68.8	4.93	5.79	16.6	2.17	5.29	20.2	80.8	1710	131
	Potassium as K	mg/kg	603	217	53.4	96.6	178	36.1	54.9	88.2	181	710	230
	Chloride as Cl^-	mg/kg	20400	6540	570	1950	2340	1002	1104	2280	3840	22100	5430
	Fluoride as F^-	mg/kg	1.07	2.73	0.57	3.33	<0.3	1.44	2.85	0.66	0.84	1.1	<0.10
	Sulphate as $SO4^{2-}$	mg/kg	2740	1080	195	451	569	184	249	328	719	3600	714
	Nitrate as N	mg/kg	<0.5	1.8	1.8	2.1	<1.5	<1.5	3	1.8	1.5	0.9	2.1
	Bromine as Br^-	mg/kg	72.8	8.6	2.2	2.5	3.1	1.04	1.18	2.2	4.6	99.6	26
			Fresh										
			Brackish										
			Highly Brackish										
			Saline										
			Sea Water										

Source: AEMCO, 2017

The aim of the Regulations is to manage risk to the environment and potential impacts on sensitive receptors. Primary and secondary processing at the Mine does not require chemical processing or treatment. In other

[8] *The total length of the tailings disposal pipeline from the processing plant to the north and south inland mine areas will be ~ 5 km with an outside diameter of 315 mm.*

words, discharged tailings are benign and contain no harmful chemicals or substances. However, seawater is used during processing, which produces a slurry with elevated salinity levels.

The risk-based approach and residue characterisation study by AEMCO concluded the following:

- *The source material holds no risk of creating acid mine drainage;*
- *The tailings material is sourced from its depositional host material and reflects the chemistry type of the receiving environment;*
- *The environment is dry and has a negative water balance. The potential of rainfall mobilizing a salt plume is low;*
- *Limited groundwater has been found by MSR below the inland mining area to a depth of ~20 m below sea level or ~60 m below the proposed mining area; and*
- *Groundwater quality in the area is saline and not suitable for potable use.*

Preliminary investigations therefore indicate that the mine residue can be classified as a Type 4 waste. The waste classification, in terms of the Regulations, will be reported in the Impact Assessment Phase.

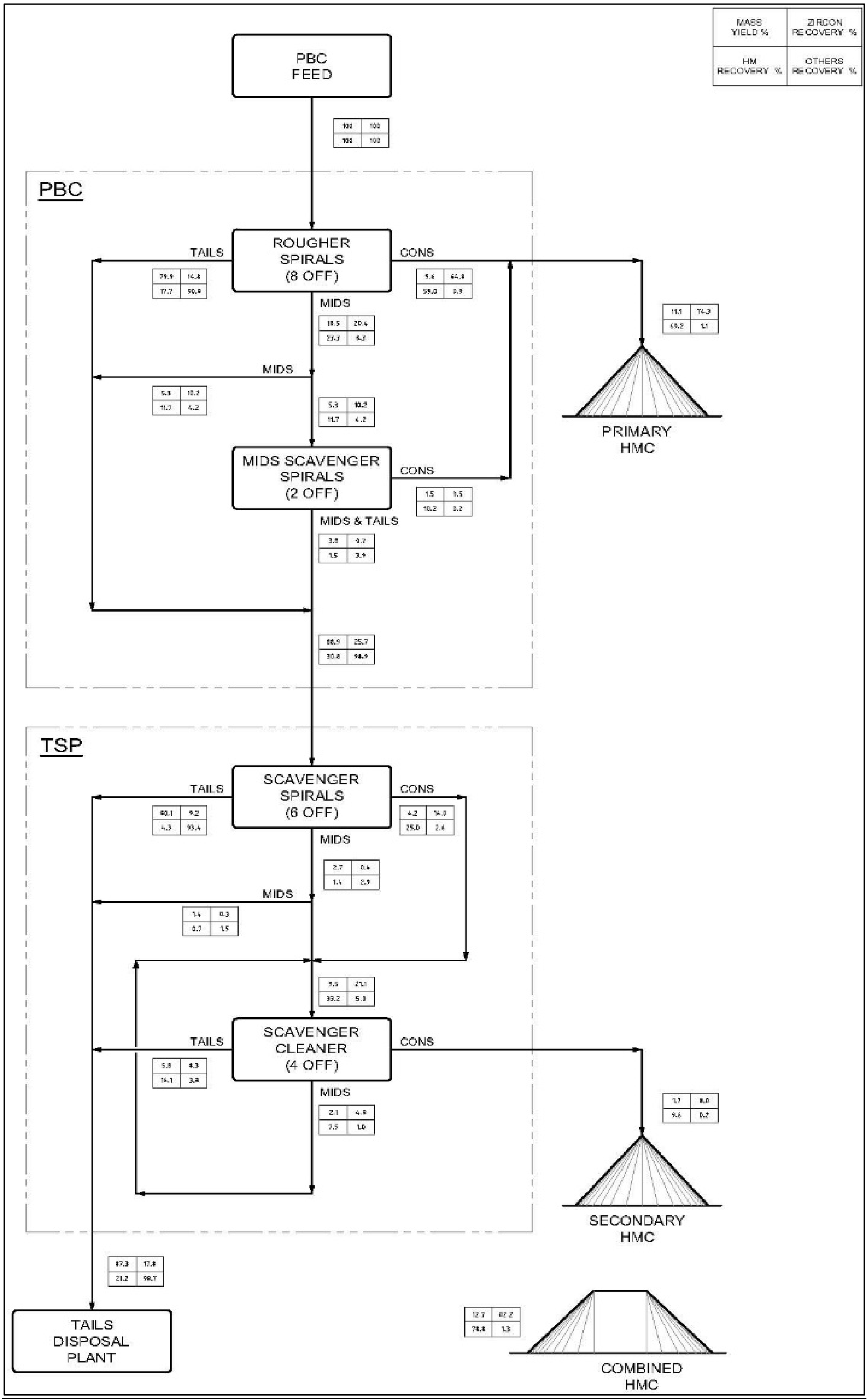
3.6 Primary Concentration Circuit Improvements

MSR has identified opportunities to increase VHM concentrate production (Table 3-6) by increasing both throughput and recovery of VHM through the Primary Concentration Circuit (PBC and TSP modules). The improvements will be implemented in stages:

- *Stage 1(a) - Improve performance of the existing Primary Concentration Circuit via installation of a new Feed Preparation Circuit including a Constant Density Tank. The feed preparation circuit will have a throughput capacity of 500 tph to accommodate increased ROM feed from the inland strand line mining area.*
- *Stage 1(b) - Increase the throughput capacity and overall VHM recovery of the Primary Concentration Circuit to 320 tph via modifications to the existing PBC and TSP modules. Two additional spirals will be retrofitted to each PBC and TSP module to reduce spiral loading. The modifications made to the Primary Concentration Circuit are summarised in the block flow diagrams below (Figure 3-9).*

The Primary Concentration Circuit and the Tailings Disposal Plant will be relocated to the infrastructure / plant expansion area (Appendix 5, Figure 12).

Stage 1(a) will improve plant availability and metallurgical performance of the PBC and TSP modules and Stage 1(b) will increase VHM concentrate production from 576 840 tpa to ~ 750 000 tpa and improve heavy mineral recovery.


MASS YIELD %
ZIRCON RECOVERY %
HM RECOVERY %
OTHERS RECOVERY %
PBC FEED
PBC
ROUGHER SPIRALS (8 OFF)
TAILS
CONS
MIDS
MIDS
PRIMARY HMC
MIDS SCAVENGER SPIRALS (2 OFF)
CONS
MIDS & TAILS
TSP
SCAVENGER SPIRALS (6 OFF)
TAILS
CONS
MIDS
MIDS
SCAVENGER CLEANER (4 OFF)
TAILS
CONS
MIDS
SECONDARY HMC
TAILS DISPOSAL PLANT
COMBINED HMC

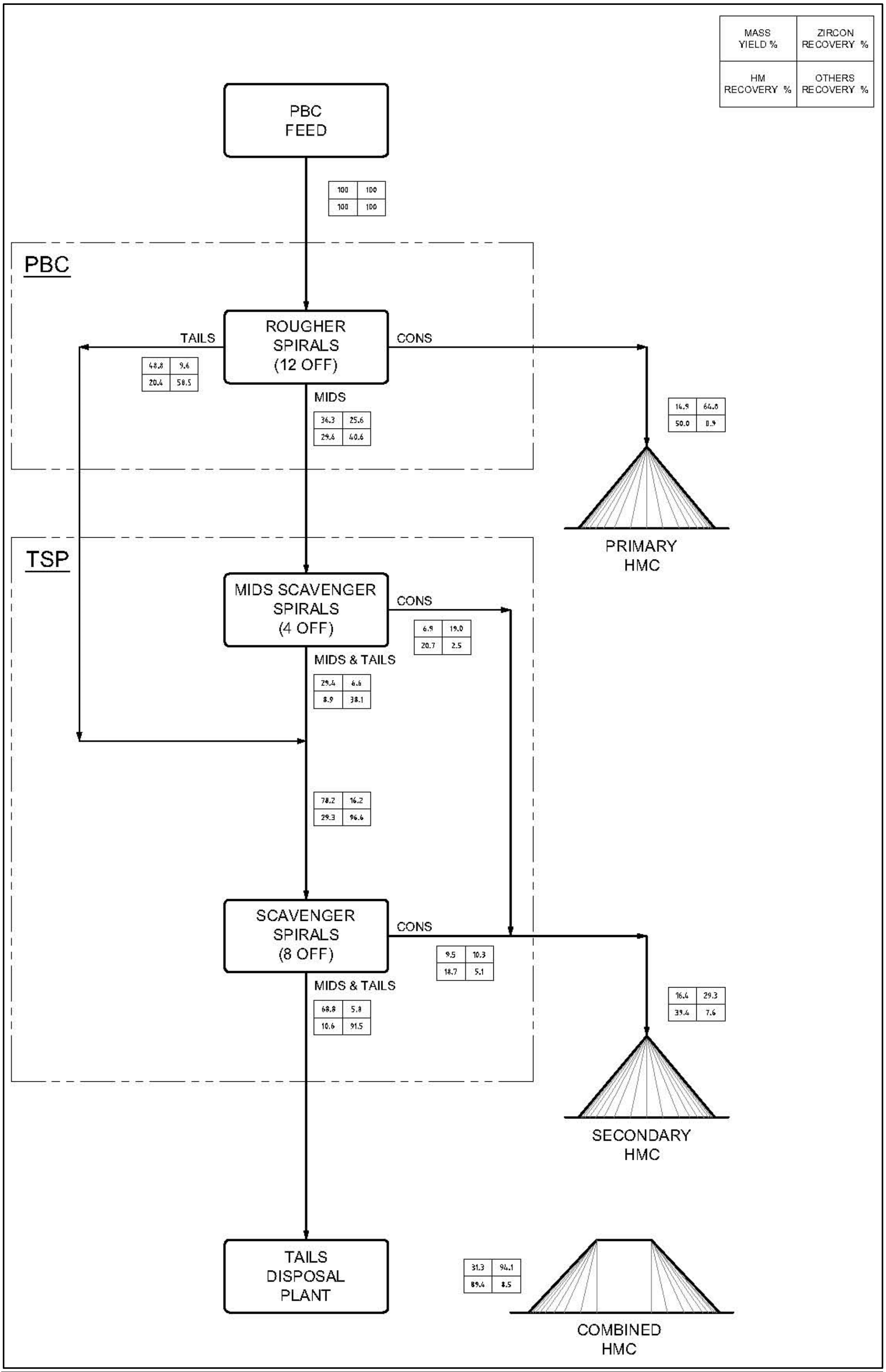


Figure 11: Primary Concentration Circuit – existing (top) and proposed (bottom)
Source: MSP Engineering, 2017

Table 8: Current and anticipated production rates

Description	***Unit***	***Current***	***Anticipated***
VHM Concentrate Production	*tph*	*76.6*	*100*
Annual VHM Concentrate Production	*tpa*	*576 840*	*752 850*
Garnet Concentrate	*tpa*	*170 658*	*284 127*
Ilmenite Concentrate	*tpa*	*81 696*	*109 858*
Non Mag Concentrate	*tpa*	*19 977*	*29 293*
Seawater Requirement	*m^3/h*	*337*	*600*[9]
Seawater Requirement per tonne VHM Concentrate	*m^3/h*	*4.39*	*4.34*

Currently, MSR uses 4.39 m^3 seawater to produce 1 tonne of VHM concentrate. With the proposed processing plant improvements, seawater use for production is likely to be of a similar magnitude (4.34 m^3/h) for each tonne of VHM concentrate produced. The total (proposed) seawater use at Tormin Mine is provided in Section 3.8.

3.7 Mineral Separation Plant

MSR proposes to construct an MSP at Tormin Mine to beneficiate the concentrates *to produce higher value products* and increase overall mineral recoveries *into payable streams*. The MSP and associated facilities will be constructed within the infrastructure expansion / plant area immediately east of the existing product stockpiles (Appendix 5, Figure 4). The MSP will consist of the main plant building (~45 m x 25 m x 20 m), three storage sheds (total: ~100 m x 75 m x 15 m), an administration building (~20 m x 20 m x 5 m) and a stockpile area, which will, where possible, utilise the cleared strand line area to reduce the overall disturbance footprint. The dimensions of the MSP infrastructure described above may change following detailed design, but will remain within the infrastructure expansion area.

The MSP will recover additional minerals from the non-magnetic (*rutile/zircon*) concentrate, garnet concentrate and magnetic (*ilmenite*) concentrate. The concentrate streams will be dried and processed using magnetic and *electrostatic* separation techniques to produce high grade and/or finished ilmenite including secondary ilmenite (leucoxene), garnet, material containing magnetite, zircon and rutile products for export.

The MSP will consist of four main circuits:

- Concentrate Wash Circuit;
- Concentrate Dryer Circuit;
- Garnet / Ilmenite MSP Circuit; and
- Non-Magnetic MSP Circuit.

3.7.1 Concentrate Wash Circuit

The Concentrate Wash Circuit removes any free salt from the concentrates prior to being fed into the other circuits. Although all products will be able to be washed in this circuit, initially the garnet concentrate will be fed through the Concentrate Wash Circuit due to customer requirements.

[9] *Includes anticipated seawater use if mining recommences on the existing beaches.*

3.7.2 Concentrate Dryer Circuit

All non-magnetic and magnetic concentrates will be processed in the Concentrate Dryer Circuit into dry mineral concentrates at a *feed* rate of *up to* ~60 tph.

A dryer will dry the non-magnetic concentrate for the downstream MSP Circuits.

Magnetic concentrates will be loaded into *the* dryer and then screened, before being fed into their respective MSP Circuits.

3.7.3 Garnet / Ilmenite MSP Circuits

The Garnet MSP Circuit will process the garnet concentrate including secondary garnet concentrates recovered from the Magnetic and Non-Magnetic MSP Circuits. The Garnet MSP Circuit will have a target output capacity of ~ 75 000 tpa.

The dry garnet concentrate will be fed to the scavenger magnetic circuit, where magnetite and other highly magnetically susceptible minerals will be scalped ahead of the high intensity downstream rare earth magnets. The magnetite will be conveyed to the ferro-magnetics stockpile for potential product expansion and blending opportunities. The *less magnetically susceptible minerals (ilmenite and garnet) as well as the* non-magnetic *minerals in the garnet concentrate* will be processed in the magnetic fractionation circuit.

Four fractions of varying magnetic susceptibility will be produced. The most magnetic (M1) stream, consisting predominantly of ilmenite, will be stockpiled to be reconstituted with the Magnetic MSP Circuit feed. The M2 stream, a mixture of ilmenite and garnet, will be processed through a further magnetic separation stage whilst the M3 stream will be conveyed to the garnet product stockpile. The non-magnetic fraction will be stockpiled to be periodically reconstituted with the Non-Magnetic MSP Circuit feed.

The M2 garnet / ilmenite fraction will be fed to the primary magnetic separator circuit. The magnetic fraction will be reprocessed whilst the non-magnetic fraction will report to the garnet product stockpile.

The Ilmenite (Magnetic) MSP Circuit will process ilmenite concentrate (magnetic concentrates), including secondary ilmenite concentrates recovered from the non-magnetic and garnet facilities. The Ilmenite MSP Circuit will have a target output capacity of ~ 200 000 tpa.

The dried magnetic concentrate will be fed to the *electrostatic* separation circuit to separate conductive ilmenite (*and rutile*) *from* non-conductive zircon and garnet. The non-conductors will be processed via a magnetic separation circuit to separate magnetic garnet and non-magnetics (*zircon and silica*), following which the garnet and non-magnetic concentrates will be stockpiled for reprocessing.

Conductors from magnetic separation will be subjected to a two stage magnetic separation circuit to recover non-magnetic concentrates (*predominately rutile*) from the magnetic ilmenite concentrate. Non-magnetic concentrates will initially report to the non-magnetic stockpile for reprocessing. Conductors will report to the ilmenite product storage area.

3.7.4 Non-Magnetic MSP Circuit

Studies are underway to determine the most efficient process to extract the non-magnetic concentrate, including secondary non-magnetic concentrates recovered from the Magnetic and Garnet MSP Circuits, which will produce finished zircon and rutile concentrates. Feasibility studies show that the Non-Magnetic MSP Circuit will have a target output capacity of ~ 57 000 tpa.

3.7.5 Associated Facilities and Services

All final product stockpiles from the MSP will be transferred by conveyors from the MSP and placed on concrete pads in new concrete storage sheds located in the infrastructure expansion area (Appendix 5, Figure 3).

Fresh water will be required in the Concentrate Wash Circuit of the MSP. The circuit will largely be a closed circuit as fresh water will be used multiple times in the Circuit to wash concentrates. The RO Plant will provide top-up fresh water to the Concentrate Wash Circuit as required.

Installed power required for the MSP is estimated at 1.4 MW. The gensets cannot economically meet this demand. MSR proposes to connect to the grid and is in discussions with Eskom to connect to the Sere wind energy facility (see Section 3.11, "Power Supply").

3.8 Water Supply

The seawater intake volume will increase as MSR proposes *to make improvements to the Primary Concentration Circuit (Section 3.6 and Table 3-6) and* to construct an RO Plant to supply fresh water for use in *concentrate washing* (e.g. in the MSP, see below) and, where possible, to supply fresh water for operational purposes (rather than trucking water in from Lutzville).

Currently, MSR extracts 337 m^3/h seawater for production and dust suppression. It is anticipated that with production improvements (Section 3.6), requirements for the RO Plant (Section 3.8.1), and if mining of the current beaches recommences, seawater extraction may increase to 656 m^3/h (Table 3-7).

Table 9: Seawater use at Tormin Mine

Seawater Use	***Unit***	***Current***	***Anticipated***
Steady State Requirement for Production (including dust suppression)	*m^3/h*	*337*	*600*
RO Plant	*m^3/h*	*-*	*56*
Total per hour	*m^3/h*	*337*	*656*
Total per day	*m^3/d*	*8 088*	*15 744*

Additional fresh water and seawater storage capacity is needed as discussed below.

3.8.1 Reverse Osmosis Plant

MSR proposes to install an RO Plant to supply fresh water to the Mine. *The fresh water will primarily be used to wash the concentrates to remove any salts and for domestic purposes.*

The RO Plant will have a footprint of approximately 15 m x 30 m and will be located in the infrastructure expansion area (Appendix 5, Figure 12). Associated infrastructure will include a pipeline[10] from the existing seawater intake point, an existing raw water (seawater) dam, a fresh water dam and a pipeline[11] to an effluent (primarily brine) discharge outfall. *The marine ecology specialist will assess three outfall location alternatives along MSR's existing seawater intake pipeline – two offshore locations beyond the surf-zone and one near-shore location within the surf zone.*

The RO Plant will have the capacity to operate continuously providing ~24 m^3/hour of fresh (potable) water at a fresh water recovery rate of 43%.

The primary treatment steps are presented in Figure 10 and discussed below.

Intake System

Seawater will be abstracted at the existing seawater intake point *at a rate of 56 m^3/h* and piped to the existing *new process water dam*. Feed water will be pumped from the raw water dam to the pre-filtration system at the RO Plant. To control microbiological activity, chlorine will be introduced into the feed line to a raw water storage tank. Similarly, coagulant (e.g. ferric chloride) is injected to assist with the removal of suspended

[10] *Total length of seawater intake pipeline = ~ 1.5 km and outside diameter of pipeline = 315 mm.*
[11] *Total length of outfall pipeline = ~ 1.8 km and outside diameter of pipeline = 315 mm.*

solids, organics and to reduce turbidity. Acid is dosed for pH adjustment to improve the efficiency of the coagulant.

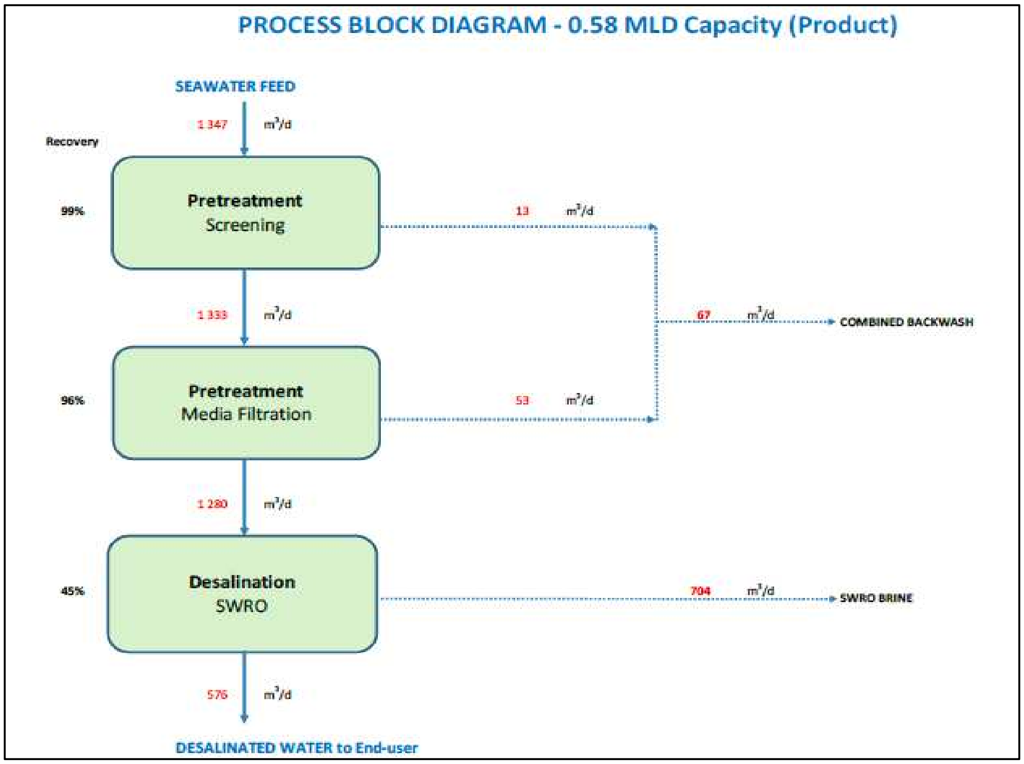


Figure 12: Process flow diagram for the RO Plant

Source: Proxa, 2016

Pre-treatment System

The aim of pre-treatment of feed water (raw water in the system) is to minimise the fouling of RO membranes by producing feed water compliant with water quality specifications. Pre-treatment includes screening to remove plankton and algae and filtration (with downflow, pressure filters) to remove suspended solids and reduce turbidity.

All filtration processes give rise to a waste streams containing the filtered solids and any coagulant used. Flocculated water is then filtered down through the media layers capturing the suspended matter. Once enough material is collected in the filter or after a pre-determined time the flow is reversed and the captured material is removed from the filter media through a backwash process.

Waste (backwash) from pre-treatment will be blended with other waste from the system and discharged to the sea via the brine discharge system.

RO Desalination System

The conditioned feed water from the pre-treatment system is directed to the high pressure pumping system, where it is forced through semi-permeable membranes under high pressure. This process retains the brine (high salinity salts and organics) on one side of the membranes and allows the water (of very low salinity) to pass to the other side. The desalinated water is piped to the new fresh water dam (75 m x 35 m x 6 m, 10 000 m^3) adjacent to the RO Plant as required. The aim is to reuse this water multiple times in processing until the mineral content is too high. The process water will then be discharged with the tailings stream to the beach.

Waste Outfall System

The effluent generated by the plant will be directed to a waste water storage tank. On average, 57% of the seawater passing through the RO Plant will be discharged to the sea as brine. Brine is the portion of feed water which does not pass through the membranes in the high pressure pumping system. Brine has higher salinity and a slightly increased temperature compared to the incoming raw seawater.

The discharge system would allow for the discharge of brine, filter backwash waste and spent membrane cleaning solutions. The cleaning chemicals used for the RO membranes constitute relatively small quantities and cleaning should not occur very often.

The combined waste streams are pumped from the waste water storage tank to the *effluent discharge point (outfall) located along MSR's existing seawater intake pipeline. Various outfall locations will be identified and assessed by the marine ecology specialist. The pipeline (315 mm outside diameter) will be laid on the seabed adjacent to the existing seawater intake pipeline and fastened in place with concrete blocks.*

Brine discharge diffusers at the outfall will disperse the brine. Brine is negatively buoyant and will tend to sink towards the seabed. The rate of brine discharge as well as the discharge infrastructure is intended to ensure that the concentrated brine mixes with the seawater and is diluted as quickly as possible, and that brine does not accumulate within the surf zone in the vicinity of the discharge outfall. Discharged brine at maximum plant capacity is anticipated to have temperatures typically 2°C higher than at the raw seawater intake and a salinity level of between 40 000 and 63 000 mg/l (as opposed to typical seawater levels of 36 000 mg/l).

3.8.2 Process Water Dams

Additional process water dams are required to accommodate increased water consumption rates for strand line mining, and to ensure there is adequate water supply for the processing plant at all times. The additional process water dams will also be used to store fresh water from the RO Plant – MSR intends on using the fresh water from the RO Plant numerous times in the processing plant prior to discharge into the sea.

These process water dams will be located in the *infrastructure / plant expansion area* (Appendix 5, Figure 12). The process water dams will be lined (HDPE) and will have a combined storage capacity of less than 50 000 m^3.

3.9 Surface Water Management

Roads and operational areas potentially affected by stormwater runoff will be protected by an earth bund (windrow). The earth bund will prevent ingress of "clean" stormwater and egress of "dirty" stormwater from these areas. As is currently the practice at the Mine, MSR will capture stormwater on-site and pump the stormwater to the process water dam.

3.10 Effluent and Waste Water Management

Process water from the processing plant is recycled, with some water losses to evaporation *but mostly* through the deposition of tailings to the beach. There will be additional water loss from the processing plant from tailings deposited in the inland strand line mine void. MSR will recover as much water as possible from the containment cells *in the inland mine voids* via decant for reuse at the processing plant.

Process water from the MSP will be recycled or transferred to the process water dams for reuse within the processing plant.

Effluent from the RO Plant will be discharged into the marine environment as discussed above.

Domestic effluent from ablution facilities at the MSP will be connected to the existing sewerage system and conservancy tank.

3.11 Solid Waste Management

Domestic waste generated in expansion areas will be collected and taken to the existing on-site solid waste storage site for final disposal at the Lutzville landfill.

Hazardous waste (such as used oils) generated in expansion areas will be collected and temporarily stored in the existing on-site hazardous waste storage area for collection by a contractor.

3.12 Power Supply

MSR has made an application to Eskom to provide power from the national grid to replace the current gensets and, more importantly, provide a cost effective power supply option for the MSP.

The current desire is to connect to the network at Skaapvlei on the adjacent Sere wind energy facility. In this event, a 22 kv powerline of approximately 4 km (*2 km of underground line within the wind farm and 2 km of overhead power line*) will be installed from the Sere wind energy facility to a new transformer near the RO Plant and MSP (Appendix 5, Figure *12*).

If a connection to *Eskom's network* is not possible, MSR will install additional Gensets to meet increased electricity demand.

3.13 Air Quality Management

MSR implements dust suppression measures to reduce dust emissions from haul roads. A watercart continuously applies seawater to all internal and external haul roads as required, including the DR2225 public gravel road to Koekenaap.

MSR will continue to implement dust suppression measures on haul roads including those to the beaches north of Tormin Mine.

3.14 Workforce

As at 1 February 2017, Tormin Mine employs 216 people, of whom 170 are from the local area, with ~ 88% of local employees categorised as historically disadvantaged South Africans (HDSA).

Approximately 80 additional employment opportunities will be created by the proposed Mine extension, predominantly at the MSP and RO Plant.

Up to 300 jobs will be created in the construction phase.

3.15 Mine Schedule

The proposed beach mining and inland strand line mining will extend the LoM by ~11 years.

The LoM of the northern beaches is estimated to be ~3 years (without any beach replenishment). The smaller beaches may be mined within two months, whilst the larger beaches could take more than a year to mine. If there is sufficient VHM replenishment on the beaches, MSR will re-mine the northern beaches, although it is likely that only beaches 3 and 10 will be re-mined[12].

3.16 Investment

The project will require an expected R 500 million capital investment and is expected to contribute approximately R 1 billion per annum to the South African economy for the next ~*11* years.

4 Decommissioning and Closure

Section 24P of NEMA requires that an applicant for EA relating to prospecting, mining, exploration, production or related activities on a prospecting, mining, exploration or production area must make the prescribed

[12] *For the purposes of the impact assessment, it is assumed that all the northern beaches will be re-mined at least once during the 11-year LoM.*

financial provision for the rehabilitation, management and closure of environmental impacts, before the Minister responsible for mineral resources issues the EA.

Section 10 of the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GN R1147, which came into effect on 20 November 2015) requires that an applicant must submit the financial provision determination and a decommissioning plan as part of the information submitted for consideration by the Minister responsible for mineral resources.

MSR has a Decommissioning Plan for Tormin Mine. The plan is reviewed annually and independent verification of the closure cost estimate is done on an annual basis. The aim of the Decommissioning Plan is to:

- Return the disturbed areas to an acceptable post-mining state;
- Ensure all areas are stable and there is no risk of erosion;
- Prevent alien plant invasions until the site is in a stable state; and
- Ensure that all areas are free draining and non-polluting.

MSR's Decommissioning Plan will be amended to include the project components as discussed in Section 3 above. Rehabilitation will take place during the LoM (i.e. concurrent) as well as during the closure phase.

The financial provision determination for the Tormin Mine Extension project will be provided in the EIA Report.

4.1 Beach Mining

In MSR's experience, tidal and wave action often reinstate the beach profile within a very short period of time. However, MSR will flatten sand berms (on beaches) and will reshape the beach profile to expedite rehabilitation where required.

All equipment and vehicles will be removed from the beach once mining has ceased.

The main haul road will not be rehabilitated and will continue to be under the authority of the Provincial Department of Transport and Public Works. All access tracks to the beach will be returned to a suitable state in consultation with the Department of Public Works.

4.2 Inland Mining

Rehabilitation of the inland strand line mining area will be undertaken as soon as the mining path allows. The backfill material will be reshaped, reseeded (if required) and demarcated as a No-Go area (see Section 3.2) to allow for successful revegetation.

4.3 Infrastructure Expansion Area

MSR will dismantle or demolish all structures / infrastructure in the infrastructure expansion area and will either sell the material or dispose of the material at a licensed waste disposal facility.

Contaminated soil will be treated on-site or removed from site and disposed of at a licensed waste disposal facility.

The disturbed footprint will then be ripped and reseeded.

e) Policy and Legislative Context

Table 10: Governance framework

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**
National Environmental Management Act 107 of 1998 (NEMA)	MSR (the proponent) has a responsibility to ensure that the proposed activities and the Scoping and Environmental Impact Reporting (S&EIR) 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 (GN R982) as amended by GN R 326 on 7 April 2017	The proponent is obliged to apply for Environmental Authorisation (EA) for the activities listed in Table 2. A S&EIR process is required to assess activities listed in terms of NEMA and NEM:WA. The proponent is therefore required to undertake an S&EIR process in support of the application, in accordance with the procedure stipulated in GN R982 under NEMA.
Financial Provision Regulations, 2015	In terms of the Regulations, the proponent must include the determination of the financial provision in the EIA Report and must provide proof of payment or the arrangements to provide the financial provision prior to commencing the activity. The applicant is obliged to update their financial provision to include aspects of the Tormin Mine Extension project within one year of approval, and annually thereafter.
National Environmental Management: Waste Act 59 of 2008 (NEM:WA)	The project *might* require a Waste Management Licence (WML) in terms of NEM:WA *for the activities listed in Table 2*.
Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015	The planning, design, operation and decommissioning of the residue stockpiles and deposits must be compliant with the requirements of GN R632. *Preliminary investigations indicate that the mine residue can be classified as a Type 4 waste. The waste classification, in terms of the Regulations, will be reported in the Impact Assessment Phase.*
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)	The mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, and an approved Environmental Management Programme (EMPr) to mine Valuable Heavy Minerals (VHM) below the high-water mark adjacent to Farm Geelwal Karoo 262. As well as the requirement of EA and WML (for which the DMR is the competent authority), in terms of Section 102 of the MPRDA, MSR must apply to the DMR for an amendment of their existing Mining Rights and EMPr.
National Water Act 36 of 1998 (NWA)	The proposed project activities *might* trigger water use activities in terms of section 21 of the NWA.

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**
Regulations Regarding the Safety of Dams, 2012	*Section 123 (1) of the NWA makes provision for the promulgation of regulations relating to the safety of dams. In this context, the Regulations Regarding the Safety of Dams, 2012 (GN R139), promulgated in terms of the NWA, govern the requirements for dams with a safety risk.* *The proposed dams at Tormin Mine will not be classified as dams with a safety risk (i.e. each dam will not have a wall height that exceeds 5 m and store more than 50 000 m^3 of water under normal operating conditions).*
National Heritage Resources Act 25 of 1999 (NHRA)	The project and associated infrastructure triggers listed activities in Section 38(1) of the NHRA: Any development or activity that will change the character of a site (i) exceeding 5 000 m^2 in extent, (ii) involving three or more existing erven or subdivisions thereof. The proponent is required to notify Heritage Western Cape (HWC) of the proposed activities through the submission of a Notice of Intent to Develop (NID*). The NID was submitted to HWC on 4 May 2017.* The assessment of heritage, archaeological and paleontological impacts will be undertaken as part of the EIA process in terms of NEMA.
National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA)	The project will include the development of infrastructure in the coastal protection zone (defined as being within 1km of the shoreline in rural areas). Impacts on the coastal environment will need to be assessed. Brine from the RO Plant will be discharged into the sea. In terms of Section 69 of NEM:ICMA, a coastal waters discharge permit (CWDP) is required from the DEA: Oceans and Coasts (O&C) for the discharge of effluent into coastal waters. The proponent *might* also require a Dumping at Sea Permit required in terms of Section 71 of NEM:ICMA
National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA)	Although a bioregional plan has not been formally *adopted* for the Matzikama Municipality, terrestrial Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) *have been identified in the project area by CapeNature in the 2017 Western Cape Biodiversity Spatial Plan*. The impacts of the project on the biodiversity of the area and, in particular, the CBAs and ESAs, will need to be assessed.
National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)	*As the drying process in the MSP will use an electric heater and not a dedicated combustion installation, an Atmospheric Emission Licence (AEL) is not required in terms of section 21 of NEM:AQA.*

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**
Dust Control Regulations, 2013	In terms of GN R632, MSR will need to be compliant with this regulation. The proposed project will be incorporated into MSR's existing dust management programme. This programme will be reported on in the EIA Report.
The Western Cape Spatial Development Framework (SDF) (2014)	The Provincial SDF identifies a number of policy objectives. Of most relevance to the project, Policy R3 ("*Safeguard the Western Cape's agricultural and mineral resources, and manage their sustainable use*") states the following: • The location of mineral deposits and known reserves of construction materials in municipal SDFs must be recorded; • Land use policies that reserve mineral deposits for possible use must be introduced and applied (subject to environmental authorisation); • Ecosystem requirements must be reconciled with conflicting land development pressures through proactive spatial planning, and application of a land use management system that safeguards biodiversity, protects resources and opens up opportunities for improved livelihoods and jobs; and New mine ventures should first take place in transformed areas.
West Coast District Municipality (WCDM) Integrated Development Plan (IDP) (2012 - 2016)	The WCDM IDP recognises mining in the West Coast District as a contributing factor towards South Africa's mining industry. *Mining and quarrying contributes approximately 1% to the regional economy*. Furthermore, the IDP also notes a high level of poverty in the WCDM and a need to enhance job creation projects that alleviate poverty. The strategic objectives of the WCDM's IDP include: • Ensuring environmental integrity for the West Coast; • Pursuing economic growth and facilitation of job opportunities; • Promoting social well-being of the community; • Providing essential bulk services in the region; and • Ensuring good governance and financial viability.
West Coast District Municipality Spatial Development Framework (2014)	The WCDM's SDF (2014) recognises that careful management is required to ensure environmental sustainability along the West

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**
	Coast. Unsustainable utilisation of resources, poor management practices, limited access to the coast, and conflicts between users are recognised to pose a threat to the environment and the human livelihoods which are dependent on natural resources. The SDF ***states*** that the WCDM has a vast number of mineral resources, some of which are currently not exploited. It acknowledges that mining could potentially increase its current economic contribution to the regional economy should these resources be utilised in future. In addition to this, the SDF recognises the potential negative impacts that mining could have on natural resources and existing road infrastructure and recommends that this aspect be carefully considered.
West Coast District Municipality Integrated Coastal Management Programme (ICMP) (2013)	The WCDM ICMP identifies objectives to guide the identification and implementation of strategies for coastal zone management in the WCDM. The objectives are based on the coastal zone management vision and unique needs and challenges of the WCDM. The objectives are to: • Facilitate co-ordinated, integrated and inclusive management of the coastal zone by all spheres of government, in accordance with the principles of co-operative governance and within the framework of NEM:ICMA and all other relevant legislation; • Preserve and effectively manage the ecological integrity, cultural values and ecosystem services of the coastal zone; • Effectively facilitate and manage the sustainable utilisation and development of the coastal zone; • Preserve, protect, extend and enhance the status of coastal public properly as being held in trust by the State on behalf of all South Africans, including future generations; • Secure equitable access to the opportunities and benefits of coastal resources and public properly for current and future communities; • Ensure the coastal zone is safe for local communities and visitors;

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**
	• Ensure the coastal zone is kept clean for local communities and visitors; and • Enable and guide the allocation and securing of adequate financial and human resources to achieve the above objectives
West Coast District Regional Economic Development Strategy (REDS) (2007)	The WCD REDS articulates four main aims for the economic development of the WCDM, namely: • Retain existing jobs; • Grow competitive businesses; • Attract new investments and funding; and • Share the benefits of growth. The following specific objectives are listed: • To reduce the number of households living below the poverty line; • To achieve an economic growth to an annual average of 4.5% - 6% p.a.; and • For 40% of all visitors to the Western Cape to visit the WCDM.
Matzikama Local Municipality (MLM) Integrated Development Plan (2012-2017)	The MLM's IDP (2012-2017) is the over-arching strategic plan of the municipal organisation with the main purpose of articulating the vision of MLM and how it should be accomplished. Strategic focus areas of the IDP include: • Economic development; • Financial stability; • Good governance and municipal transformation; • Good quality municipal basic services; • A socially advanced community; • Capacitated and informed communities; and • A sustainable natural and built environment. The MLM recognises the mining sector as one of the slower growing sectors (approximately 4% of the local economy) in the region that will increase its contribution to the local economy with the opening of new companies.

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**
Matzikama Local Municipality Spatial Development Framework (2014)	The vision of this SDF is to optimise the agricultural, mining, tourism and heritage related resources, existing and proposed mines, the coastal corridor, the Knersvlakte and northern Cederberg and Kouebokkeveld Mountains and the historic homesteads and core of Vanrhynsdorp for the social and economic development of its communities (CNDV, 2014). Relevant aspects of this vision to the project are as follows: • The major mines in the area should make the greatest contributions possible to long term social, economic and infrastructure development and their legacy effects should be maximized; • Opportunities for a strong overlap between biodiversity conservation and wilderness tourism should be explored; and • Integration is required between bio-diversity conservation and mining operations and their rehabilitation. The SDF therefore recognises the importance of the contribution of the mining sector to the regional economy, and specifically states that an implication of the development vision for the local municipality is to sustain existing mining operations, and to promote new mining ventures. The SDF promotes the integration of biodiversity management, tourism and industry.
DEA's Draft Companion to Environmental Impact Assessment Regulations of 2010	The S&EIR process will be guided by DEA and DEA&DP's guidelines. DEA&DP's Information Document Series includes guidelines on Generic ToR for EAPs and Project Schedules, Public Participation, Alternatives, Need and Desirability, and Exemption Applications and Appeals.
DEA&DP's EIA Guideline and Information Document Series (DEA&DP, 2013),	

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).

5. Analysis of Need and Desirability

Best practice, as well as the EIA Regulations, 2014 (Appendix 3 Section 3 [f]) requires that the need and desirability of a project (including viable alternatives) are considered and evaluated against the tenets of 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 (which is often implicit in a [private] proponent's intention to implement the project), but also in terms of the specific needs and interests of the community and the opportunity cost of development (DEA&DP, 2013).

The principles in NEMA serve as a guide for the interpretation of the issue of "need", but do not conceive "need" as synonymous with the "general purpose and requirements" of the project. The latter might relate to the applicant's project motivation, while the "need" relates to the interests and needs of the broader public. In this regard, an important NEMA principle is that environmental management must ensure that the environment is "held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage" (DEA, 2014).

There are various proxies for assessing the need and desirability of a project, notably national and regional planning documents which enunciate the strategic needs and desires of broader society and communities: project alignment with these documents must therefore be considered and reported on in the EIA process. With the use of these documents or - where these planning documents are not available - using best judgment, the EAPs (and specialists) must consider the project's strategic context, or justification, in terms of the needs and interests of the broader community (DEA&DP, 2013).

The consideration of need and desirability in EIA decision-making therefore requires the consideration of the strategic context of the project along with broader societal needs and the public interest (DEA, 2014). However, it is important to note that projects which deviate from strategic plans are not necessarily undesirable. The DEA notes that more important are the social, economic and ecological impacts of the deviation, and "the burden of proof falls on the applicant (and the EAP) to show why the impacts…might be justifiable" (DEA, 2010b). *Questions relating to project Need and Desirability (DEA, 2017) will be considered in more detail in the EIA Report.*

5.1 Social Aspects

The *social* component of need and desirability can be assessed using regional planning documents such as SDFs, IDPs and EMFs to assess the project's social compatibility with plans. These documents 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. These documents describe specific social objectives and emphasise the need to:

- Retain existing jobs;
- Enhance job creation projects that alleviate poverty;
- Promote social well-being of the community and share economic benefits; and
- Manage the sustainable utilisation and development of the coastal zone and secure equitable access to all.

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

Coastal access along the West Coast is largely inequitable and access to the coast is particularly limited north of the Olifants River Estuary. The project may affect public access to the coast in the proposed beach mining extension area.

The potential social impacts will be assessed in the Impact Assessment Phase.

5.2 Economic Aspects

The *economic* need and desirability of a project can be assessed using national, provincial, district and local municipal planning documents to assess the project's economic compatibility with plans. These documents describe specific economic objectives and emphasise the need to:

- Promote economic growth;
- Promote development in transformed areas and in areas with proven economic potential;
- Retain existing jobs;
- Enhance job creation projects that alleviate poverty;
- Reserve mineral deposits for future use;
- Attract new investments; and
- Share economic benefits.

Regional planning documents also emphasise the need to increase the role of the tourism sector, which promises to provide economic growth and employment coupled with greater protection of the environment (the main draw card for tourists in the area). Protection of the coastal zone is recognised as a key objective in this regard.

Notwithstanding the above, regional planning documents also highlight the need to retain existing jobs and exploit mineral resources sustainably. Tormin Mine employs approximately 216 employees and is therefore an important employer in the region.

The potential economic impacts will be assessed in the Impact Assessment Phase.

5.3 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 (DEA, 2014). The regional planning documents include specific ecological objectives and emphasise the need to:

- Ensure environmental integrity and reconcile ecosystem requirements with conflicting land development pressures;
- Promote tourism through the protection and rehabilitation of the environment;
- Integrate bio-diversity conservation and mining through rehabilitation;
- Use environmental resources sustainably; and
- Manage the sustainable utilisation and development of the coastal zone.

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 as a whole, 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 (DEA, 2014).

There will be ecological impacts associated with an extension of the mining footprint, which will need to be carefully planned and managed. The potential environmental/ecological impacts will be assessed in the Impact Assessment Phase.

5.4 Summary of Need and Desirability

In summary:

- The expansion of the Mine (and related LoM) 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 continued mining at Tormin Mine will need to be considered and weighed up against ecological concerns; and
- Social, economic and ecological factors will be considered and assessed in the Impact Assessment Phase. Mitigation measures will be recommended in the EIA Report to prevent, minimise (and optimise) impacts and to secure stakeholders' environmental rights. An EMPr will be drafted and implemented to ensure that potential environmental pollution and degradation can be minimised, if not prevented.

g) Period for which the environmental authorisation is required.

Five years.

h) Description of the process followed to reach the proposed preferred site.

NB!! – This section is not about the impact assessment itself; It is about the determination of the specific site layout having taken into consideration (1) the comparison of the originally proposed site plan, the comparison of that plan with the plan of environmental features and current land uses, the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout as a result.

i) Details of all alternatives considered.

With reference to the site plan provided as Appendix 5 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

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

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

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

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity.

(a) Location / Site Alternatives

Mine areas

MSR owns Farm Geelwal Karoo 262, the property on which the Tormin Mine and the inland strandline is located.

The locations of the VHM beach deposits and inland deposits are fixed, which dictates possible mining locations. MSR is applying for extension into areas in immediate proximity to existing operations, infrastructure and facilities at Tormin Mine to take advantage of such infrastructure and facilities and maximise operational efficiency.

Location / site alternatives for the mine sites will thus not be considered in the Impact Assessment Phase. *However, specialists will consider the location of new mining and infrastructure footprints within the extension areas, taking into account environmental constraints identified during their site visits. The specialists did not identify any specific areas of high sensitivity within the proposed mining and infrastructure footprints that should be designated as "exclusion zones" (specialist studies will be provided in the EIA Report).*

MSP

The proposed MSP is an addition to the processing facility. Possible location alternatives initially considered for the MSP by MSR during the pre-feasibility phase included:

- Tormin Mine;
- Saldanha Bay; and
- Lutzville industrial area.

Based on capital costs, operating costs and hauling costs, MSR identified Tormin Mine as the most feasible location for the MSP and no location alternatives are considered for the MSP.

(b) Activity Alternatives

The purpose of the project is to expand existing mining operations north along the coastline and inland of the processing plant to ensure the ongoing operation of Tormin Mine. No other activity alternatives (other than the No-Go alternative) are being 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) Design Alternatives

MSR proposed a layout design for the infrastructure / plant expansion area that extended close to the eastern boundary of Farm Geelwal Karoo 262 (see Figure 13). Under advice of the terrestrial ecology specialist, MSR revised the layout of the infrastructure / plant expansion area (refer to Appendix 5, Figure 12) to increase the ecological corridor between the infrastructure / plant expansion area and the eastern fenceline. The revised layout will also reduce the overall disturbance footprint, as the "overflow area" will now be located partly over areas to be mined. This layout design has been selected for assessment and no other design alternatives will be assessed.

Figure 14: Initial layout of the infrastructure / plant expansion area

Source: MSR, 2017

(d) Technology Alternatives

A number of technology alternatives were considered by MSR during the pre-feasibility phase:

- Technology alternatives for **transporting ore to the processing plant**:
  - Conveyors;
  - Pump an ore slurry; or
  - Use dump trucks.

  MSR does not consider conveyors and pipelines to be feasible, as these alternatives will require significant capital outlay and the infrastructure will significantly increase the disturbance footprint[13].

- Technology alternatives **enabling beach mining**:
  - Use dredging techniques and machinery; or
  - Geofabric "socks" as an alternative to sand berms and wave breakers.

  The high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators during lower tides.

- MSR considered three alternatives for **additional electricity supply**:
  - Connect to the *Eskom network at the* Sere wind energy facility;
  - Install additional generator sets (gensets); or
  - Install photovoltaic panels to generate electricity on-site.

  A connection to the Eskom network at the Sere wind energy facility is MSR's preferred alternative. Installing photovoltaic panels to supply electricity is not considered viable by MSR. MSR may need to install additional gensets if the Mine is unable to connect to the wind energy facility.

- MSR considered four alternatives for **additional fresh water supply**:
  - Continue to truck in water from Lutzville;
  - Apply for an allocation from the Lower Olifants River canal;
  - Groundwater; or

- o Seawater desalination (RO Plant).

MSR considers seawater desalination as the only viable option, as trucking of water is not considered to be feasible due to cost, the Lower Olifants River Water User Association canal has insufficient unallocated water available for Tormin Mine and no aquifers were identified.

- **Brine discharge –** The effluent generated by the RO Plant will be discharged to the sea as brine *from a single effluent discharge point (outfall). Four outfall locations were considered by the project team:*

1. *Offshore disposal beyond the surf-zone;*
2. *Near-shore disposal;*
3. *Beach void disposal; and*
4. *Rocky shore disposal.*

The Beach void disposal and rocky shore disposal options were screened out because of potential negative environmental impacts identified by the marine ecology specialist (specialist studies will be provided in the EIA Report). The marine ecology specialist will assess three outfall location alternatives along MSR's existing seawater intake pipeline – two offshore locations beyond the surf-zone and one near-shore location within the surf zone (Table 5-1 and Figure 15).

Table 11: Locations of outfall alternatives

Outfall Alternative	Water depth at spring low tide (m)	Approximate distance offshore (m)	Coordinates	
			Latitude	Longitude
Outfall A	3	130	31°33.499'S	18°5.577'E
Outfall B	6	320	31°33.559'S	18°5.500'E
Outfall C	10	468	31°33.592'S	18°5.434'E

[13] *MSR has also committed to processing the ore on the beaches using mobile PBCs. This will significantly reduce the number of truck trips between the beaches and the processing plant.*

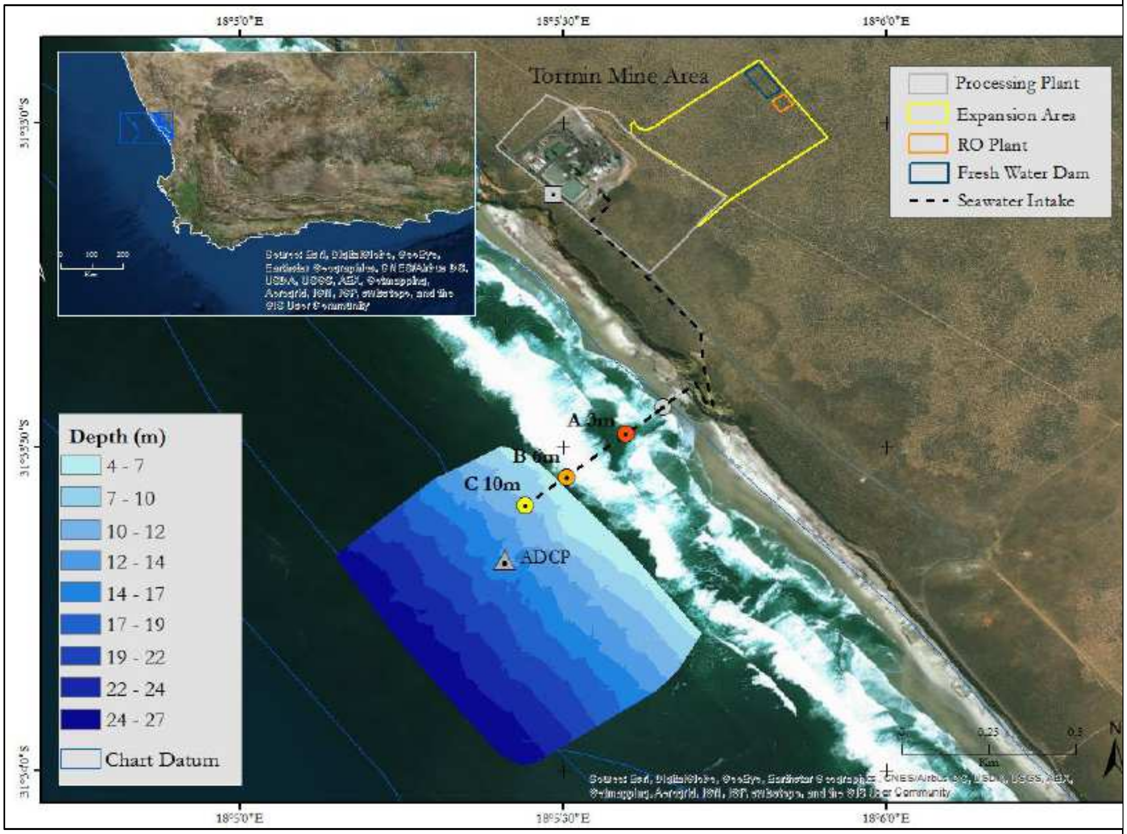


Figure 15: Map of the proposed outfall locations. ADCP (Acoustic Doppler Current Profiler) indicates the position at which wave and current monitoring was undertaken

Source: Anchor, 2017

(e) Operational Alternatives

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

(f) No Go Alternative

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-Go alternative will have major implications for the sustainability of Tormin Mine and will probably entail the closure of the Mine.

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 overall aim of stakeholder engagement is to ensure that all Interested and Affected Parties (IAPs) have adequate opportunity to provide input into the process and raise their comments and concerns. More specifically, the objectives of stakeholder engagement are to:

- Identify IAPs and inform them about the proposed development and S&EIR process;
- Provide stakeholders with the opportunity to participate effectively in the process and identify relevant issues and concerns; and
- Provide stakeholders with the opportunity to review documentation and assist in identifying mitigation and management options to address potential environmental issues.

Activities Undertaken during the prior EIA Process

SRK initiated an EIA Process for the proposed extension of Tormin Mine in January 2017 (DMR Reference Number: WC 30/5/1/2/2 MR). A Draft Scoping Report (SRK Report No. 507228/2, dated April 2017) was released for stakeholder comment in April 2017. On 22 November 2017 DMR refused the Environmental Authorisation at the Scoping Phase.

A new EIA process for the proposed extension of Tormin Mine has now been initiated. This Scoping Report has been updated in response to:

- *Stakeholder comments previously submitted;*
- *Preliminary findings of draft specialists studies (specialist studies will be provided in the EIA Report); and*
- *Refinements to the project description since April 2017,*

As the report is substantially similar to the Scoping Report dated April 2017 and previously released for stakeholder comment, ***all comments previously submitted in response to the April 2017 Scoping Report are included in Appendix 6B of this report and will be responded to in the Issues and Responses summary that will accompany the Final Scoping Report and draft EIA Report.*** *Additional comments can be submitted as part of the current EIA process.*

Although not part of this EIA process, Table 6 provides a brief overview of the stakeholder engagement activities undertaken during the previous EIA process.

Table 12: Stakeholder engagement activities during the previous EIA process

Task	Objectives	Dates
Advertise commencement of EIA process and release a Background Information Document (BID)	To notify IAPs of the commencement of the EIA process and to provide an initial description of the proposed project and the affected environment.	24 January 2017
Release Scoping Report for public comment period	To provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase.	24 – 26 April 2017
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase.	28 April – 29 May 2017
Public Open Day	To present the findings of the Scoping Report to stakeholders and provide an opportunity for questions and discussion.	10 May 2017

Activities during the Scoping Phase of the current EIA Process

The activities undertaken and proposed during the Scoping Phase of the current EIA process are outlined in Table 6.

Table 13: Stakeholder engagement activities during the Scoping Phase

Task	Objectives	Dates
Advertise commencement of EIA process and release of Scoping Report for public comment	To notify IAPs of the commencement of the EIA process and to provide an initial description of the proposed project and the affected environment.	*6 April 2018*
Release Scoping Report for public comment period	To provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase.	*6 April 2018*
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase.	*7 April – 8 May 2018*
Compile Issues and Responses Summary and finalise Scoping Report	To record all issues and concerns raised and collate these comments in the final report which provides DMR with information to decide whether to accept the Scoping Report.	*May 2018*

As required by the EIA Regulations, 2014, relevant local, provincial and national authorities, conservation bodies, local forums and representatives and surrounding land owners and occupants have been notified of the EIA and the release of the Scoping Report for comment. *In addition, all IAPs who were registered on the stakeholder database during the previous EIA process for this project were also directly notified*.

Relevant authorities (Organs of State) have been automatically registered as IAPs. In accordance with the EIA Regulations, 2014, all other persons must request in writing to be placed on the register, submit written comments or attend meetings in order to be registered as stakeholders and included in future communication regarding the project. As specified in GN R 982, all persons who submit written comments, attend meetings or request in writing to be placed on the register will be registered as IAPs, and advertisements advise that IAPs register as such.

A list of stakeholders that were notified of the availability of the Scoping Report for review is provided in Appendix 6A. The stakeholder database will be updated throughout the process.

Newspaper advertisements announcing the EIA process, availability of the Scoping Report for review and inviting IAPs to register on the project database were placed in:

- *One regional newspaper:*
  - *Die Burger (in Afrikaans); and*
- *One local newspaper:*
  - *Ons Kontrei (in English and Afrikaans).*

English and Afrikaans site posters with details of the project and EIA process and EAP contact details were placed at Tormin Mine and along the access road to Gert du Toit-se-Baai.

Hard copies of the full Scoping Report are available for viewing at the following venues:

- Lutzville Public Library;
- Vredendal Public Library; and
- SRK's office in Rondebosch.

An electronic version of the report is also available on SRK's website **www.srk.co.za** (via the 'Library' and 'Public Documents' links).

Stakeholders are provided with a 30 day comment period until *8 May 2018*.

iii) Summary of issues raised by I&APs

(Complete the table summarising comments and issues raised, and reaction to those responses)

*During the **previous EIA process**, 22 stakeholder comments were received. Stakeholders who submitted written comments during the **previous EIA process** are listed in Table 7. Copies of the full comments are provided in Appendix 6B. The comments will be included in the Comments and Responses Summary to be compiled for this EIA Process.*

Table 14: Stakeholders who submitted comments on the BID and Scoping Report

No	**Name**	**Affiliation**	**Comment date**
Authorities			
1	Alana Duffell-Canham	CapeNature	3 February and 17 May 2017
2	Malcolm Watters	DTPW	17 March and 6 June 2017
2	Adri La Meyer	DEA&DP	29 May 2017
4	Doretha Kotze	WCDM	29 May 2017
5	Derrick Makhubele	DEA	2 June 2017
6	Rassie Niewoudt	DWS	6 June 2017
7	Andrew September	HWC	6 June 2017
Other Stakeholders			
8	Martin Calitz	Private	25 January 2017
9	Dr Philip Desmet	Private	25 January 2017
10	Nick Helme	Private	25 January 2017
11	Hansie Visser	Adjacent property owner	27 January 2017
12	Jacobus Nolte	Private	30 January 2017
13	Mike Winfield	Elands Bay Environmental and Development Action Group	5 February and 2 May 2017

No	Name	Affiliation	Comment date
14		Centre for Environmental Rights	24 February and 29 May 2017
15	Carel Nolte	Private	4 May 2017
16	Allen Lyon	Strandfontein Ratepayers Association	18 May 2017
17	Dinah Louw	Private	29 May 2017
18	Johan Bornman	Property owner (Tronox Namakwa Sands)	29 May 2017
19	Sandra du Plessis	Olifants River Estuary Management Forum	29 May 2017
20	Glenn Ashton	Private	29 May 2017
21	Lionell van Wyk	Private	29 May 2017
22	Jan Briers	Private	31 May 2017

*The main issues raised by stakeholders **during the previous EIA process** are:*

1) *A Section 102 application process is the incorrect procedure to apply for an extension of Tormin Mine, and may potentially not be submitted while the Prospecting application is still under review;*
2) *Authorisation should not be granted to MSR as they are not in compliance with their existing authorisations / approvals (relating to inter alia mining area, process and transportation) and must undertake a Section 24G rectification process;*
3) *Road transport has a significant impact on other road users and the existing road network; rail must be investigated;*
4) *It is not clear how MSR obtained the required prospecting data to determine the resource and financial viability of the proposed mine extension;*
5) *Insufficient information has been provided for the proposed beach access roads and beach mining areas;*
6) *Impacts related to seawater in tailings and cliff stability must be investigated;*
7) *The removal of beach sand may result in beach, cliff and dune erosion, and setback lines should be stipulated;*
8) *The extension of Tormin Mine will restrict public access to the coast, affecting the tourism value of this stretch of coastline; and*
9) *The project may compromise the ecological functioning and integrity of the CBA and rehabilitation is very difficult; a biodiversity offset may be required.*

i) The Environmental attributes associated with the sites

(1) Baseline Environment

(a) Type of environment affected by the proposed activity.

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

6 Biophysical Environment

Updates in this section are not indicated.

6.1 Geology and Topography

The geology and topography of the area, together with the semi-arid climate and the proximity to the coast, have determined the basic landscape features and visual elements of the study area.

The geology of the study area is complex with a diversity of metamorphic formations and sedimentary and igneous rock types. The most prominent and resistant are volcano-sedimentary metamorphites and gneisses of the mid-Protozoroic Namaqualand Metamorphic Complex and the limestones, dolomites and phylites of the Pan-African Gariep Supergroup (AEMCO, 2016). Formations in the study area include ancient fluvial deposits (Koingnaas Formation), the marine Kleinzee, Avontuur and Hondeklip Bay Formations and aeolian formations of various ages, including the Graauw Duinen Formation and the Olifants River Formation (ACO, 2016).

The coastline of Farm Geelwal Karoo 262 consists of wide beaches separated by rugged rocky promontories. Steep dunes and rocky cliffs (between 30 and 50 m above mean sea level) are a feature of the area. The coastal platform is almost flat before rising to a ridgeline along the western boundary of Farm Geelwal Karoo 262.

The coastline to the north of Tormin Mine is characterised by a rocky shoreline with isolated beaches in small bays. The character of the coastline changes further north, as longer beaches and primary dune systems become more prominent. The vertical change from the high-water mark to the inland zone is less abrupt; the topography rises gently to a ridgeline ~ 5 km inland.

6.2 Soils and Land Capability

This section is based on information provided by the soil and land capability specialist, TerraAfrica.

6.2.1 Soil Forms

Eight different soil forms were identified within the study area. The soil profiles ranged in depth between 0.55 m to deeper than 2 m. The largest part of the study area consists of the Bloemdal and Clovelly soil forms. Most of the surface and middle horizons of the profiles are single grained and weakly structured or structureless (apedal). Firm more clayey subsurface horizons above the dorbank show some signs of structural development. The soil forms are described below and presented in Figure 11.

- **Bloemdal**: This soil form is abundant in the inland mining area. It is a non-calcareous soil form, where an orthic A-horizon overlies a red apedal horizon that is overlying unspecified material with signs of wetness. The depths of the soil profiles ranged between 1.3 to deeper than 1.5 m. The soil profile is dominated by the sand fraction (90.65%) with very low organic matter content (organic carbon is 0.13%). The cation exchange capacity is dominated by sodium because of the proximity of the ocean and the effect of evaporation of salt-containing dew from the soil surface. In areas of higher rainfall, this soil form usually has high arable potential for dryland crop production, however, because of the very low rainfall of the study area, this soil form can only support indigenous vegetation that may be used for small stock grazing;
- **Clovelly**: The Clovelly form can also be found in the inland mining area. The soil profiles identified in this soil group have very sandy, orthic A horizons (92.38% sand) overlying highly permeable yellow-brown B horizons. The Clovelly profiles identified on site are deeper than 1.5 m where it is possibly underlain by dorbank. The cation exchange complex is dominated by sodium while the phosphor content is low as expected for undisturbed soil under natural vegetation. Clovelly soil can be stripped for topsoil conservation purposes to a depth of 0.5-1m;

- **Namib**: The beaches were all classified as the Namib soil form (regic sand). This soil form consists of an orthic A horizon (91.06% sand) underlain by regic sand. Regic sands are found widely in arid regions of the country and coastal areas. Regic sand is defined as sand or cover sand that has experienced limited or no soil development. Horizon differentiation resulting in a slight darkening of the orthic A horizon caused by decomposing organic matter was not visible (organic carbon is only 0.25%). This is because of the absence of vegetation cover (or very sparse vegetation cover). The sodium content is high, as expected from the accumulation of salt through seawater movement over the surface;
- **Tukulu**: An area of 9 ha of the Tukulu soil form is present in the northern area of the infrastructure / plant expansion area. The Tukulu soil form consists of an orthic A horizon, overlying a neocutanic B horizon on unspecified material with signs of wetness. Soils of the Tukulu form are deep and generally highly suited to cultivation but rainfall in the study area is extremely limited and erratic thereby reducing the arable potential of this soil form. It has signs of wetness beneath the neocutanic horizon. The A-horizon's texture is dominated by the sand fraction (88.66%) with very low organic matter content (organic carbon is 0.10%). The cation exchange capacity is dominated by sodium. The areas where the Tukulu soil form occurs have wilderness land capability;
- **Witbank**: Witbank is the only soil form that describes the anthropic group of soils in South Africa. Anthropic soils are those soils that have been so profoundly affected by human disturbance that their natural genetic character (i.e. their link to the natural factors of soil formation) has largely been destroyed or has had insufficient time to express itself. The Witbank soil form encountered in the study area consists of old alluvial diamond mining areas where topsoil stockpiles have been left derelict and in the existing processing plant area. In these areas, the subsoil horizons have been mixed with the topsoil and this has changed the original physical (and most likely chemical) soil properties. The areas where the Witbank form occurs have wilderness land capability;
- **Garies**: The Garies soil form was identified at the northern end of the northern beach haul road. This soil form consists of an orthic A horizon (30 cm or more) overlying a red apedal horizon with dorbank underneath. This dorbank horizon is formed by silica cementation and is very hard. The subsurface dorbank layer is typical of the arid regions of South Africa. The orthic A and red apedal B1-horizon has a sandy texture with associated high water infiltration rates, but the dorbank layer has water retaining properties that assists in conserving water in the landscape. The dorbank can be ripped up and used as road construction material (Fey, 2010), but the disturbance of this horizon impedes the water storage ecosystem service provided by it;
- **Oudtshoorn**: The Oudtshoorn soil form is prevalent to the north of Tormin Mine and consists of an orthic A horizon overlying a neocutanic B horizon that is underlain by dorbank. The neocutanic B horizon is characterised by the aggregation of soil particles to the extent that it is no longer structureless, but insufficient to qualify as a diagnostic pedocutanic or prismacutanic B horizon. The agricultural use of this soil is limited by a number of factors – not least of which is the arid climate in which they are found. Further limitations include shallow soil depth and low water holding capacity. The Oudtshoorn soil form has wilderness land capability. The soil chemical composition of this form is dominated by calcium and magnesium while sodium are higher than potassium levels because of the proximity to the ocean; and
- **Pinedene**: The Pinedene soil form is present in the northern extent of the study area and consists of an orthic A horizon overlying a yellow-brown apedal B horizon that is underlain by unspecified material with signs of wetness. The Pinedene soil form has a moderately high degree of weathering, depletion of bases and moderate acidity and a sandy loam structure. Dolomitic lime would be needed to achieve good crop yields. The soil is suited to dryland crop production, subject to appropriate chemical amelioration and sufficient rainfall. The climatic conditions in the study area are not suited to crop production if irrigation water is not available and is best used as grazing for small stock or wildlife. The Pinedene form in the study area has wilderness land capability.

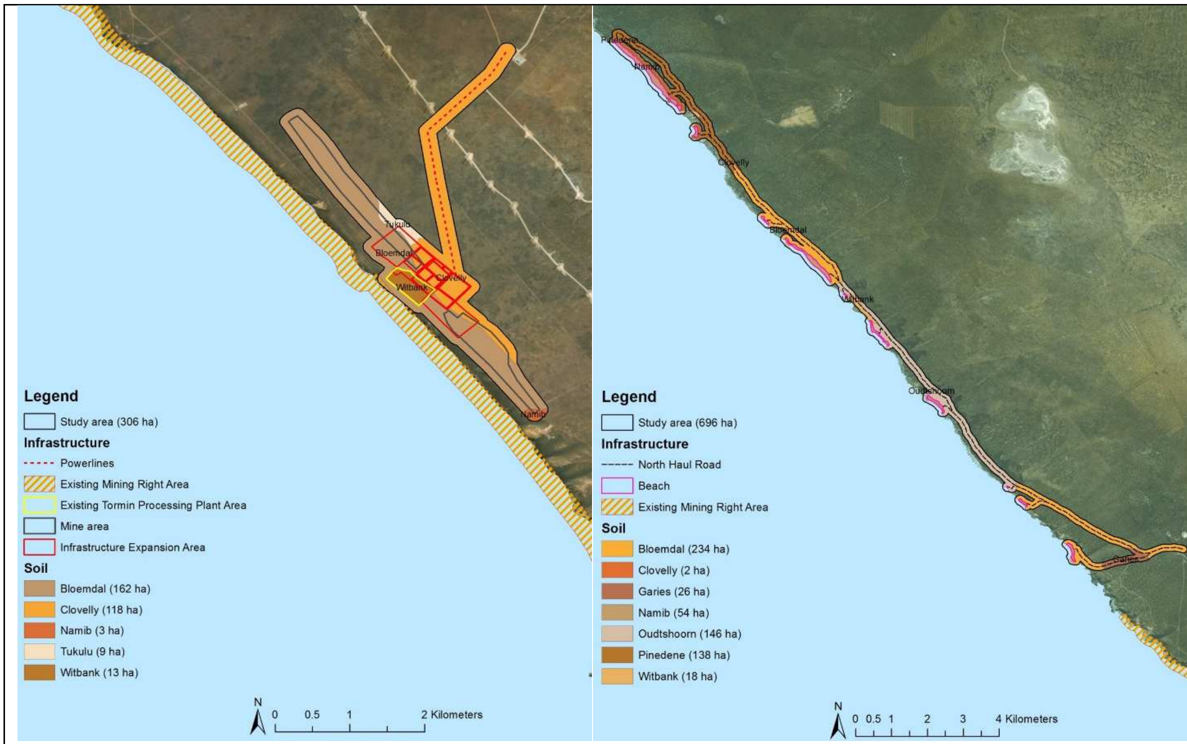


Figure 16: Soil forms of the study area

Source: TerraAfrica, 2017

6.2.2 Soil Chemical Properties

Five soil samples were collected in the study area. The pH of these samples ranges between 6.98 and 7.71 which is neutral to slightly alkaline, an indication of a high saturation of the base cations (K^+, Ca_2^+, Mg_2^+ and Na^+). The high sodium levels of all samples analysed correlates well with the study area's close proximity to the sea where the presence of salt in the dew precipitates on the soil surface. These high sodium levels make the soil forms unsuitable for crop production, although the natural vegetation is well-adapted to high salinity levels. The high bulk densities of the soils in this region reflect the presence of heavy minerals. Significant amounts of heavy minerals sometimes provide a false indication of bulk density as an indicator of soil compaction.

6.2.3 Land Capability

Table 14 indicates the set of criteria as stipulated by the guidelines outlined in Section 7 of The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981) to group soil forms into different land capability classes.

Table 15: Pre-mining land capability criteria

Criteria for Wetland	• Land with organic soils; or • A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick occurring within 750mm of the surface.
Criteria for Arable Land	• Land which does not qualify as a wetland; • The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm; • The soil has a pH value of between 4,0 and 8.4; • The soil has a low salinity and SAR; • The soil has a permeability of at least 1,5 mm per hour in the upper 500 mm of soil; • The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100 mm in diameter in the upper 750 mm; • Has a slope (in %) and erodibility factor (K) such that their product is <2.0; and

	• Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops, or is currently being irrigated successfully.
Criteria for Grazing Land	• Land, which does not qualify as wetland or arable land; • Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm; and • Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis.
Criteria for Wilderness Land	• Land, which does not qualify as wetland, arable land or grazing land.

The soil and land types identified in the study area could all be classified as land with wilderness land capability. Even though the Clovelly, Bloemdal and Tukulu forms have the potential for arable agriculture, the very low rainfall of the study area makes it unsuitable for crop production. The study area could be suitable for grazing by small stock, but this may negatively affect faunal biodiversity. *Small stock grazing occurred on Farm Geelwal Karoo 262 until MSR bought the property in August 2016*.

6.2.4 Land Use and Agricultural Potential

According to Ndeinoma (2006), the larger Namakwaland region is used for grazing, mining and in very small areas irrigated crop production in the Olifant's River valley. However, the dominant agricultural activity in the Namaqualand region is sheep and goat farming.

During the specialist site visit, it was established that the dominant land use in the study area is small livestock farming. There are also beehives present on Farm Graauw Duinen. Ndeinoma (2006) indicates the grazing capacity of the Namakwa Sands area as 10 – 20 ha per Small Stock Unit (the equivalent of one sheep or one goat).

This region is not suited to the production of arable agricultural products owing to the low rainfall. Consequently, there is no record of any significant form of agricultural production in any of the proposed expansion areas. This was confirmed by the specialist during the site visit as there was no evidence of historical or recent dryland or irrigated crop production in the study area.

6.3 Climate

This section is based on information provided by the air quality specialist, Airshed Planning Professionals.

6.3.1 Regional Climate

The Western Cape has a Mediterranean climate, with wet winter and dry summer seasons. Inland and coastal temperatures usually differ as the mild, dry and very sunny summers warm the coast with temperature lows of around 20°C and highs averaging around 30°C, and inland temperatures are often 3-5 °C higher than the coastal areas. Summer starts around September and lasts until April. Winters are spread across the months of May to July, and may extend into August. The region is considered to be semi-arid with the highest rainfall months between May and August. June is the highest rainfall month with approximately 28 mm of rainfall. The lowest rainfall months are between January and March with January and February reaching approximately 3 mm of rainfall for both months.

6.3.2 Wind

The predominant wind direction for the area, based on data from the South African Weather Station (SAWS) in Vredendal, is from the south-west and west-south-west. These wind directions are also associated with strong winds of above 10 m/s. For day-time conditions, winds from the west and south-south-west predominate with increased winds from the west-north-west occurring during night-time conditions.

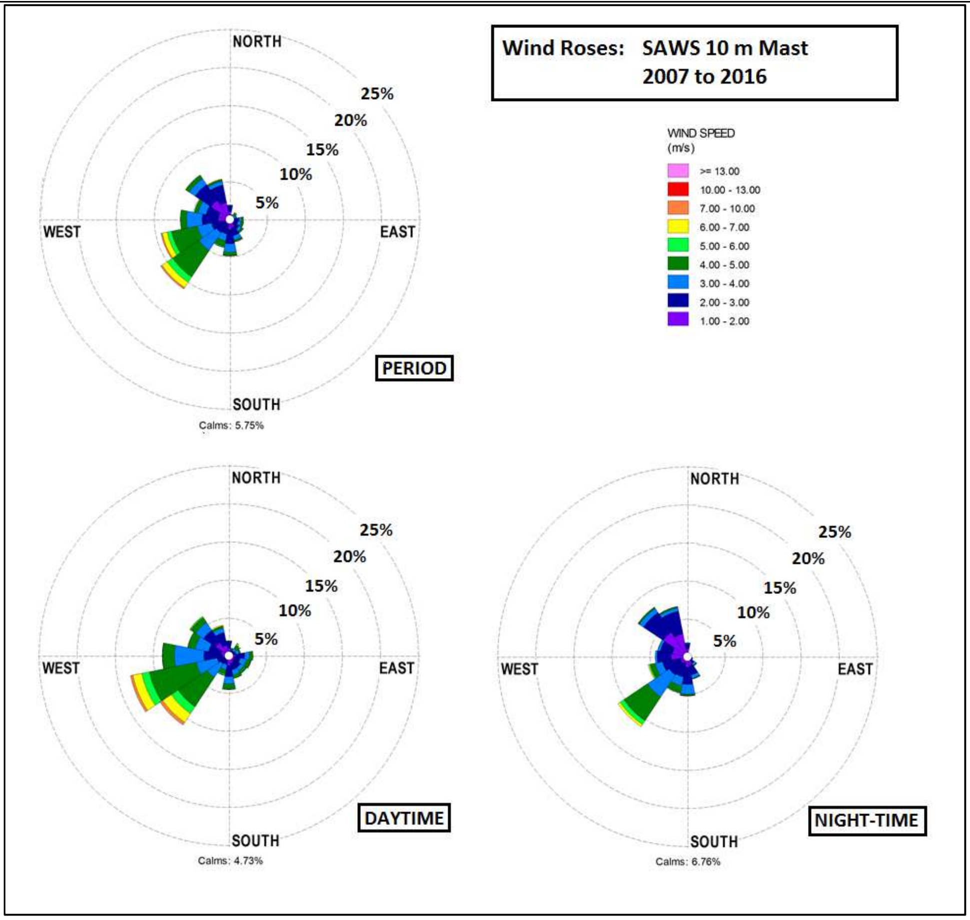


Figure 17: Period, day- and night-time wind roses as observed at 10 m on the SAWS weather station mast in Vredendal for the period 2007-2016

Source: Airshed, 2016

The wind conditions at Tormin Mine are expected to be slightly different due to the proximity to the coastline. In the absence of onsite measurements, a comparison is made to the observations at Brand-se-Baai, approximately 9 km north of Beach 10. The predominant wind directions differ considerably with the winds at Brand-se-Baai following the coastline (south-east and north-west) with a very predominant southerly component.

During daytime there is an increase in winds from the south and south-south-west. Nocturnal wind flow reflects predominant winds from the south-east and north westerly sectors. Night-time conditions also reflect a decrease in wind speeds ranging mainly from 1-2 m/s in comparison to daily wind speeds of 3-4 m/s.

As shown in the seasonal wind roses (Figure 14), the north-westerly winds are more predominant during the winter (including autumn and spring), with significantly less occurrences during the summer months. Winter also observes considerably less southerly winds. During the summer months, strong winds from the south and south-east dominate with wind speeds of up to 15 m/s. Strong winds also occur from the north-westerly sector. Infrequent but strong winds are also noted to occur from the north-easterly sector. During autumn (April to May), a similar pattern of wind flow is observed with winds blowing more frequently from the south and south-east with some strong winds from the north-west. Winter months reflect more frequent flow from the north-westerly sector. During springtime wind flow becomes more dominant from the south and south easterly sector with an increase in wind speed. Wind speeds are fairly similar throughout the year with slightly lower wind speeds during the winter months.

Mean daily wind speeds are generally in the range of 1 m/s to 4 m/s, with maximum daily speeds typically ranging from 5 m/s to 15 m/s.

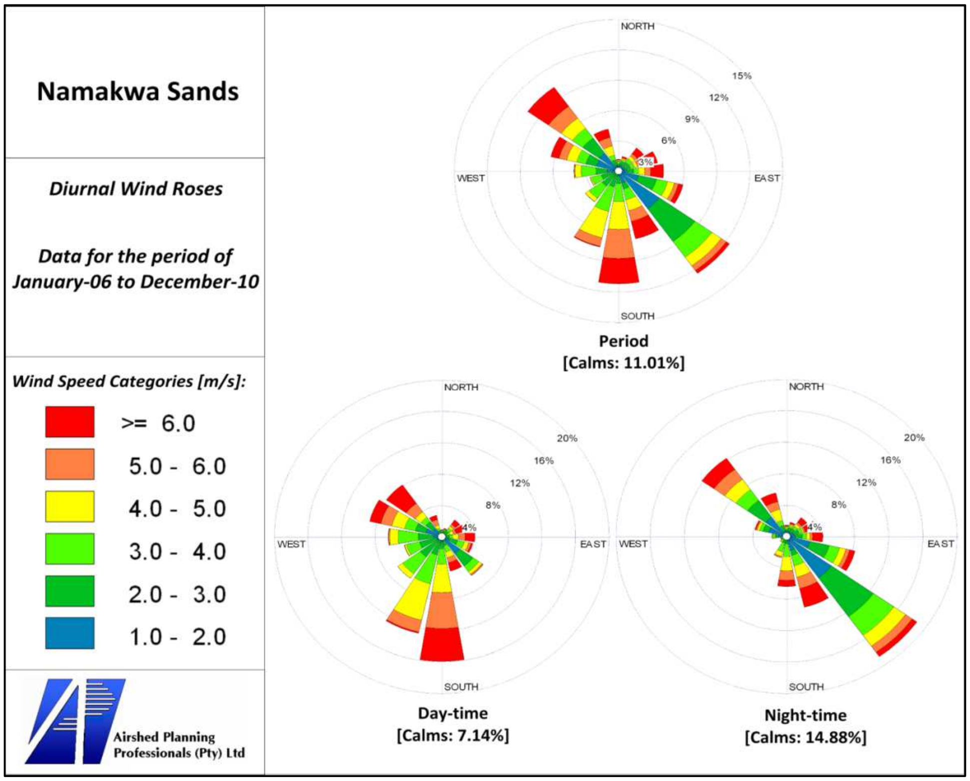


Figure 18: Diurnal wind roses for the period January 2006 to December 2010

Source: Airshed, 2016

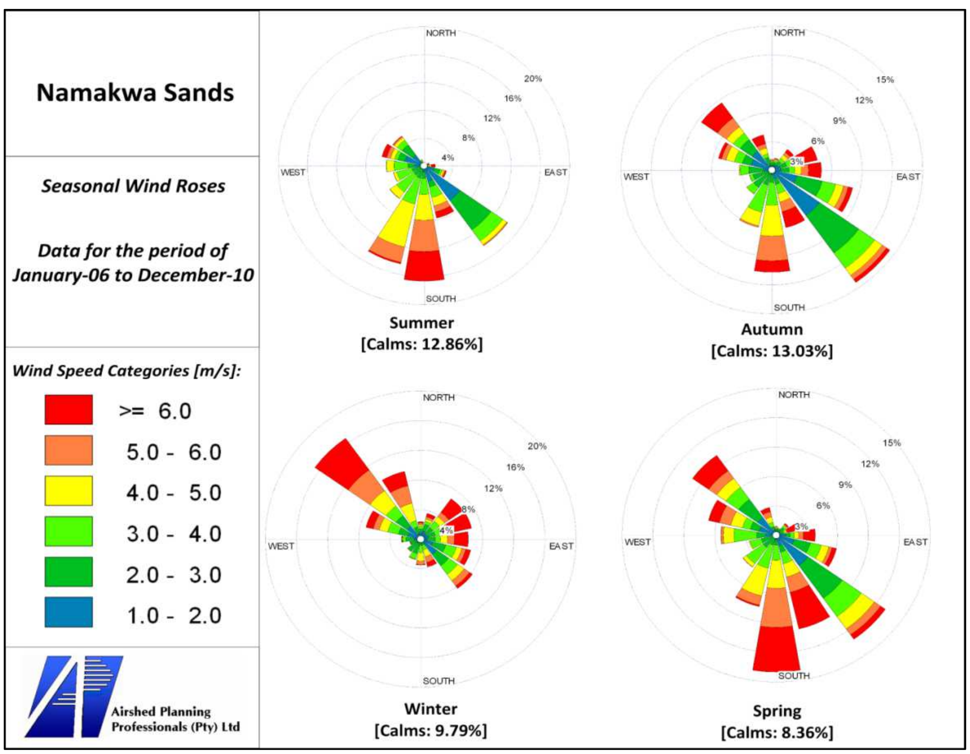


Figure 19: Seasonal wind roses for the period January 2006 to December 2010

Source: Airshed, 2016

6.3.3 Precipitation

No historical data is available for the Tormin Mine and reference was made to long-term SAWS rainfall statistics (Schultz 1986) for Vredendal and summarised produced for the Matzikama SDF (2013). Figure 15 depicts the distribution of the mean annual rainfall in the Matzikama Municipality. This figure generally shows that a band running south-west to north-east, east of Klawer, receives the highest rainfall in the municipality (200 mm to 600 mm of rainfall per annum). Whilst small parts of the study area receive the lowest rainfall of between 0 mm to 100 mm per annum, most receives between 100 mm and 200 mm.

This is also clearly shown in the long-term monthly average rainfall figures for Vredendal, as provided in Table 9 (Schultz 1986), i.e. 145 mm. Rain falls mainly in winter from May to August, with the peak being in June (~ 28 mm). The lowest rainfall months are between January and March.

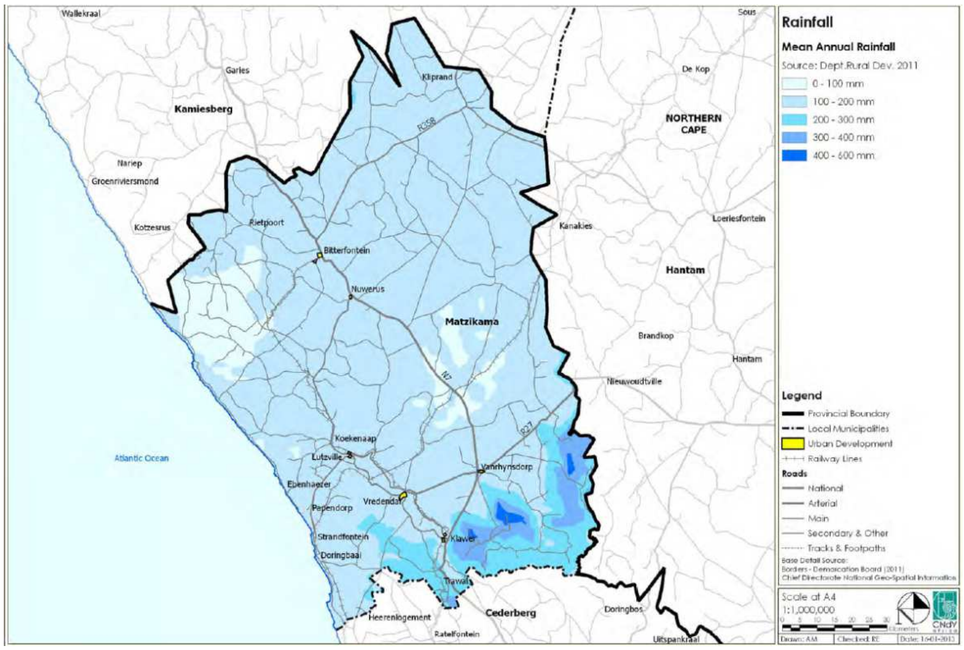


Figure 20: Mean annual rainfall

Source: Matzikama SDF, 2013 in Airshed, 2016

Table 16: Long-term average monthly rainfall figures (mm) for the Vredendal station (1957-1984)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Vredendal	2	3	5	14	23	30	17	20	8	8	9	6	145

Source: Airshed, 2016

No historical data for temperature trends was available for the Tormin Mine and reference is made to long-term average maximum, mean and minimum temperatures for Vredendal. Long-term average maximum, mean and minimum temperatures for Vredendal (1957-1984) are given in Table 6 (Schulze, 1986). Annual mean temperature is given as 22.3°C, with a minimum of 14.8°C and a maximum of 29.8°C. The proximity to the coast is expected to reduce the average temperature conditions, especially considering that fog is very prevalent along the coast, notably in the morning. As shown in Burger and Gresse (2012), the annual mean temperature for Brand-se-Baai is 13.7°C, with a minimum of 8°C and a maximum of 18.8°C.

Table 17: Long-term minimum, maximum and mean temperature for Vredendal

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Maximum	29.8	30.3	29.7	27.2	23.5	21.2	20.9	21.2	23.3	25.2	27.6	28.9	29.8
Mean	22.3	22.5	21.8	19.6	16.4	14.4	13.8	14.2	15.9	17.9	20.0	21.4	22.3
Minimum	14.8	14.7	13.8	12.0	9.2	7.6	6.6	7.2	8.5	10.6	12.5	13.9	14.8

Source: Schulze, 1986 in Airshed, 2016

6.3.4 Air Quality

This section is based on information provided by the air quality specialist, Airshed Planning Professionals.

South African National Ambient Air Quality Standards

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. These generally include carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), Particulate Matter (PM) and ground level ozone (O_3).

In determining ambient air quality, concentrations of pollutants are measured and/or modelled and compared against air quality standards. These standards are intended to protect human health and environmental degradation and, as such, focus on emissions perceived to pose a health or environmental risk. The National Ambient Air Quality Standards (NAAQS) and additional standards for particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$) are provided in Table 6-4. These standards are based on international best practices and aim to protect human health and indicate safe exposure levels for the majority of the population throughout an individual's lifetime, including the very young and the elderly.

Table 18: National Ambient Air Quality Standards

Pollutant	Averaging Period	Concentration (µg/m³)	Permitted Frequency of Exceedance	Compliance Date
SO_2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hour	125	4	Immediate
	1 year	50	0	Immediate
Benzene	1 year	5	0	1 January 2015
CO	1 hour	30000	88	Immediate
	8 hour(a)	10000	11	Immediate
Lead	1 year	0.5	0	Immediate
NO_2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
O_3	8 hour(b)	120	11	Immediate
$PM_{2.5}$	24 hour	40	4	1 January 2016 till 31 December 2029
	24 hour	25	4	1 January 2030
	1 year	20	0	1 January 2016 till 31 December 2029
	1 year	15	0	1 January 2030
PM_{10}	24 hour	75	4	1 January 2015

	1 year	40	0	1 January 2015

Source: Airshed, 2017

National Dust Control Regulations

The National Dust Control Regulations (NDCR) prescribe general measures for the control of dust. The standard for acceptable dustfall rates is set out in Table 6-5 for residential and non-residential areas. According to these regulations the dust fall at the boundary or beyond the boundary of the premises where it originates cannot exceed 600 mg/m²/day in residential and light commercial areas; or 1 200 mg/m²/day in areas other than residential and light commercial areas.

In addition to the dust fall limits, the NDCR prescribe monitoring procedures and reporting requirements.

Table 19: Acceptable dust fall rates

Restriction Area	Dust-fall rate (D) (mg/m²/day, 30-day average)	Permitted frequency of exceeding dust fall rate
Residential	D < 600	Two within a year, not sequential months.
Non-residential	600 < D < 1 200	Two within a year, not sequential months

Health Effects

Carbon Monoxide

CO is a colourless, odourless and poisonous gas produced by incomplete burning of carbon in fuels. Majority of CO emissions are from transportation sources, particularly highway motor vehicles. Other major CO sources are wood-burning stoves, incinerators and fuel combustion at industrial sources. When CO is inhaled, it enters the bloodstream and reduces the delivery of oxygen to organs and tissues.

Nitrogen Oxides

NO and NO_2 (commonly referred to as NOx) are the most important oxides of nitrogen in the context of local air quality. Nitrous oxide (N_2O), the only other oxide found in appreciable quantities, plays an important role in the enhanced “greenhouse effect” as well as being involved in other reactions in the upper atmosphere, but is of far lesser significance in the lower atmosphere.

NOx form when fuel is burned at high temperatures. The major emission sources in urban areas include motor vehicles, stationary fuel combustion sources, rail and aviation activities, and domestic burning of wood, coal and natural gas. The major mechanism for the formation of NO_2 in the atmosphere is the oxidation of the primary air pollutant NO. The proportion of NO to NO_2 in the discharge from combustion sources is typically 90-95% NO. There is, therefore, little NO_2 that is discharged directly into the air.

NOx are important precursors to photochemical reactions, ozone and acid rain and may affect human health and terrestrial and aquatic ecosystems. Excess levels of ozone in the lower atmosphere are formed by the photolysis of NO_2. Other products of photochemical reactions include nitric acid (HNO_3), peroxyacetyl nitrate (commonly written as PAN) and various organic particulates containing nitrogen. NOx interact with other compounds in the air to form inorganic particulates, which may have impacts on health and visibility.

Sulphur Dioxide

SO_2 is formed when the sulphur in fuels combines with oxygen at high temperature. SO_2 is a colourless, pungent gas that is a respiratory irritant and is a precursor to acid rain. SO_2 can also interact with other compounds in the air to form PM contributing to visibility impairment. Ambient SO_2 results largely from stationary sources, such as coal and oil combustion, steel mills, refineries, pulp and paper mills and non-ferrous smelters. In the project area, the most common source of SO_2 is likely to be vehicle emissions, as there are few large industries in the area.

Particulate Matter

Particulates are pollutants of much concern regarding their health and environmental effects, especially in the inhalable / respirable size ranges. Particulates can be referred to as total suspended particulates (TSP), as visible smoke, or by direct or indirect descriptions of their size. Common size-related terms are the inhalable and respirable classes, PM_{10} and $PM_{2.5}$ (i.e. particulate matter, with the numbers referring to the maximum particle diameter in micrometers). Particulates originate from a variety of sources:

- Natural sources, i.e. windblown dust and fires;
- Combustion sources, i.e. motor vehicles, power generation, fuel combustion. Combustion sources emit particles of ash or incompletely burned materials;
- Activities, i.e. materials handling, crushing and grinding operations, travel on unpaved roads; and
- Interaction of gases (e.g. NH_3, SO_2, NOx, and Volatile Organic Compounds (VOCs)) with other compounds in the air to form PM.

The chemical and physical composition of PM varies depending on location, time of year and meteorology.

Ambient Air Quality

The air quality of the study area is mostly influenced by activities at the Tronox Namakwa Sands' MSP and current Tormin mining operations, farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles. These emission sources vary from activities that generate relatively coarse airborne particulates (such as farmland preparation, dust from paved and unpaved roads and the Tormin Mine) to fine PM such as that emitted by vehicle exhausts, diesel power generators and dryers. Other sources of PM include occasional fires in the residential areas of Koekenaap, Lutzville, Vredendal and farm activities.

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in South Africa. Dust emissions from unpaved roads are a function of vehicle traffic and the silt loading on the roads. Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time that a surface is disturbed e.g. by mining, agriculture and/or grazing activities, its erosion potential is restored.

Sensitive receptors that may be influenced by emissions from Tormin Mine are identified in Table 6-6 and Figure 6-6.

Table 20: Potential sensitive receptors

ID	Location	Distance and Direction from Tormin Processing Plant	ID	Location	Distance and Direction from Tormin Processing Plant
1	Brand-se-Baai	34 km NNW	**11**	Ebenhaeser	15 km SW
2	Graafwater	22 km NNW	12	Olifantsdrift	14 km SW
3	Baievlei	21 km NNW	13	Robeiland	12 km SSW
4		14 km NNW	14	Transhex	13 km SSW
5	Gert du Toit se Baai	10 km NW	15	Olifants River Settlement	17 km ENE
6	Skaapvlei	6 km NNW	16	Koekenaap	18 km ENE
7	Skilpadvlei	9 km ENE	17	Lutzville	24 km E
8	Nooitgedagt	6 km ESE	18	Pependorp	20 km SSW
9	Die Toring	6 km SSE	19	Strandfontein	26 km SSW
10	Olifants River Smallholdings	14 km E	20	Vredendal	40 km SW

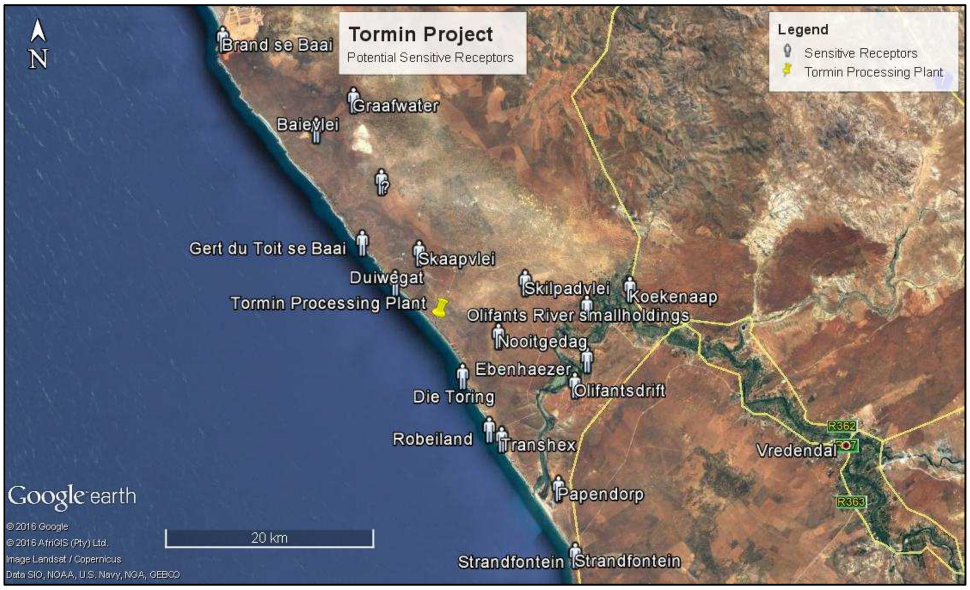


Figure 21: Locations of sensitive receptors in the study area

Source: Airshed, 2016

Dispersion modelling of routine emissions from Tormin Mine, concluded the following:

- Simulated annual average NO_2 concentrations exceed the NAAQS of 40 µg/m^3, but not at any of the identified sensitive receptors. The 1-hour NAAQS (88 hours of exceedance of 200 µg/m^3) is exceeded, but not at sensitive receptors;
- Simulated 24-hour average dustfall rates do not exceed the NDCR non-residential limit of 600 mg/m^2-day;
- Simulated annual average PM_{10} concentrations exceed the NAAQS of 40 µg/m^3, but not at sensitive receptors. The 24-hour NAAQS (4 days of exceedance of 75 µg/m^3) is exceeded at Skaapvlei; and
- Simulated annual average $PM_{2.5}$ concentrations do not exceed the NAAQS of 20 µg/m^3. The 24-hour NAAQS (4 days of exceedance of 40 µg/m^3) is exceeded, but not at sensitive receptors.

6.4 Noise

The site is surrounded by farmland with typical, low noise levels. Along the coast, noise generated by wave action is likely to result in higher than normal ambient noise levels, especially during rough sea conditions.

Mining, processing and the operation and movement of vehicles are sources of noise and vibration locally at the Tormin Mine site. There are very few noise receptors in the area.

6.5 Coastal and Marine Environment

This section is based on information provided by the marine ecology specialist, Anchor Environmental.

6.5.1 Regional Oceanography

The physical oceanography of an area (particularly water temperature, nutrient and oxygen levels, and wave exposure) is the principal driving force that shapes marine communities. The broader oceanography of the region is influenced by the cold Benguela upwelling system of the West Coast (Figure 17). The Benguela Current originates from the South Atlantic Circulation, which circulates just north of the Arctic Circumpolar Current.

The cool Benguela current (10-14°C) is enhanced by the upwelling of colder nutrient-rich deep water (Branch 1981). The area experiences strong southerly and south-easterly winds which are deflected by the Coriolis force (rotational force of the earth which causes objects in the southern hemisphere to spin anticlockwise). These prevailing conditions deflect the surface waters offshore and draw cold, nutrient rich water to the surface (Figure 18). Phytoplankton bloom when the nutrients reach the surface waters where plenty of light is available for photosynthesis. The phytoplankton is preyed upon by zooplankton, which is in turn eaten by filter feeding fish such as anchovy or sardine. This makes the West Coast one of the richest fishing grounds in the world and attracts large colonies of birds and seals (Branch 1981). The water temperature and nutrient levels are strongly influenced by wind with minimum temperatures and maximum nutrient levels occurring in conjunction with upwelling events (Branch and Griffiths 1988). Cape Columbine and the Cape Peninsula are areas that experience the most intense upwelling activity in the southern Benguela.

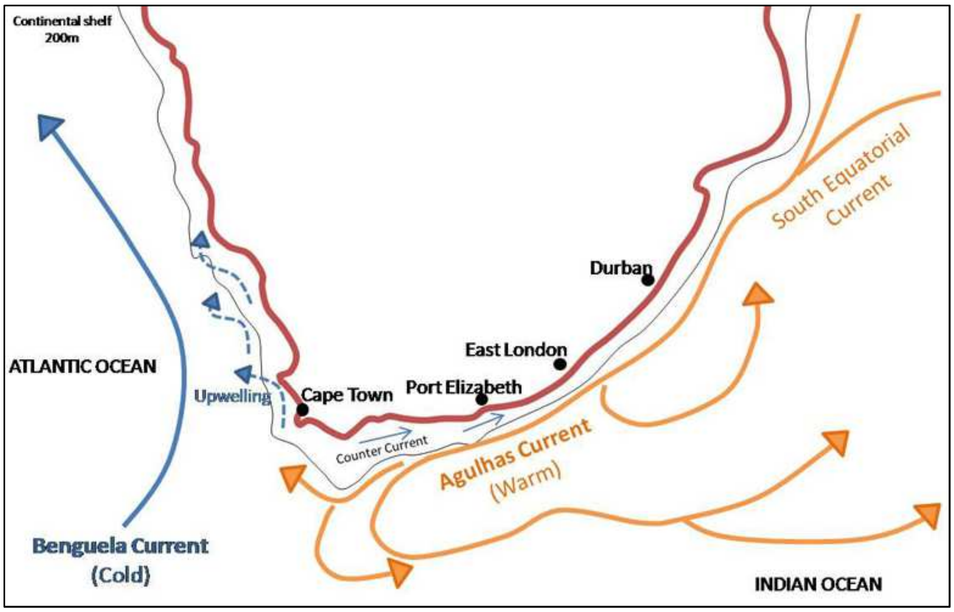


Figure 22: Major current streams around South Africa

Source: Anchor Environmental, 2016

Occasionally phytoplankton blooms contain species that are toxic to marine life and people who consume shellfish. Under certain oceanographic conditions (calm periods following intense upwelling), extremely dense phytoplankton blooms can sink and decay in coastal waters, leading to oxygen depletion of water and the production of hydrogen sulphide, which is toxic to marine life. Both toxic phytoplankton blooms (often referred to as red tides) and low oxygen events (colloquially referred to as black tides) are known to occasionally occur along the entire West Coast. These events are, however, more common in retentive bays downstream of intensive upwelling cells (e.g. St Helena Bay and Elands Bay). The coastline around the study area is at little risk of low oxygen events in the near shore due to the exposed nature of the coastline.

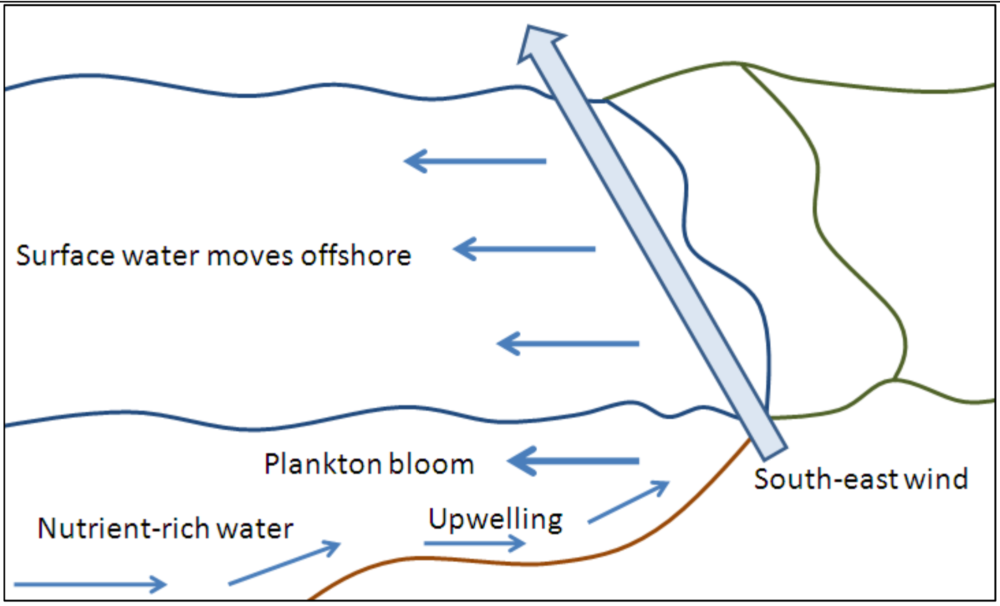


Figure 23: Wind-driven upwelling on the west and south west coasts of South Africa

Source: Anchor Environmental, 2016

6.5.2 Local Oceanography

Tormin Mine is located in the southern section of the Benguela Current System, which extends along the West Coast of southern Africa between Cape Agulhas and the Congo River mouth in Angola. The area falls within the Namaqua inshore ecozone, which is nested within the Southern Benguela Ecoregion as defined by Sink et al. (2012) (Figure 6-9).

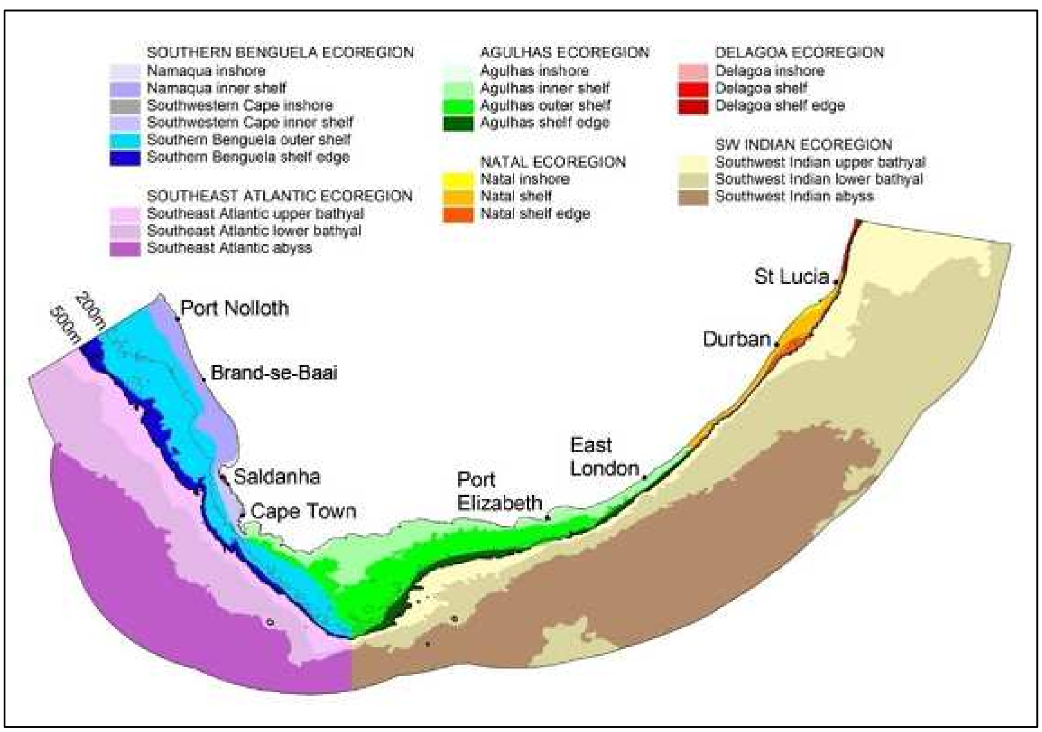


Figure 24: Marine ecoregions and ecozones in the South African marine environment

Source: Anchor Environmental, 2016

The Benguela system is influenced predominantly by the wind-driven upwelling of deep nutrient rich water close to the coast. Wind is the primary driver of life in the system, strongly influencing both water temperature and inorganic nutrient levels, and in turn, primary production. The prevailing south-easterly winds displace surface water offshore during the summer, and cause cold, nutrient rich water to rise from deeper water masses to replace this surface water. These upwelling events are the trigger for minimum temperatures and maximum nutrient levels (Branch and Griffiths 1988). The oceanic primary producers, phytoplankton, bloom when upwelled inorganic nutrients become available for photosynthesis in the presence of sunlight. These are consumed by zooplankton, which are in turn consumed by small pelagic fish species such as anchovy and sardine. As such, the Benguela is one of the world's most productive systems, supporting rich fishing grounds and attracting large colonies of sea birds and seals (Branch 1981).

The West Coast is subject to semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. High tide occurs approximately 25 minutes later every day. Spring tides occur once a fortnight during full and new moons. Tidal activity greatly influences the biological cycles (feeding, breeding and movement) of intertidal marine organisms, and has an influence on when people visit the coastline to partake in various activities such as bathing and harvesting of marine resources. The tidal variation on the West Coast usually ranges between 0.28 m (relative to the chart datum) at mean low water springs and 1.91 m at mean high water springs, with the highest and lowest astronomical tide being 2.25 m and 0.056 m respectively.

Another factor which greatly influences marine ecology and human activities along the coastline is wave energy. Wave size is determined by wind strength and fetch (distance over which it blows) and determines the degree to which breaking waves at the shore will shift sand and erode rock. The West Coast typically experiences high wave energy and is dominated by south-westerly swells with a long fetch and a period of 10 to 15 seconds (Branch and Griffiths 1988). Southerly and south-westerly waves frequently exceed 2 m (Figure 6-10).

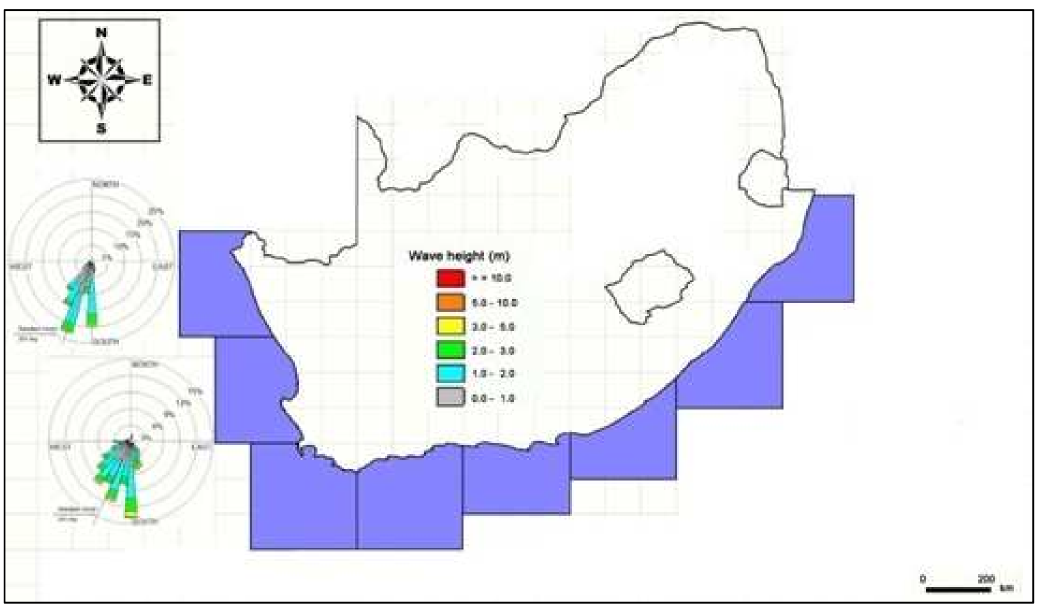


Figure 25: Wave roses showing frequency of wave heights and direction on the West Coast

Source: SADCO Voluntary Observing Ships data in Anchor Environmental, 2016

6.5.3 Marine Ecology

Sandy Beaches

Intertidal sandy beaches are dynamic environments. A wide range of human uses (from recreation to intensive mining operations) alter the physical characteristics and profile of a beach, as do natural processes such as storms (Pulfrich 2011b). The profile of a beach and its characteristics (i.e. grain size and wave exposure) are intricately linked, and directly influence the biotic community composition present on that beach and its surrounds. As such, an alteration in beach profile may result in temporary or permanent changes in faunal communities inhabiting them (Brown and McLachlan 1990; Brown and McLachlan 2002; Gomez-Pina et al. 2002).

Two types of beaches are found within the study site: long stretches of wide, flat dissipative beach with fine sands rich in sandy macrofaunal species, and steep, short, reflective, pocket beaches with coarse-grained sand, an accumulation of empty bivalve shells and few sandy macrofaunal species. Reflective beaches typically have low wave energy, a narrow surf zone and high natural variability in macrofaunal community composition over a short/medium time scale due to storm events, tidal cycles, seasons or inter-annual weather changes (McLachlan 1980; Souza and Gianuca 1994; Calliari et al. 1996; Pulfrich 2011b). Beaches with a high input of kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch and Griffiths 1988, Field and Griffiths 1991).

In the southern Benguela, a rich outer turbulent zone (10-33 m from the shore) supports cnidarians (anemones), tube building polychaetes and amphipods; while the less diverse offshore turbulent zone (3-5 m from the shore) is typified by deep burrowing polychaetes and crustaceans. Poor species diversity and abundance, as well as the presence of cumaceans, characterise the inner turbulent part of the surf zone (0-1 m from the shore). Fish such as galjoen (*Dichistius capensis*) and white steenbras (*Lithognathus lithognathus*) frequent turbulent surf zone waters off the West Coast where they swim over submerged beaches at high tide and feed on small crustaceans (Branch 1981). Surf zone habitats, particularly medium to low energy beaches, are in fact widely recognised as important nursery areas for fish (Lenanton et al. 1982; Clark et al. 1996). The intertidal zone of a west coast sandy beach is typified by mysids, scavenging gastropods (*Bullia* spp.), isopods and polychaetes. The upper drift line is typified by air-breathing amphipods (*Talorchestia* spp.) and giant isopods (*Tylos* spp.), as well as insects. Birds such as African black oystercatchers (*Haematopus moquini*), white fronted plovers (*Charadrius marginatus*) and sanderlings (*Calidris alba*) feed on sandy beach organisms along the West Coast.

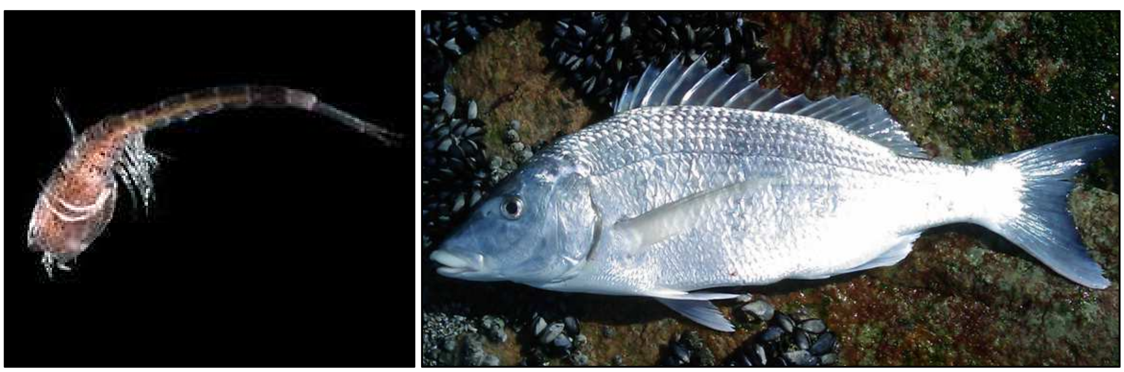


Figure 26: A cumacean (left) and a white Steenbras (right), both found in the surf zone

Source: Hans Hillewaert in Anchor Environmental, 2016

Of particular importance is the presence of the isopod *Tylos granulatus* on sandy beaches that are likely to be suitable for mining (Figure 22). Populations of these invertebrates are easily disturbed and due to declining numbers, Brown (2000) made the recommendation to list these invertebrates as *Vulnerable* in the IUCN Red Data Book.

Figure 27: Holes in sand sediment (left) indicating the presence of *Tylos granulatus* (right)

Source: Hans Hillewaert in Anchor Environmental, 2016

Subtidal Sandy Benthic Habitat

Fauna and flora that inhabit the surfaces of subtidal sand are called benthic epifauna, while those that burrow or dig into the soft sediments are called benthic infauna (Castro and Huber 1997). The distribution of infauna and the depth at which organisms can live in the substrate is largely dependent on sediment particle size. More porous, larger grained substrates allow greater water circulation through the sediment, thereby replenishing the oxygen that is used up during the decomposition processes.

Much of the benthic infauna are deposit feeders (e.g. worms), which either ingest sediments and extract organic matter trapped between the grains, or actively collect organic matter and detritus (Castro and Huber 1997). Suspension feeders eat drifting detritus and plankton from the water column (e.g. seapens and some species of crabs), while filter feeders actively pump and filter water to extract suspended particles (e.g. clams and some species of amphipods and polychaetes). Predators in soft bottom habitats either burrow through sediments or catch their prey on the surface (Castro and Huber 1997). Most bottom-dwelling fish in soft bottom habitats are predators that scoop up prey (e.g. rays and skates), while flat fish (e.g. flounders and sole) lie camouflaged on the bottom. Predators such as crabs, hermit crabs, lobsters and octopuses, which inhabit rocky areas, may move to sandy benthos to feed (Castro and Huber 1997). Similarly, reef-associated fish also rely on sandy substrate for food.

Rocky Reefs

Temperate rocky reefs are found below the low-water mark. Sources of disturbance include wave action and occasional sedimentation of shallow reefs surrounded by sand. Many large predators such as fish and sharks are attracted to rocky reefs and form an important component of these ecosystems (Barros *et al*. 2001).

Rocky reefs provide substratum to which kelp (*Ecklonia maxima* and *Laminaria pallida*) can attach (Figure 23). These large kelp forests provide food and shelter for many organisms. As light is the limiting factor for plant growth, kelp beds only extend down to approximately 10 m depth (Branch *et al*. 2010). Encrusting coralline is the dominant algae below the kelp canopy. Ephyphitic (grows harmlessly on another plant) algae grows on kelp, while under-storey algae are numerous (Meyer and Clark 1999). Filter feeders such as mussels, red bait and sea cucumbers comprise a large part of the faunal community on subtidal rocky reefs (Branch *et al*. 2010). Grazers include the dominant sea urchin *Parechinus angulosus*, limpets, isopods (i.e.*Paridotea reticulate)* and the amphipods (i.e. *Ampithoe humeralis)* (Branch 1981). West Coast rock lobster (*Jasus lalandii)* and octopus (*Octopus vulgaris)* are two of the most important carnivores that occur within kelp forests. Other kelp forest predators include the starfish *Henricia ornata*, various feather and brittle stars (*Crinoidea* and *Ophiuroidea*), and the whelks *Nucella* and *Burnupena* spp.

Fish species associated with rocky reefs include hottentot (*Pachymetopon blochii*), galjoen (*Dichistius capensis*), milk fish (*Parascorpis typus*), rock suckers (*Chorisochismus dentex*) and the catshark (*Haploblepharus pictus*) (Branch et al. 2010).

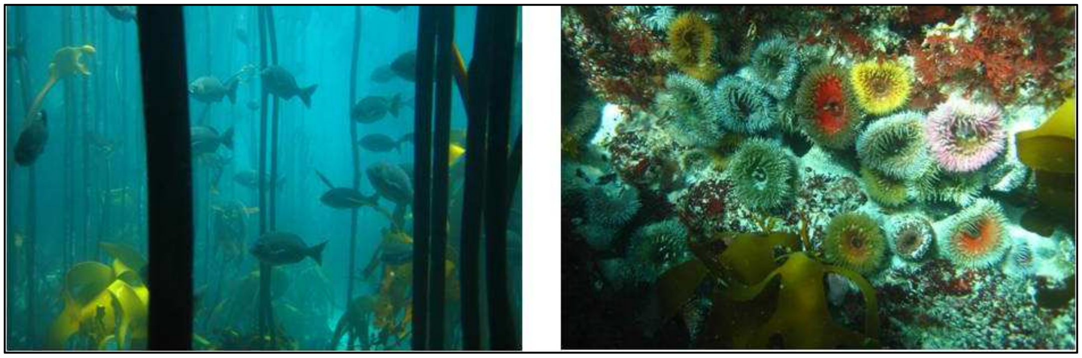


Figure 28: *Ecklonia maxima* kelp forest with *Laminaria pallida* sub-canopy and Hottentot *Pachymetopon blochii* (left). Blankets of sandy anemones *Bunodactis reynaudi* (right) are common both inter- and subtidally

Source: Anchor Environmental, 2016

Rocky Shores

West Coast rocky shores (Figure 6-14) can be divided into distinct bands according to the amount of time each section is exposed to the air. These zones (moving in a landward direction) are named the infratidal zone, the cochlear zone, the lower balanoid zone, the upper balanoid zone and the littorina zone. Rocky shore is a common habitat along this stretch of coast (Coastal Sensitivity Atlas of South Africa, 1984).

The infratidal zone is inhabited by species that cannot withstand long periods of exposure. These species include algae (e.g *Gigartina* spp. and *Champia lumbricalis),* articulated corallines, sea urchins (*Parechinus angulosus*) and the invasive black mussel, *Mytilis galloprovincialis*. The limpets, *Scutellastra argenvillei* and *Cymbula granatina*, form dense stands that extend up into the cochlear zone, effectively replacing *Scutellastra cochlear*, which are somewhat rare in the region. *Octopus vulgaris*, and various species of fish, known as “klipvis”, are found in subtidal rock pools where they prey upon bivalves and other invertebrates.

Above the cochlear zone is the lower balanoid, where the limpet *Scutellastra granularis*, winkles (*Oxystele tigrina* and *O. variegata*) and whelks (*Burnupena* spp.) are found. The black mussel also extends into this zone and often competes for space with *Gunnarea gaimardi*, the Cape reef worm. Seaweed is sparse in the lower balanoid zone, however, some sea lettuce (*Ulva* spp.) is usually present and there are often scattered patches of the encrusting brown alga, *Ralfsia verrucosa*. The upper balanoid zone is dominated by animals, limpets and barnacles in particular. The harshest of all the zones is the littorina zone, which is dominated by the snail *Afrolittorina knysnaensis* and the flat-bladed alga *Porphyra capensis* (Branch 1981).

The rocky shore survey identified 49 different invertebrate species including filter-feeders, grazers, predators and algae. None of these species are rare or vulnerable locally or regionally and rocky shore is a common habitat along this stretch of coast.

Figure 29: Typical rocky shore at the study site

Source: Anchor Environmental, 2016

6.5.4 Coastal Sensitivity

As sandy beaches are highly dynamic, these habitats are less sensitive to disturbance than rocky shore environments. Sandy beaches are also quicker to recover from disturbance than rocky habitats, with recovery from intensive mining operations being found to occur within two to three years in Namibia (Pulfrich and Branch 2014). Relatively few species occur on sandy beaches in comparison to rocky shores due to the unstable and harsh nature of beaches. Those species that do occur on sandy beaches are hardy and well adapted to life in these environments (Branch 1981).

Although beaches are less sensitive than rocky shores, beach surf zones are classified as ecologically sensitive areas that take time to return to their natural state following disturbance. They are especially vulnerable to the impact of land-based marine discharges, which may result in high concentrations of contaminants accumulating in the sediment. Although wave mixing does occur in the surf zone, many beaches are retentive, meaning that water is cycled between the shore and the backline for an extended period of time. As a result, the mixing potential of most beach surf zone environments is inadequate for the discharge of effluent streams (Anchor 2015). Effluent only escapes the cycle when the discharge is situated in a rip current, which channels the water offshore. Due to inshore currents and sand movement, rip currents constantly shift along the length of a beach and sometimes disappear altogether. Continuous discharges into the shallow water zone where circulation is limited, will cause accumulation of effluent resulting in unnatural habitat (DWAF 2004).

The rocky shore survey identified 49 different invertebrate species including filter-feeders, grazers, predators and algae. None of these species are rare or vulnerable locally or regionally. Although rocky shores are more sensitive to disturbance than sandy beaches, the reefs in this area experience sand inundation and scouring due to sediment movement. This results in them being more tolerant to disturbance than typical rocky shores that are impacted only by wave action and tidal movement.

Subtidally, sandy benthic habitats are generally not as diverse as offshore rocky reefs; however, they do host an assemblage of species not found in rocky areas. The majority of offshore habitat within the study area was found to consist of sandy benthic communities scattered with patches of reef. These rocky patches are generally more diverse than areas consisting solely of sand (Barros *et al.* 2001) and can tolerate higher levels of disturbance due to sand inundation.

During the ground-truthing survey, existing mining impacts, largely due to historical and current diamond and mineral sands mining, were apparent. These activities have affected the marine environment and continue to do so. Land-based excavations have left deep furrows in the coastal zone that are vulnerable to erosion; while marine diamond mining with suction hoses render the subtidal environment barren. Field surveys showed that vegetated slopes are dominant in the supratidal zone, mixed sand and rock is most common in the high shore, rocky substrata is abundant in the low shore and subtidal reef interspersed with sand is common subtidally.

6.6 Hydrology and Surface Water

This section is based on information provided by the aquatic ecology specialist, Freshwater Consulting cc.

6.6.1 Catchment Context

The study area lies in the Olifants-Doorn Water Management Area (WMA), which is planned to be incorporated into a larger Olifants-Berg WMA. Within this WMA, most of the study area falls within DWS's quaternary catchment F60E, comprising a large quaternary without any major rivers. The rivers in the WMA rise primarily in the north eastern part of the quaternary (approximately 20 km inland) and comprise relatively minor systems. They have been mapped in the national 1:50 000 river cover as "non-perennial" (i.e. ephemeral) rivers.

A few very short ephemeral rivers are also shown along the coastline in this quaternary. These systems comprise short drainage lines through the coastal dunes, which may act as local recharge areas. The coastal zone in the vicinity of the study area is narrow and separated abruptly from the inland zone by steep dunes and rocky cliffs.

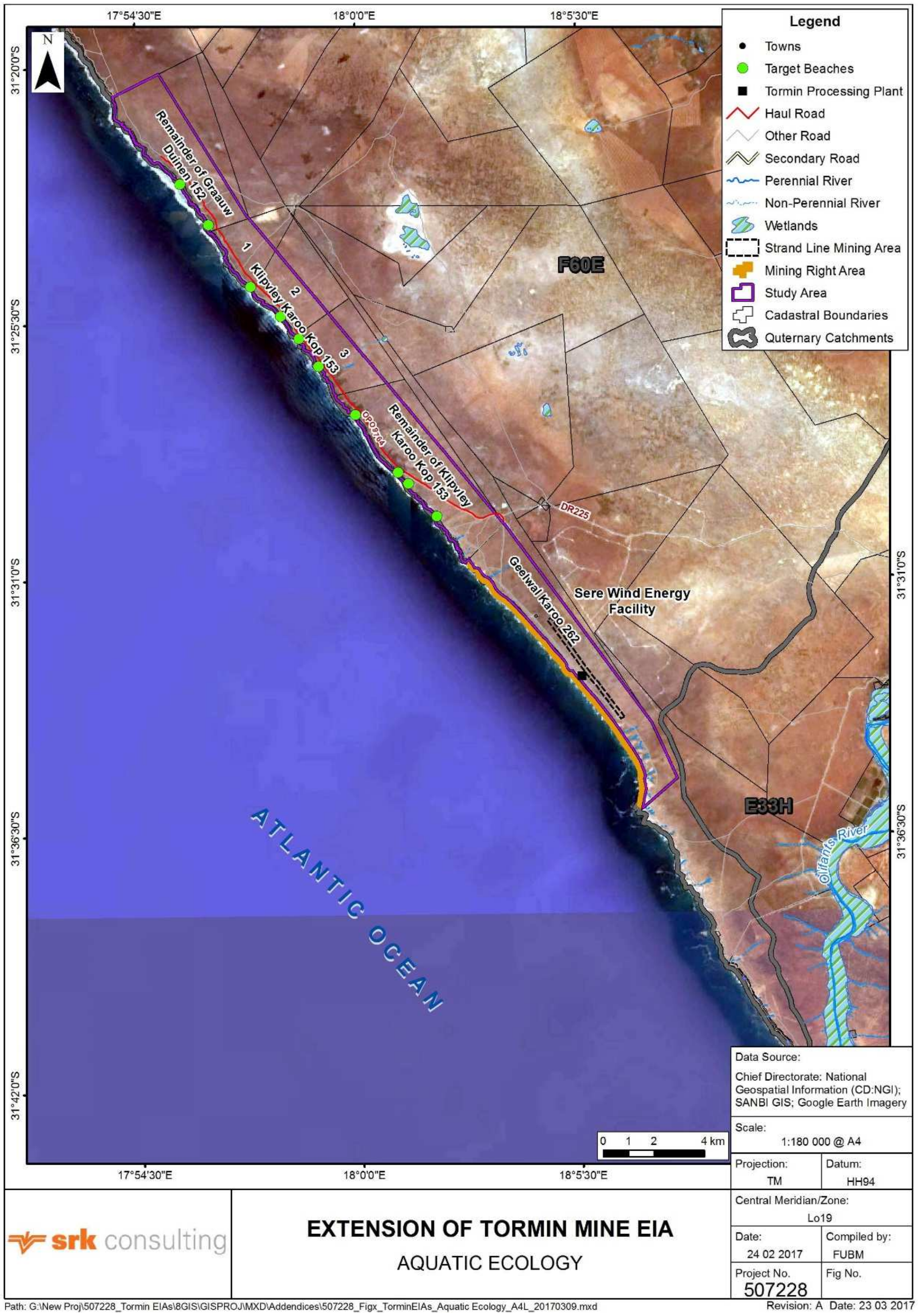


Figure 30: Aquatic ecosystems in the study area

Source: NFEPA and Matzikama Fine Scale Planning Data

6.6.2 Ecoregion Context

Ecoregions are groups of rivers that share similar physiography, climate, geology, soils and (under natural conditions) natural vegetation. The National Ecoregional Classification of Kleynhans et al. (2005) classifies the study area as falling with Ecoregion 25: the Western Coastal Belt Ecoregion. This ecoregion is characterised by plains with low and moderate relief, an altitude between sea level and 700 m amsl and vegetation that comprises primarily Succulent Karoo types (Kleynhans et al. 2005). The ecoregion includes the Olifants, Doring, Sout, Groen, Buffalo and western section of the Orange Rivers. Although it lies within a winter rainfall area, mean annual precipitation is very low / arid (Mean Annual Rainfall = 200 mm) with a high to very high co-efficient of annual precipitation, indicating high inter-annual variability between months and seasons (Schulze et al. 1997). Drainage density (length of river channel per unit area) is low, suggesting relatively slow discharge of runoff at a catchment level after a rainfall event.

6.6.3 Aquatic Ecosystems

All of the rivers and wetlands in the study area comprise minor ephemeral systems (the Olifants River is outside the study area). This is not surprising, given the low rainfall and high rates of evaporation in this ecoregion. The high rates of evaporative concentration in the area suggest that its ephemeral systems are likely to be characteristically mildly brack to saline. In agricultural areas, such systems are often least-impacted because of their marginal value as water supplies for irrigation or livestock (e.g. see Rountree et al. 2016). This notion is supported by data from the National Freshwater Water Ecosystem Priority Area (NFEPA) project for this area, which ascribe Present Ecological State (PES) or “condition” ratings of A/B and C to these systems, indicative of aquatic ecosystems that are in a natural or near-natural condition, to moderately impacted, respectively (Driver at al. 2011). Few of these data have however been ground-truthed and the condition of several of the systems are moreover listed as “unknown” or unassessed but disturbed (Category Z).

Wetlands in the surrounding area comprise mainly pans, which are classified by Ollis et al (2013) and identified in NFEPA data as “depressions”. However, no wetlands occur in the study area.

Drainage lines in the study area are all considered highly ephemeral, and likely to be dry throughout most if not all of most years, flowing only intermittently after significant rainfall events. Ground-truthing of the mapped watercourses showed only clearly identifiable systems including a system north of Tormin Mine near Beach 1 (Figure 27) and a number of minor watercourses in Geelwal Karoo 262. Locations of the identified watercourses are provided in below.

Table 21: Locations of watercourses (drainage lines) identified within the study area

	Watercourse Location	Coordinates		Located in Project Footprint (Yes / No)
		S	E	
1	Beach 1	31°29'31.76"	18° 2'38.61"	Yes
2	North of Processing Plant	31°30'51.00"	18° 3'32.78"	Yes (crossed by existing haul road between northern beaches and processing plant)
3	South of Processing Plant 1	31°34'26.47"	18° 6'55.89"	No
4	South of Processing Plant 2	31°35'10.25"	18° 7'23.91"	No

Source: Freshwater Consulting, 2017

The drainage line near Beach 1 (watercourse 1) seemingly dissipates into the sands following all but the most major of storm events, largely as a result of the high evaporation rate that characterizes this region (Schulze 2007) and it is assumed to derive its flow from surface rather than groundwater surfaces (refer to discussion on hydrogeology). The drainage line is not even associated with obvious riparian zones and it is assumed that flow occurs in this system too infrequently to sustain particular riparian species. Nevertheless, the drainage line near Beach 1 accords with the DWS definition of a watercourse, as “a natural channel in which water flows regularly or intermittently”. The condition of the watercourse is coarsely assessed as PES Category C, based on the DWAF (2008) definitions of PES categories, with the main impact being fragmentation as a result of the passage of minor roads across the system, and low to moderate erosion, mainly in the vicinity of roads. The watercourse is considered of Low to Medium conservation importance, but would have high sensitivity to changes in flows – particularly increases, and physical disturbance to the adjacent areas as a result of the passage of heavy vehicles through these areas. Its chief function as an aquatic ecosystem is the conveyance of water under episodic flood conditions.

Figure 31: Watercourse north of Tormin Mine near Beach 1, downslope of OP9764

Source: Freshwater Consulting Group, 2017

The coastline steepens adjacent to Farm Geelwal Karoo 262 and the minor watercourses along this area drop steeply down to the beach. Many of these systems are highly eroded, with the source of disturbance assumed in all cases assessed to be runoff and diversions of flow from haul roads. Under natural conditions, these systems would also be driven by episodic surface runoff, and possibly seepage from adjacent dunes. It is likely that the systems flow only occasionally and that their water quality is rendered more saline by the influence of sea spray. This said, in the event that they are linked to seepage water from dune areas, it is possible that they may have importance as sources of relatively fresh water along an otherwise arid, salt-dominated coast. No exploitable sources of freshwater have been identified in the study area.

Figure 32: Ephemeral watercourses in Geelwal Karoo 262 - located south (left) and north of the Processing Plant (right)

Source: Freshwater Consulting Group, 2017

Watercourse condition is difficult to assess using the standard PES approach, given that these watercourses have no riparian component, and include instream habitat on a temporary basis only. However, with consideration of the definitions for PES categories, it is estimated, with low confidence, that these watercourses vary in condition from Category D for systems south of the Tormin processing plant, to Category C/D for a watercourse north of the processing plant. The main reason for these different categories appears to be the fact that the area south of the processing plant has, historically, been heavily mined.

Like the watercourses north of the Tormin Mine, the main role in the landscape of these watercourses is the conveyance of water from the coastal dunes / cliffs down to the sea. Given the arid conditions, likely high runoff rates in places and steep gradients of these areas, the watercourses have very high sensitivity to erosion caused by runoff.

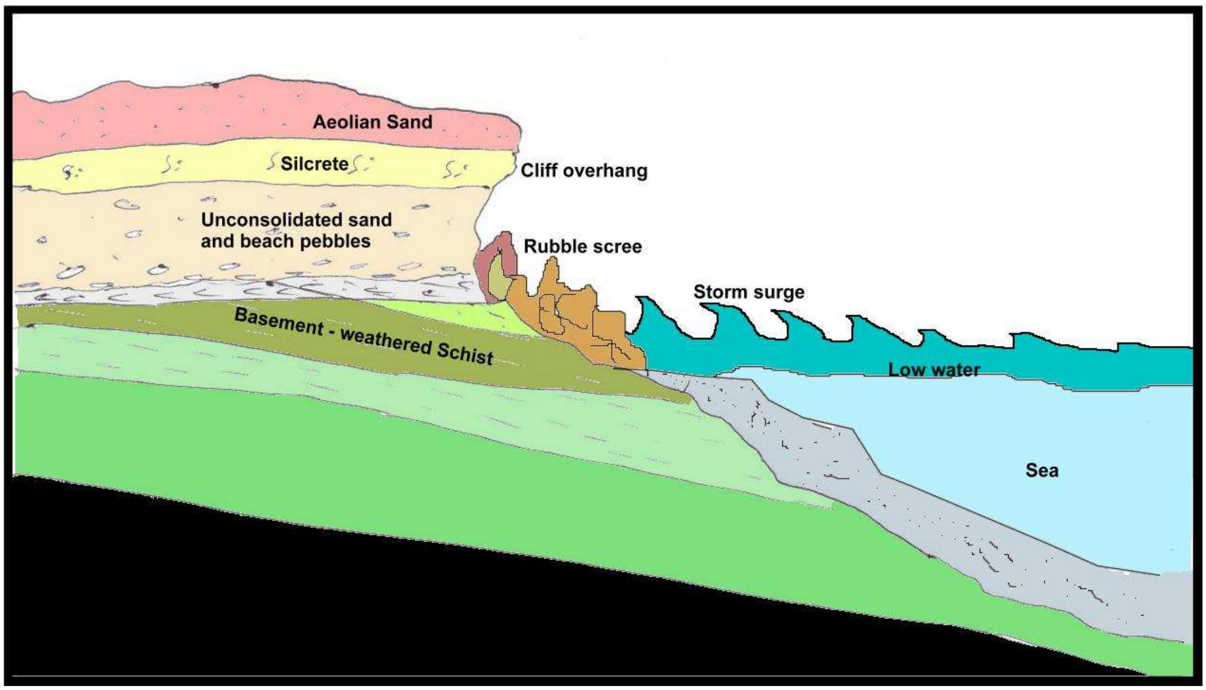
6.7 Hydrogeology

This section is based on information provided by the hydrogeology specialist, GEOSS.

6.7.1 Regional Hydrogeology

Farm Geelwal Karoo 262 is underlain by sandy deposits of Quaternary age with known heavy mineral deposits (predominantly ilmenite and garnet), with calcareous deposits in the south-west. Underlying this are the schists and phyllites of the Gariep Supergroup, while to the north-west along the beaches, augen gneisses outcrops are evident, derived from biotite granites of the Little Namaqualand Suite.

A cross section from south-west to north-east across the study area is provided in Figure 6-18 to illustrate the underlying geology. The cross-section is inferred from the 1:250 000 geological map as there is insufficient borehole log information or surface outcrop information.



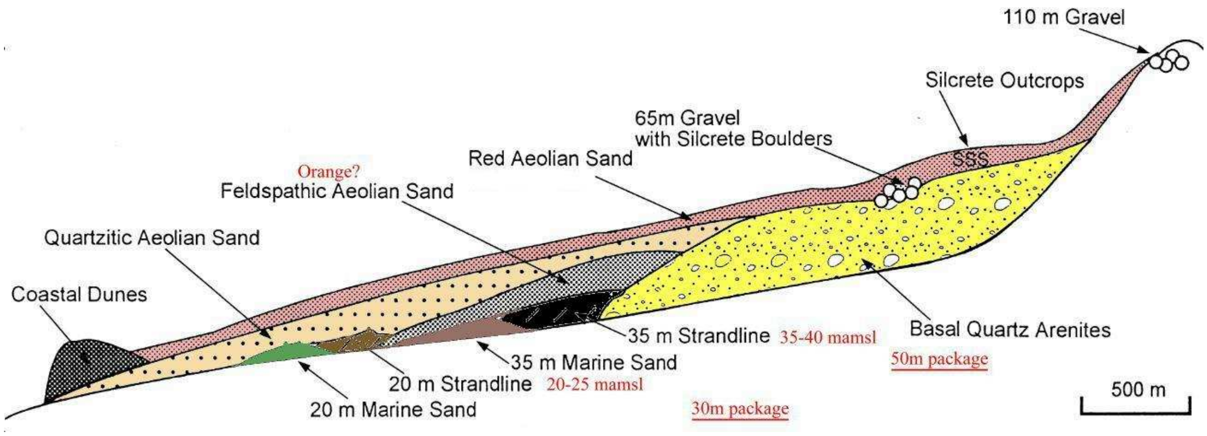


Figure 33: Schematic geological cross-section east to west (top) and detailed geological section across Farm Geelwal Karoo 262 west to east (bottom)

Source: AEMCO, 2018

The cross-section indicates the topographical slope towards the coast, with the inferred geology below, overlain by red aeolian sands and calcrete lenses. Shallow groundwater flow is largely within the sands, and will flow towards the coast.

According to the 1:500 000 scale groundwater maps produced by DWS (2000), the area contains three classifications of groundwater (Figure 6-19):

- The area to the north of Tormin Mine is listed as intergranular and fractured, with an average borehole yield of 0.1 - 0.5 litres per second (L/s);
- The area south of the Tormin processing plant is listed as a karstic aquifer, with an average borehole yield of 0.5 – 2 L/s. Based on field observations and supplied drilling data, the geology does not seem to be one that is typically associated with a karst aquifer, but is rather fracture aquifer geology consisting mainly of schist, phyllite and greywacke with an overlying sand layer. No water was found in any of the hydrocensus boreholes visited in this area; and
- The karstic aquifer then becomes a fractured aquifer, further south near the Olifants River, with an average borehole yield of 0.5 – 2 L/s.

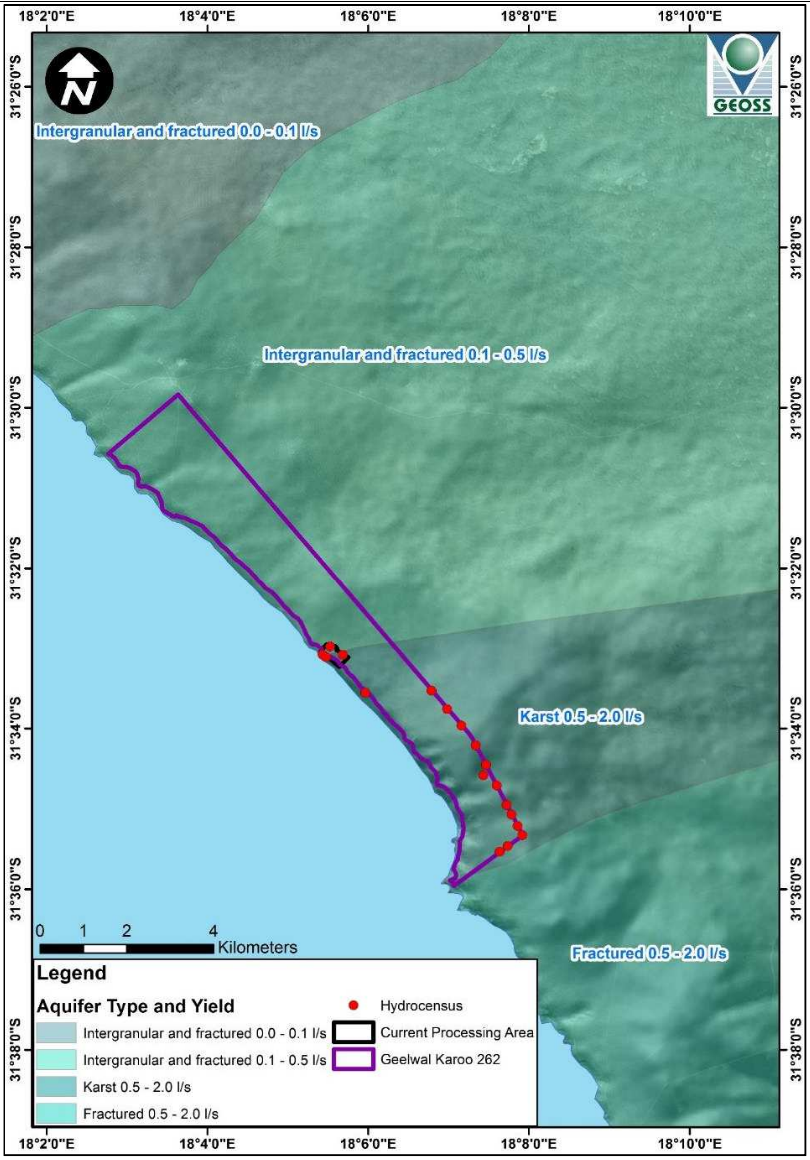


Figure 34: 1:500 000 aquifer type and yield of the Tormin Mine area (DWAF, 2000)

Source: GEOSS, 2017

Despite the variable classifications for the study area, it is likely that the major component of any shallow/medium depth groundwater flow is in the overlying sands, which were evident in the field. These are unsaturated, which may hinder seep flow from the proposed inland mining area towards the coast, as the pore spaces will first require filling, before any substantial flow occurs. The expected aquifer properties for the aeolian sands found in the area are provided in Table 6-8.

Table 22: Expected aquifer properties

Property	Expected Range	Reference
Hydraulic Conductivity (m/s)	$9x10^{-7} – 5x10^{-4}$	Domenico and Shwartz, 1990
Porosity (%)	25	Heath, 1983
Storativity (unitless)	0.1 – 0.3	Lohman, 1972

Source: GEOSS, 2017

6.7.2 Hydrocensus

There are no groundwater discharge points, such as springs, located in the study area. Two equipped and closed boreholes were identified (TMB01 and TMB04), but are no longer in use. The water from these boreholes was highly saline and, as they are both approximately 150 m from the sea, it is likely that these boreholes may have intersected sea water seep. A further 13 boreholes were identified on Farm Geelwal Karoo 262, the details of which are provided in Figure 6-20, Table 6-9 and Figure 6-21 to Figure 6-23.

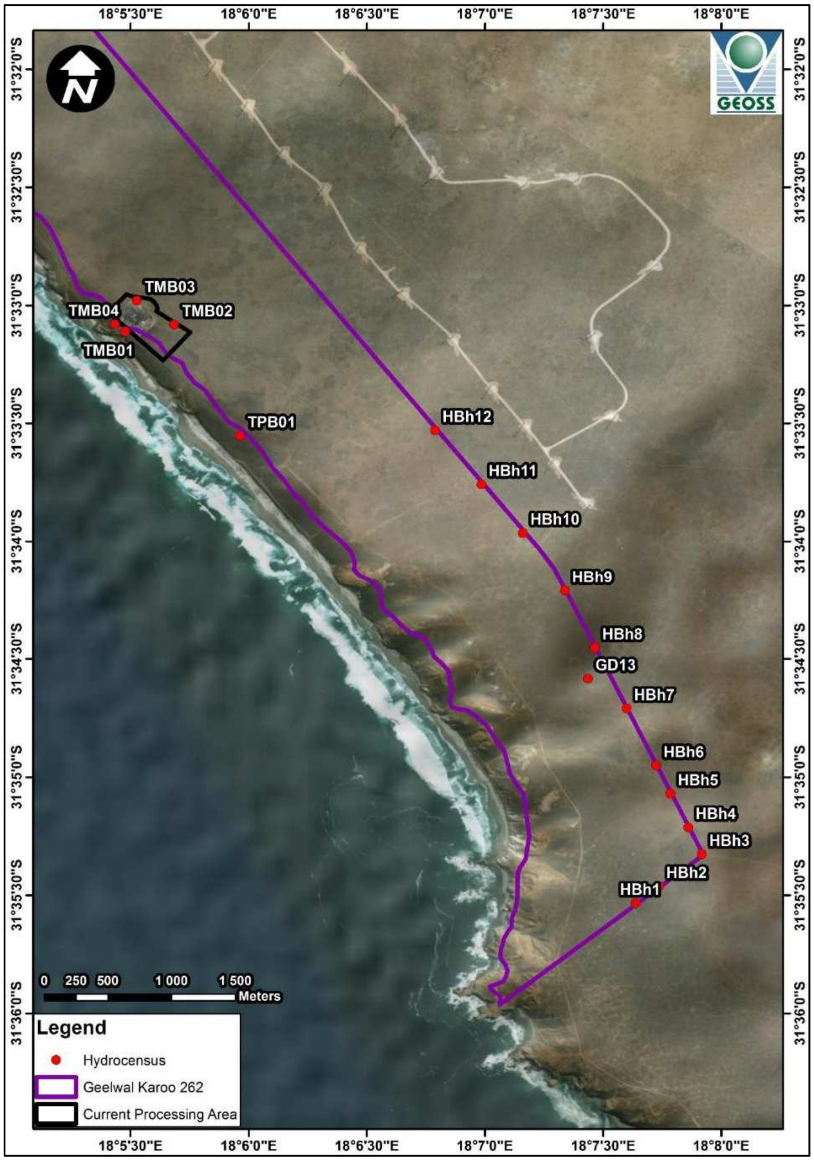


Figure 35: Hydrocensus boreholes visited in the area – all HBh sites were found to be dry

Source: GEOSS, 2017

Table 23: Hydrocensus boreholes

ID	Latitude (S)	Longitude (E)	Depth (mbgl)	Groundwater Level (mbgl)
TMB01	31.551840°	18.091280°	Unable to measure	Unable to measure
TMB04	31.551330°	18.090560°	Unable to measure	Unable to measure
TPB01	31.559210°	18.099380°	30	Dry
HBh1	31.592220°	18.127290°	9	Dry
HBh2	31.591040°	18.128950°	9.5	Dry
HBh3	31.588770°	18.131970°	15	Dry
HBh4	31.586880°	18.131010°	7	Dry
HBh5	31.584500°	18.129750°	4.2	Dry
HBh6	31.582520°	18.128740°	3	Dry
HBh7	31.578490°	18.126660°	Surface collapse	Dry
HBh8	31.574200°	18.124420°	34	Dry
HBh9	31.570160°	18.122290°	Surface collapse	Dry
HBh10	31.566070°	18.119340°	45	Dry
HBh11	31.562640°	18.116410°	5	Dry
HBh12	31.558820°	18.113150°	19	Dry

Source: GEOSS, 2017

Figure 36: Borehole TMB01 – unable to measure water level and no longer in use

Source: GEOSS, 2017

Figure 37: Borehole TMB04 – unable to measure water level and no longer in use (left) and Borehole TPB01 – dry to 30 m (right)

Source: GEOSS, 2017

Figure 38: Dry hydrocensus boreholes showing casing and cap and down borehole photos

Source: GEOSS, 2017

Five boreholes were drilled by MSR at Tormin Mine in order to source drinking water in the area (Table 6-10). Of these, TMB02 and TMB03 no longer exist as they were lost during mining activities. MSR recorded that TMB02 and TMB04 contained low, but significant yields, although the water was highly saline and therefore unsuitable for drinking.

Table 24: Boreholes drilled by MSR

ID	Latitude (S)	Longitude (E)	Depth (mbgl)	Water Level (mbgl / (mamsl)
TMB01	31.551840°	18.091280°	48	-
TMB02	31.551360°	18.094747°	18	9 / (34)
TMB03	31.549655°	18.092111°	18	10 / (35)
TMB04	31.551330°	18.090560°	30	5 / (25)
TPB01	31.559210°	18.099380°	31	-
GD13	31.576381°	18.123928°	120	-

Source: GEOSS, 2017

6.7.3 Groundwater Levels and Flow

It is thought that there is very limited groundwater in the area, however theoretical flow is predominantly through the topographical lows and may be hindered by the subsurface fluctuations in bedrock level. This is largely based on data supplied by MSR, which shows that groundwater was intersected within the sandy units overlying the schists and phyllites at TMB02, TMB03 and TMB04 (refer to Figure 6-20), but that at TPB01 bedrock was encountered at a shallower depth and the borehole was dry to 30 m. This indicates little to no saturation in the bedrock below, and that only the primary, unconfined aquifer has been found on site. It also indicates that flow in this aquifer is not uniform, and may follow subsurface paleochannels, which are not evident on the surface. This is likely the 0.1 – 0.5 L/s classification aquifer (Figure 6-19). An estimate hydraulic gradient of 0.0417 was calculated between TMB03 and TMB04 (approximately 240 m apart). The estimated linear groundwater velocity, considering the values provided in Table 6-8, is 0.013 – 7.20 m/day. The large range is due to the dependence on hydraulic conductivity, which is not accurately known on site. Seep flow from the proposed inland mining area may be expected to take a few months to a few decades to reach the coast.

Table 25: Water levels in relation to the coast

Bh_ID	Latitude	Longitude	Approximate Distance from Coast	Water Level mbgl / (mamsl)
TMB03	-31.549655°	18.092111°	385m	10 / (35)
TMB04	-31.551330°	18.090560°	140m	5 / (25)

Source: GEOSS, 2017

A conceptual model of the potential groundwater flow in the area was determined based upon the geological cross section, the hydrocensus and the geological logs provided by MSR. This conceptualisation of potential flow through the area suggests that any flow will accumulate in the shallow subsurface above bedrock material and follow low-lying topographical trends. From the recorded water levels and the topographical map, this suggests that flow would be localised to the middle portion of Farm Geelwal Karoo 262, where it would travel south-west towards the coast. As such, any seep into the subsurface is expected to flow down towards bedrock, where it would accumulate/mound and then begin flowing towards the coast. This would be most pronounced in the current processing area and immediate surrounds. Any sources of contamination in this seep will likely follow a similar path, and over time trend towards the coast. As there are no current groundwater users, the coastal environment is the only receptor to this flow.

The (conceptual) flow only in low-lying / depression areas is supported by no groundwater being intersected at the HBh boreholes, which are predominantly located on the higher elevation areas in the south-east of Farm Geelwal Karoo 262. While GD13 was drilled in a localised depression in the south-east (94 mamsl), the surrounding area is still relatively high and thus, despite the depth of GD13 (120 m), this is not indicative of there being no groundwater at lower topographical elevations.

In order to illustrate the theoretical flow directions, the three available water levels are shown in meters above mean sea level with the interpreted direction of flow (Figure 6-21). This is then extrapolated to a larger area shown in Figure 6-22. As the water levels at TMB04 were recorded to dry up after use of the water, it is likely that there is little to no remaining groundwater, despite intersecting groundwater at these sites.

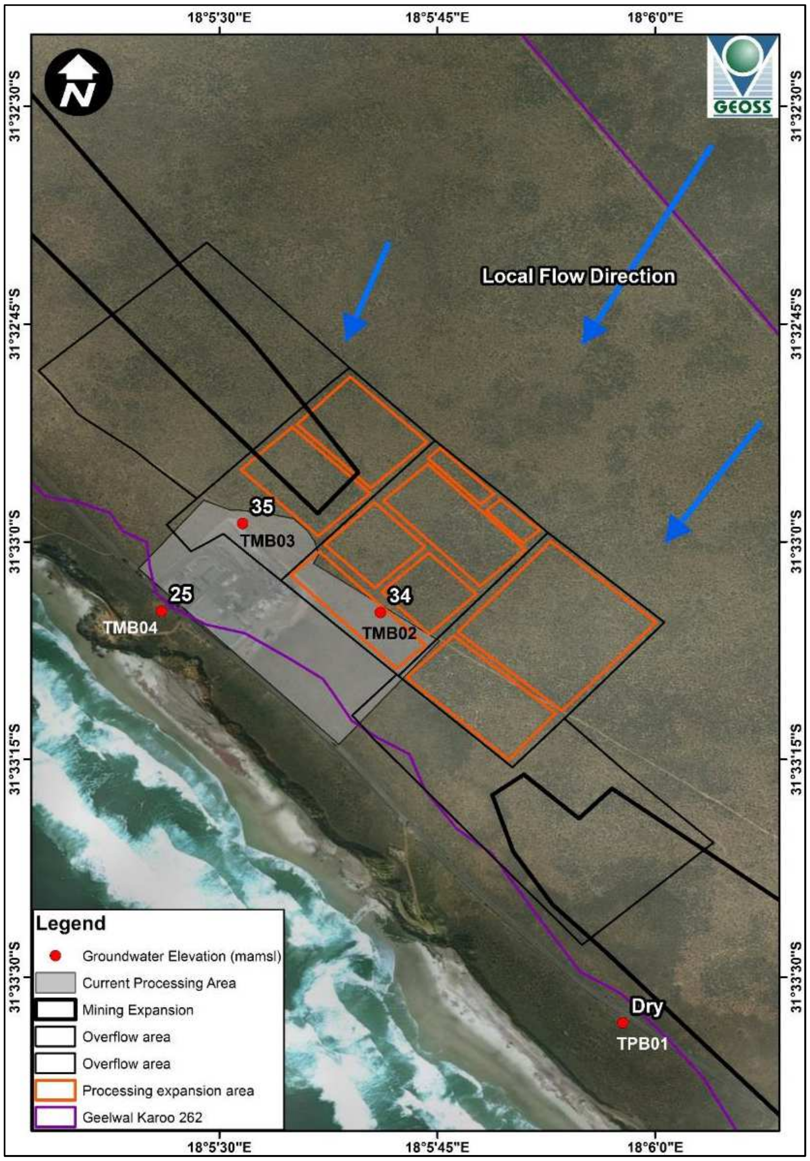


Figure 39: Available groundwater levels (mamsl) supplied by MSR

Source: GEOSS, 2017

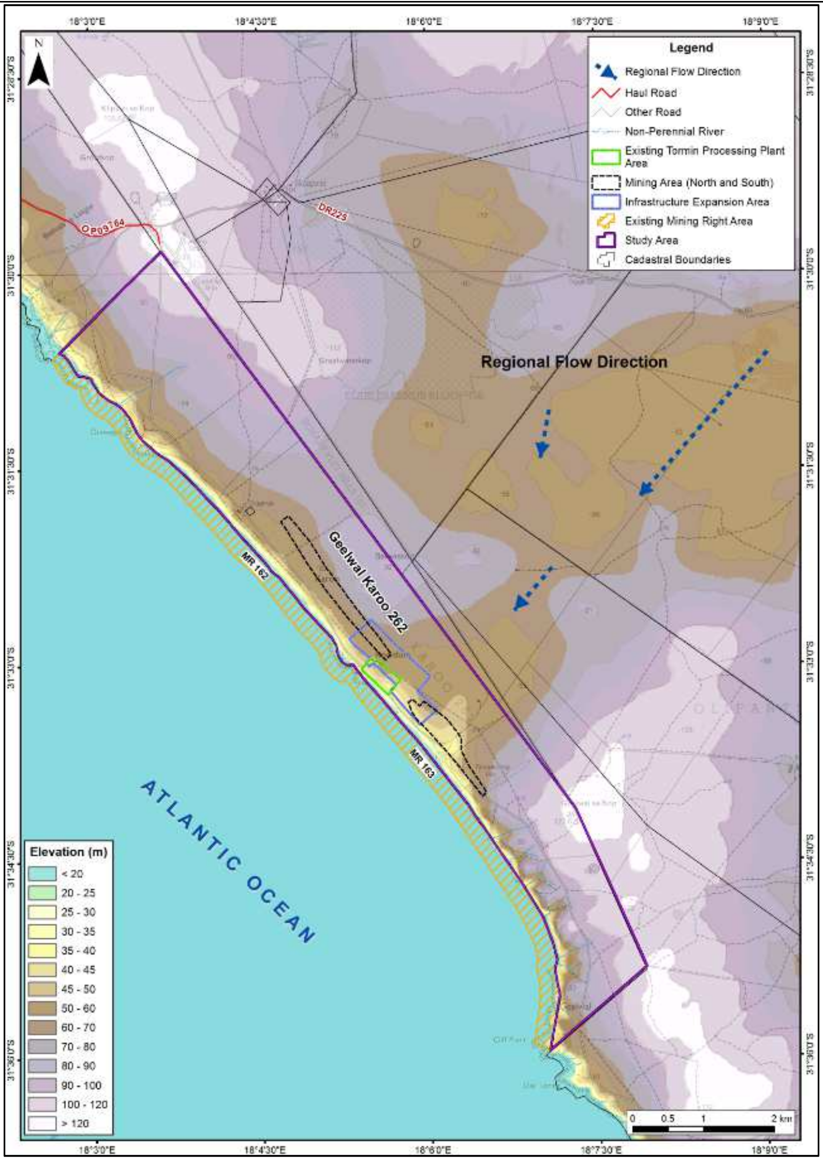


Figure 40: Extrapolated groundwater flow direction as a function of topography and previous groundwater levels on site

Source: GEOSS, 2017

From the groundwater levels of TMB02 and TMB03 (now non-existent), it is possible that the lower portion of the northern inland mining area (~ 350 m which overlaps part of the infrastructure / plant expansion area), has the potential to intersect groundwater within a depth of 15 m (estimated average mining depth). This is unlikely though as water levels were qualitatively noted to decrease at TMB04 with use. However, if groundwater is intersected, it could mark the lowest mineable depth.

6.7.4 Groundwater Quality

The regional groundwater quality varies greatly with the associated geologies of the area, and ranges from *good* to *very poor*. The groundwater electrical conductivity (EC) associated with the project area, as provided by DWAF (2000), ranges from 70 to 1000 mS/m (Figure 6-23). Groundwater with EC in excess of 300 mS/m is not considered suitable for prolonged domestic consumption.

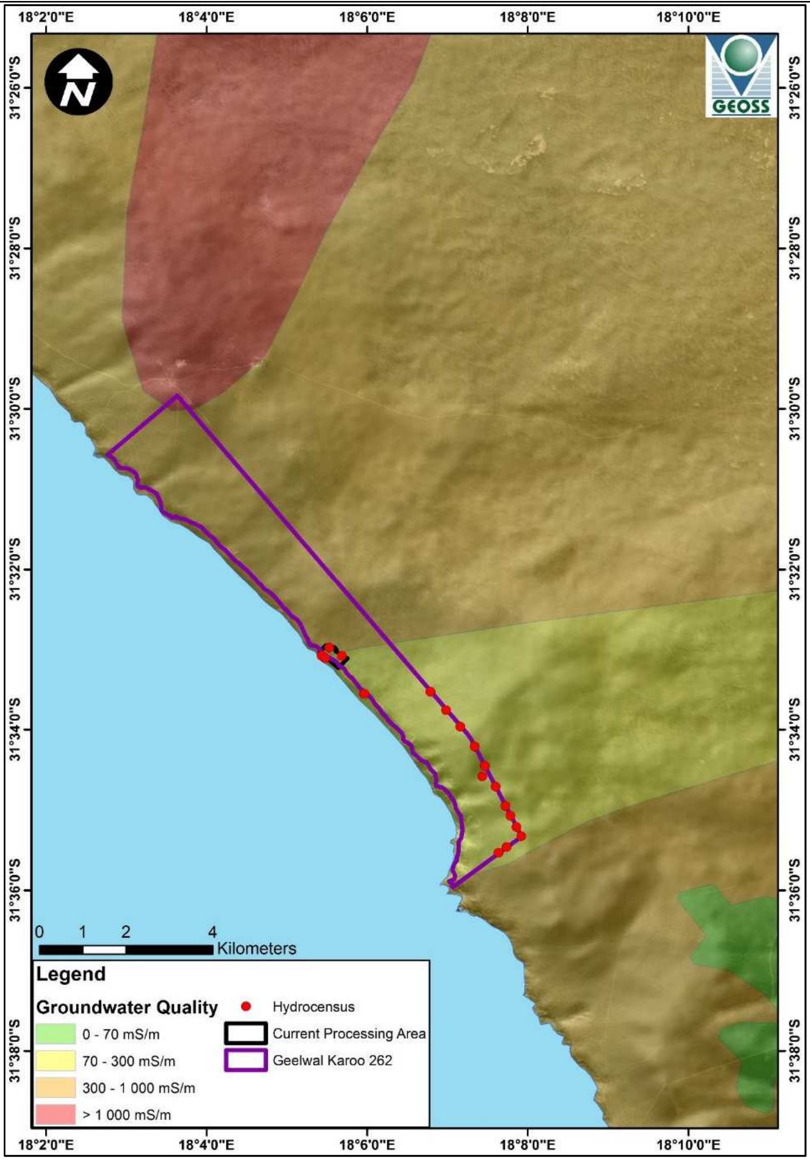


Figure 41: 1:500 000 groundwater quality of the Tormin Mine area (DWAF, 2000)

Source: GEOSS, 2017

There are no existing groundwater contaminants thought to be present in the study area, as the land is not utilised for any activities that interact with the subsurface (i.e. groundwater users, agricultural activities and large infrastructure).

6.8 Terrestrial Vegetation and Habitats

This section is based on information provided by the terrestrial ecology specialist, Simon Todd Consulting.

6.8.1 Regional Context

The study area occurs on the West Coast of South Africa within the Succulent Karoo Biome (Mucina and Rutherford 2006). The Succulent Karoo Biome extends from the West Coast of South Africa, northwards along the coast into southern Namibia and inland to Calvinia and almost as far as Port Elizabeth along the coast eastwards. The biome covers approximately 11 000 km, making it the fourth largest biome in South Africa (Mucina et al. 2006). The majority of the biome lies below 800 m and is generally flat to gently undulating. The Succulent Karoo is a recognised global biodiversity hotspot and is considered unique on account of the dominance of dwarf leaf-succulent shrubs. Apart from flora, the region also forms the centre of endemism for groups such as mole-rats, lizards, tortoises and various invertebrates. The area is incredibly diverse and rich botanically, containing 6 356 plant species 26% of which are strict endemics and 14% near endemics. Of the species occurring within the biome, 17% are International Red Data species (Mucina and Rutherford 2006).

Mining has been identified as one of the major threats to the biodiversity of Namaqualand, especially along the West Coast, which has been heavily impacted by mining activities. As such, the vegetation types which occur along the coast, such as Namaqualand Seashore Vegetation, have been particularly affected due to cumulative habitat loss and disturbance. Transformation and disturbance along the coastline also threatens to disrupt the connectivity of the coastal strip for fauna endemic or restricted to this region. Fauna that are likely to be particularly vulnerable to mining activities include the various subterranean species which are associated with the coastal sands and dune systems. This includes the various endemic golden moles that are restricted to the coastal areas, as well as the subterranean skinks which occur in this area.

6.8.2 National Vegetation Types

Broad-scale Patterns

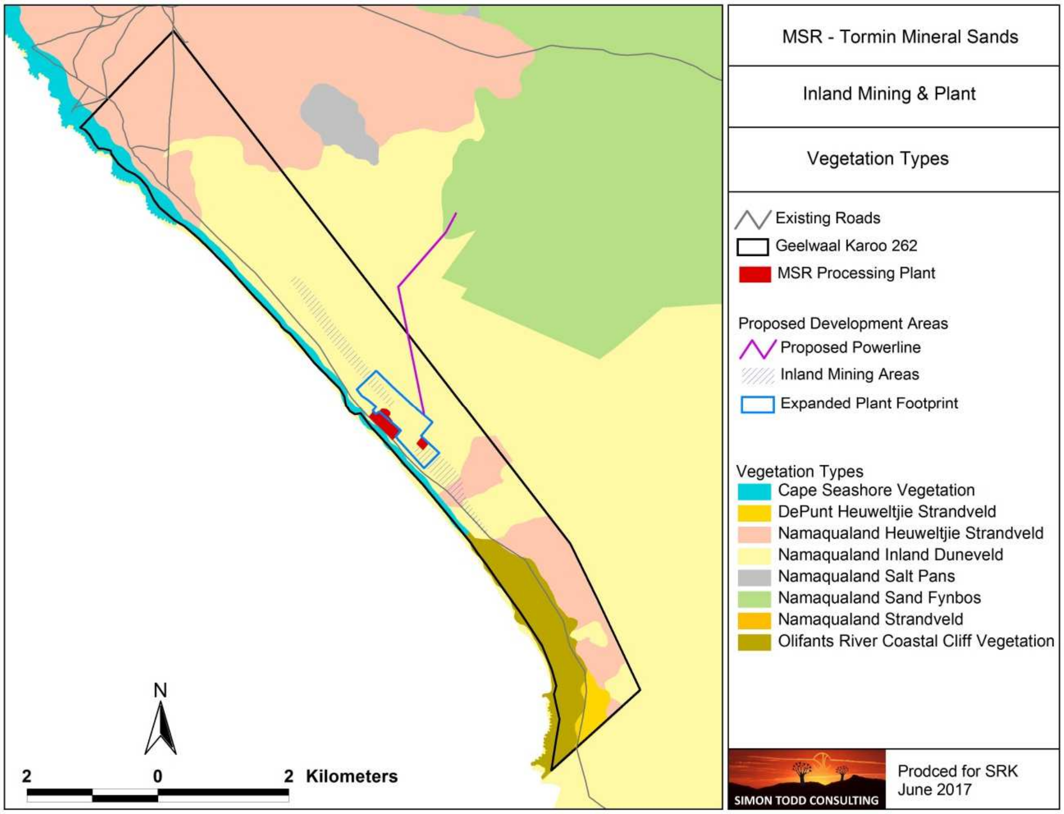
According to the national vegetation map (Mucina and Rutherford 2006, 2012), there are only two vegetation types within the study area - Namaqualand Seashore Vegetation along the seashore and Namaqualand Strandveld inland. This is, however, a very coarse depiction of the vegetation of the area and Skowno et al. (2009) provide a more realistic and detailed mapping of the vegetation of the area as part of a conservation assessment of the West Coast District Municipality (Figure 6-26). Skowno et al. (2009) recognised the following vegetation types in the area:

- Cape Seashore Vegetation;
- Namaqualand Heuweltjie Strandveld;
- Namaqualand Inland Duneveld; and
- Olifants River Coastal Cliff Vegetation.

Not all of these vegetation types are officially recognised vegetation types in the national vegetation map, but were defined by Skowno et al. (2009). Namaqualand Heuweltjie Strandveld represents the ecotone vegetation between the Namaqualand Strandveld and Namaqualand Heuweltjieveld of Mucina and Rutherford (2006). The main driver here is soil texture, with typical Namaqualand Strandveld on sandy soils and the Namaqualand Strandveld of Skowno et al. associated with more compact, fine-textured soils. Olifants River Coastal Cliff Vegetation is not defined by Skowno et al. but represents a community of Cape Seashore Vegetation occurring on the steep seacliffs characteristic of this part of the coastline, especially in the vicinity of the Olifants River mouth.

Although the vegetation along the shore is classified in the National Vegetation Map as Namaqualand Seashore Vegetation, Skowno et al. define this vegetation as Cape Seashore Vegetation. It is not clear whether this is simply a naming convention or based on real information with regards to the composition of the vegetation of this area. However, given the aridity of the site and its features, the seashore vegetation clearly has greater affinity with Namaqualand and the Olifants River mouth is taken as the break between Cape and Namaqualand Seashore Vegetation.

The areas of Namaqualand Inland Duneveld which are mapped by Skowno et al. are based on their affinity with the areas of Namaqualand Inland Duneveld mapped under the National Vegetation Map. The site visit and field assessment, however, suggests that there are some obvious differences between these areas. The Namaqualand Inland Duneveld to the north and the areas classified as Namaqualand Inland Duneveld within Farm Geelwal Karoo 262 are, at best, transitional between typical Namaqualand Strandveld and Namaqualand Inland Duneveld, but certainly don't conform to the typical concept of Namaqualand Inland Duneveld. Although the naming of the units identified is therefore considered debateable, they are nevertheless considered useful in delineating Strandveld on deep sands from Strandveld on shallow or more finely-textured soils.



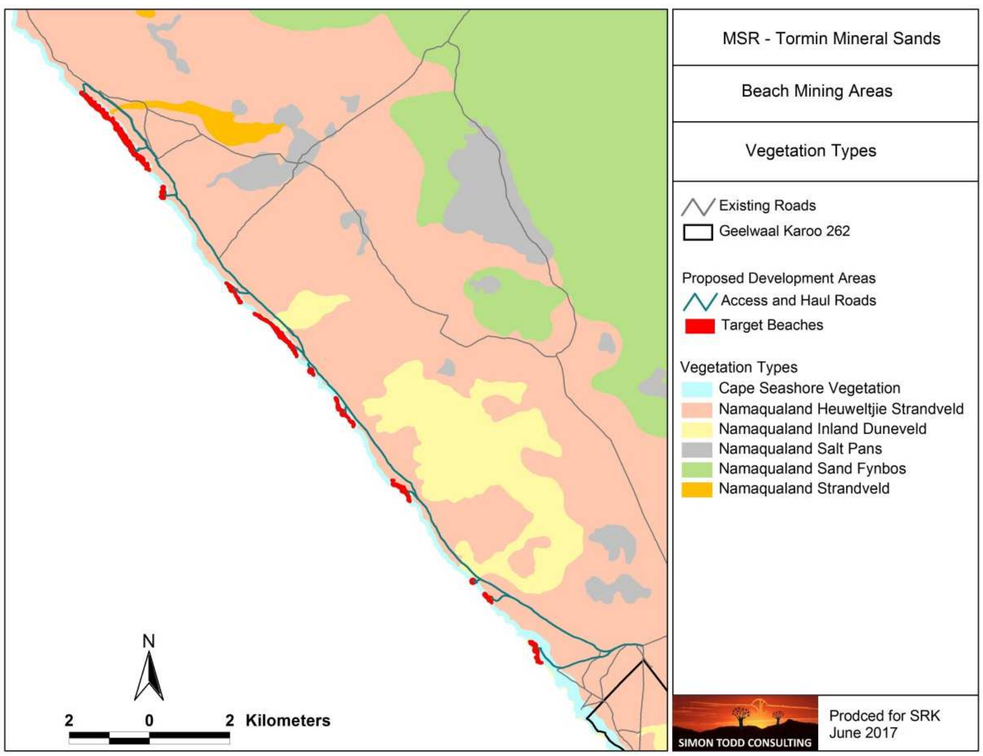


Figure 42: Vegetation maps of the area as described by Skowno et al (2009) for the West Coast District Municipality

Source: Simon Todd Consulting, 2017

Description of Vegetation Units

Namaqualand Strandveld which incorporates the areas mapped as Namaqualand Heuweltjie Strandveld by Skowno et al. occurs on the coastal peneplain, associated with deep stabilised aeolian yellowish-red dunes and deep sand overlying marine sediments and granite gneisses. The vegetation consists of low species-rich shrubland dominated by erect and creeping succulent shrubs as well as non-succulent shrubs (Mucina and Rutherford 2006). It has a rich component of annual and perennial flora, producing spectacular spring displays. Mucina and Rutherford (2006) list eight endemic species for this vegetation type (*Lampranthus suavissimus, Tylecodon decipiens, T. fragilis, Afrolimon sp., Gorteria sp. nov. Sutera multiramosa, Lachenalia valeriae* and *Romulea sinispinosensis*). This is likely an underestimate and there are certainly additional species of conservation concern present as undescribed species are regularly encountered in this vegetation unit as it has not been well investigated in the past.

Namaqualand Seashore Vegetation occurs in the Northern Cape, along a very narrow strip above the high tide zone of the Namaqualand coast from the Holgat River to just south of the Olifants River (Mucina and Rutherford 2006). This vegetation type occurs on slightly sloping beach, coastal rocky formations supporting sparse vegetation composed partly of succulent hummock-forming and spreading dwarf shrubs and herbs on the beach, in shell beds and on low dunes. The soils associated with this vegetation type are typically recent sandy marine sediments. The vegetation is under constant maritime influence from salt spray but is not directly influenced by sea tides. Biogeographically important taxa (West Coast endemics) include: *Drosanthemum luederitzii, Limonium sp., Arctotis scullyi, Salsola nollothensis* (Mucina and Rutherford 2006). Mucina and Rutherford (2006) list mining as the greatest threat to this vegetation type.

According to Mucina and Rutherford (2006), **Namaqualand Inland Duneveld** is distributed in the Northern Cape Province where it occurs in two patches: one between Kotzesrus northwards to the Groen River and the other between Wallekraal and Hondeklipbaai. However, as the vegetation mapping of Skowno et al. as well as others suggest, this unit has been under-mapped and it is more extensive than previously mapped. The vegetation occurs on coastal peneplains with mobile dunes and consists of tall shrubland dominated by non-succulent shrubs (*Berkheya, Eriocephalus, Euclea, Gloveria, Lycium* and others) as well as some grasses (*Ehrharta*) and restioids (*Willdenowia*). It occurs on Quaternary Aeolian deep, loose, red to yellowish sand. Although some of the areas inland of the beach mining sites were seen to correspond to this vegetation unit, the areas mapped as Namaqualand Inland Duneveld within Farm Geelwal Karoo 262 by Skowno et al. are considered to be more representative of Namaqualand Strandveld than this unit. Species typical of this and the other units are described below.

Plant Community Analysis within Farm Geelwal Karoo 262

Based on analysis of 33 sample plots on Farm Geelwal Karoo 262, three plant communities could be distinguished. There is a clear separation of the plots from the south of the study area which represent low and open (short) Strandveld on fine-textured soils from the other plots. The remaining plots consist of moderate Strandveld and tall Strandveld, which are not as easily distingioshable as the short Strandveld. The analysis also revealed that the vegetation of the affected area is not unique or well differentiated from adjacent areas. The field assessment confirms that, while there is a clear vegetation gradient from the ocean inland, the affected area is fairly homogenous and similar to habitat in the broader area. The different communities identified in the analysis are described in the next section.

Short Strandveld

On fine-textured soils, usually underlain by hardpan, the vegetation is generally short and open and is characterised by the occasional presence of heuwetljies. This vegetation type corresponds with what Skowno et al. (2009) called Namaqualand Heuweltjie Strandveld. Common and dominant species include *Othonna cylindrica, Exomis microphylla var. axyrioides, Tetragonia fruticosa, Asparagus capensis, Cephalophyllum framesii, Psilocaulon dinteri, Vanzijlia annulata, Galenia fruticosa, Phyllobolus spinuliferus, Rushia sp.,* *Leipoldtia schultzei, Berkhaya fruticosa, Didelta carnosa var carnosa, Euphorbia caput-medusae, Tripteris oppositifolia, Hypertelis angrae-pequenae* and *Zygophyllum morgsana*. The diversity of this plant community is quite high, but the only endemic species observed in this habitat and within the site was *Hermannia sp. nov. (bungholensis*), which also present in the other strandveld communities of the site. Although this is a relatively widespread community in the area and is prevalent to the south and north of Farm Geelwal Karoo 262, it has a relatively limited extent within the site itself and tends to be restricted to the southern end of the inland mining area (Figure 6-27). The firmer soils present here make it a preferred habitat of smaller burrow-dwelling fauna such as Meerkat which cannot maintain burrows in the more sandy parts of the site.

Figure 43: Short Strandveld typical of the southern section of Farm Geelwal Karoo 262

Source: Simon Todd Consulting, 2017

Moderately Tall Strandveld

The majority of Farm Geelwal Karoo 262 consists of moderately tall Strandveld. Common and typical species associated with this habitat include *Stoeberia utilis, Zygophyllum morgsana, Othonna cylindrica, Pteronia onobromoides, Eriocephalus racemosus var. affinis, Exomis microphylla var. axyrioides, Tetragonia fruticosa, Senecio sarcoides, Ehrharta calycina, Asparagus capensis, Asparagus lignosus, Asparagus aethiopicus, Helichrysum hebelepis, Babiana thunbergii* (*Near Threatened*), *Boophone disticha (Declining), Pteronia divaricata, Lycium ferocissimum, Salvia africana-lutea, Euphorbia burmannii, Galenia fruticosa, Conicosia pugioniformis subsp pugioniformis, Rushia sp., Leipoldtia schultzei, Mesembryanthemum crystallinum, Hermannia sp. nov., Tripteris oppositifolia* and *Pelargonium gibbosum*. This community is widespread at the site and forms the majority of the affected area. Although there are some listed species present in this community, including *Babiana thunbergii* (*Near Threatened*) and *Boophone disticha* (*Declining*), the overall abundance of these species within the site is low and a high impact on listed plant species within this community is unlikely.

Figure 44: Moderately tall Strandveld typical of the majority of Farm Geelwal Karoo 262

Source: Simon Todd Consulting, 2017

Tall Strandveld

In areas of deep sand and in valleys between the dunes, the vegetation consists of tall Strandveld, dominated by many of the same species as the moderately tall Strandveld plant community, but growing to a larger size or at a higher density (Figure 6-29). This community is closest to what Skowno et al. (2009) have mapped as Namaqualand Inland Duneveld, but is driven by moisture availability rather than mobile sands. Strandveld community rather than a different vegetation typeDominant and characteristic species include *Stoeberia utilis, Salvia africana-lutea, Searsia rigida, Zygophyllum morgsana, Lycium ferocissimum, Othonna cylindrica, Pteronia divaricata, Eriocephalus racemosus var. affinis, Tetragonia fruticosa, Senecio sarcoides, Ehrharta calycina, Asparagus aethiopicus, Melianthus elongatus, Helichrysum hebelepis, Tylecodon paniculatus, Euphorbia burmannii, Tripteris oppositifolia* and *Pelargonium gibbosum*. Although the abundance of listed plant species in this habitat is low, the higher density of vegetation cover in these areas makes them important for fauna, especially species preferring dense vegetation to hide in such as Duiker and many of the predators. The overall extent of this habitat within the development footprint is relatively low and most of the affected habitat occurs in the northern section of the inland mining area.

Figure 45: Tall Strandveld community occurring in wetter areas on deep sands

Source: Simon Todd Consulting, 2017

Plant Communities of the Beaches and Foredunes

Most of the larger target beaches are backed by semi-vegetated dunes which transition into Namaqualand Coastal vegetation and Strandveld (Figure 6-30). The dunes are usually dominated by either *Cladoraphis cyperoides* or *Sporobolus virginicus*, with shrubs in more stable areas and inland, with dominant species being *Lycium tetrandrum, Lycium ferocissimum, Asparagus capensis, Amphibolia laevis, Carpobrotus quadrifidus, Thesium spinosum, Zygophyllum morgsana, Zygophyllum cordifolium, Delosperma crassum, Othonna cylindrica, Psilocaulon dinteri, Vanzijlia annulata, Atriplex vestita, Tripteris oppositifolia, Galenia fruticosa* and *Hypertelis angrae-pequenae*.

Due to the relatively low vegetation cover and high winds along the coast, the dunes are vulnerable to disturbance and easily mobilised.

Figure 46: Dunes along Beach 10, showing the dominance of *Cladoraphis cyperoides*, with *Thesium spinosum*, *Othonna cylindrica* and *Amphibolia laevis*

Source: Simon Todd Consulting, 2017

Large stretches of the coastline have been disturbed by diamond mining activities and virtually all the beaches have been disturbed (Figure 6-31).

Figure 47: Large waste dumps at the high water mark have been partially recolonised by vegetation but will not fully recover

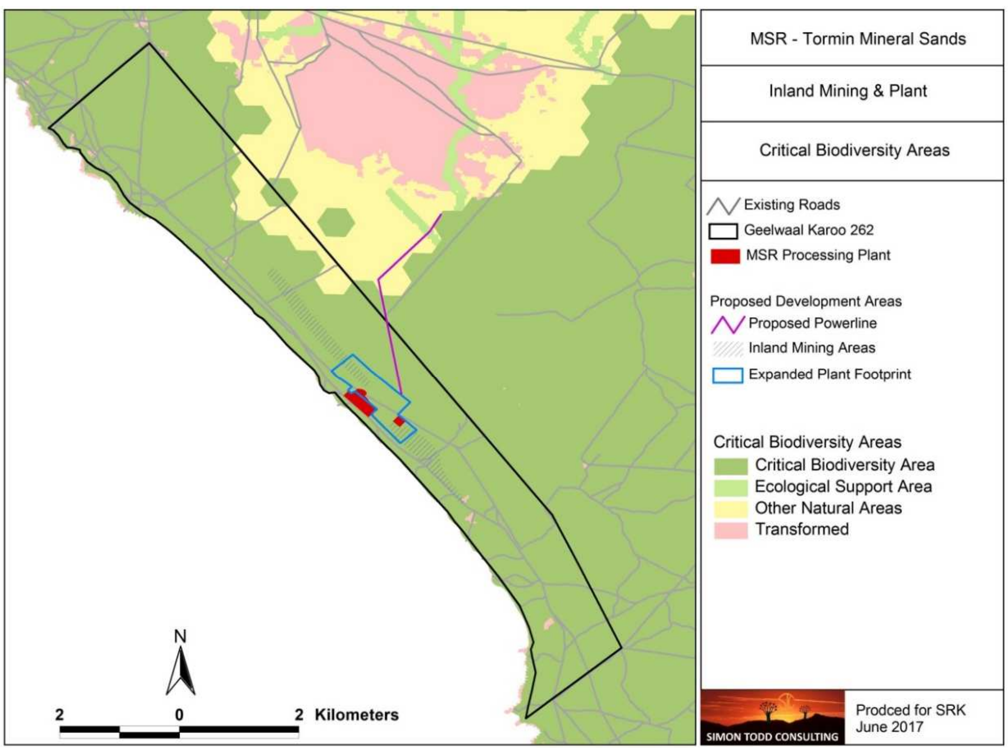
Source: Simon Todd Consulting, 2017

6.8.3 Vegetation Sensitivity

The Critical Biodiversity Areas (CBAs) map of the study area is illustrated below (Figure 6-32) and indicates that the majority of the area under application falls within CBAs. These areas have been designated as CBAs to promote coastal resource protection and to maintain ecological processes associated with the coastal strip, especially the ability of fauna to move along the coast. Although CBAs confer no rights and have no official conservation status in law, they provide an indication of ecological status (biodiversity).

The ecological sensitivity of the study area, as determined by the specialist following a site visit in the summer season, is depicted in Figure 6-33. A large proportion of Farm Geelwal Karoo 262 is considered to be of *Medium-high* sensitivity on account of the sensitivity of the vegetation and likely presence of species of conservation concern. There are areas in the study area that have been affected by historic prospecting activities and overgrazing; however, much of the vegetation of the proposed footprint of the strand line can be considered mostly natural, although fairly homogenous and no features of specific concern were identified. Large parts of the coastal forelands are considered to be of *High* sensitivity on account of the significance of these areas for fauna and their vulnerability to disturbance.

Within the proposed beach extension area north of Farm Geelwal Karoo 262, the strip immediately inland of the beaches is considered to be of *High* sensitivity on account of the vulnerability to disturbance and the role as an ecological corridor along the coast, with a variety of species restricted to this habitat. The beaches themselves are *Moderately* sensitive as they are used by a variety of faunal species but do not appear to be critical for any of the observed fauna in the area. Areas of dense vegetation in low-lying areas and coastal valleys that are important movement corridors for fauna have been identified as having a higher sensitivity than the surrounding Strandveld.



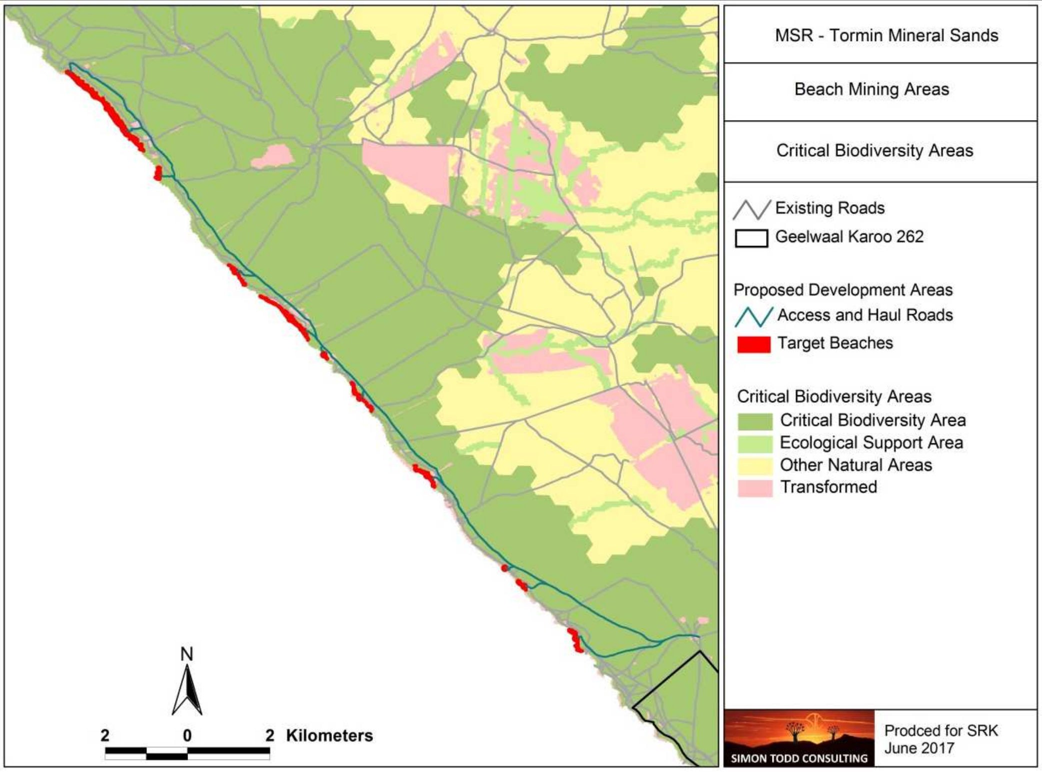
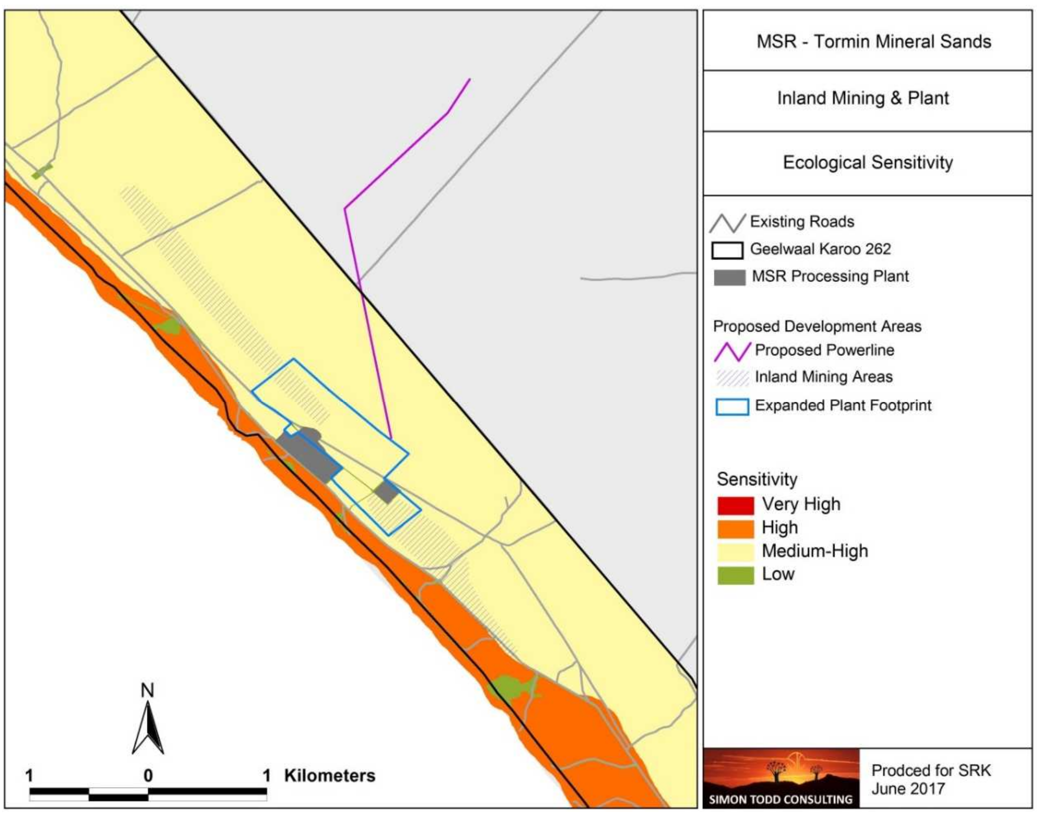


Figure 48: CBA maps of the study area

Source: SANBI in Simon Todd Consulting, 2017



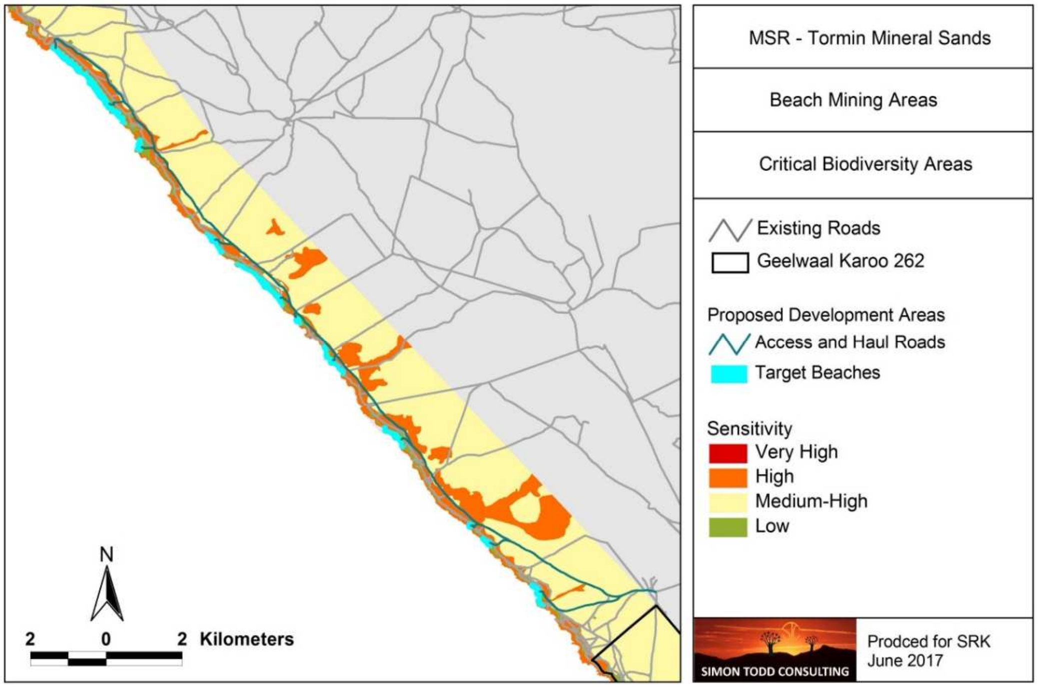


Figure 49: Ecological sensitivity maps of the study area

Source: Simon Todd Consulting, 2017

6.9 Fauna

This section is based on information provided by the terrestrial ecology specialist, Simon Todd Consulting.

6.9.1 Mammals

More than 1700 faunal images were captured (with camera traps) over the course of two sampling periods. Twenty-two terrestrial mammals were confirmed present in the study area including: Steenbok *Raphicerus campestris*, Duiker *Slyvicapra grimmia*, Cape porcupine *Hystrix africaeaustralis*, African Wild Cat *Felis silvestris*, Cape Fox *Vulpes chama*, Bat-eared Foxes *Otocyon megalotis*, Honey Badger *Mellivora capensis*, Striped Polecat *Ictonyx striatus*, Aardvark *Orycteropus afer*, Cape Hare *Lepus capensis*, Caracal *Caracal caracal*, Small Spotted Genet *Genetta genetta*, Yellow Mongoose *Cynictis penicillata*, Cape Grey Mongoose *Galerella pulverulenta*, Water Mongoose *Atilax paludinosus*, and Meerkat *Suricata suricatta*. A number of small mammals were captured in the Sherman Traps or in the pitfalls and include Lesser Dwarf Shrew *Suncus varilla*, Four-striped Grass Mouse *Rhabdomys pumilio*, Bush Vlei Rat *Otomys unisulcatus* and Hairy-footed Gerbil *Gerbillurus paeba*.

The relative abundance of the larger mammals is dominated by Steenbok, Common Duiker and Cape Porcupine with Cape Fox and African Wild Cat the most common predators (Figure 6-34). Notable species observed include the Honey Badger, Small Spotted Genet and Water Mongoose (Figure 6-35). The Water Mongoose is common across the area despite the fact that there is little perennial water available. The Water Mongoose are most likely using the coast as their main movement corridor. Genet use the taller Strandveld vegetation on deep sands for cover. Although Honey Badger were previously red-listed, they have been revised to *Least Concern* in the latest red-list assessment but are nevertheless uncommon mammals which occur at a low density.

There do not appear to be any significant differences between the mammalian community structure in the study area and the broader area. This is expected as the range of habitats is similar. The only discernible spatial patterns that were observed was that Cape Hare and Suricate were observed only within areas of short Strandveld on shallow soils. It is not clear why Cape Hare avoided these areas, but for Suricate, this is most likely related to the lack of suitable burrow sites within the areas of deep soils. There are no specific faunal habitats of high sensitivity within Farm Geelwal Karoo 262.

The beaches appear to be important for several predators such as African Wild Cat and Black-backed Jackal which regularly visit the beaches to look for carrion. Both the Cape Golden Mole *Chrysochloris asiatica* and the Namib Golden Mole *Eremitalpa granti* (*Vulnerable*) could occur at the site and it was not possible to ascertain which species was present although it is more likely that it is the Cape Golden Mole.

In 2012 a Brown Hyaena *Hyaena brunnea* (*Near Threatened*) was found killed on the road east of the Olifants River Estuary and it is considered likely that a small population still exists in this area, especially towards the north of the Estuary (Birdlife SA). This species was not captured by the camera traps and, although it may be present, it would be very rare and occur at a very low density.

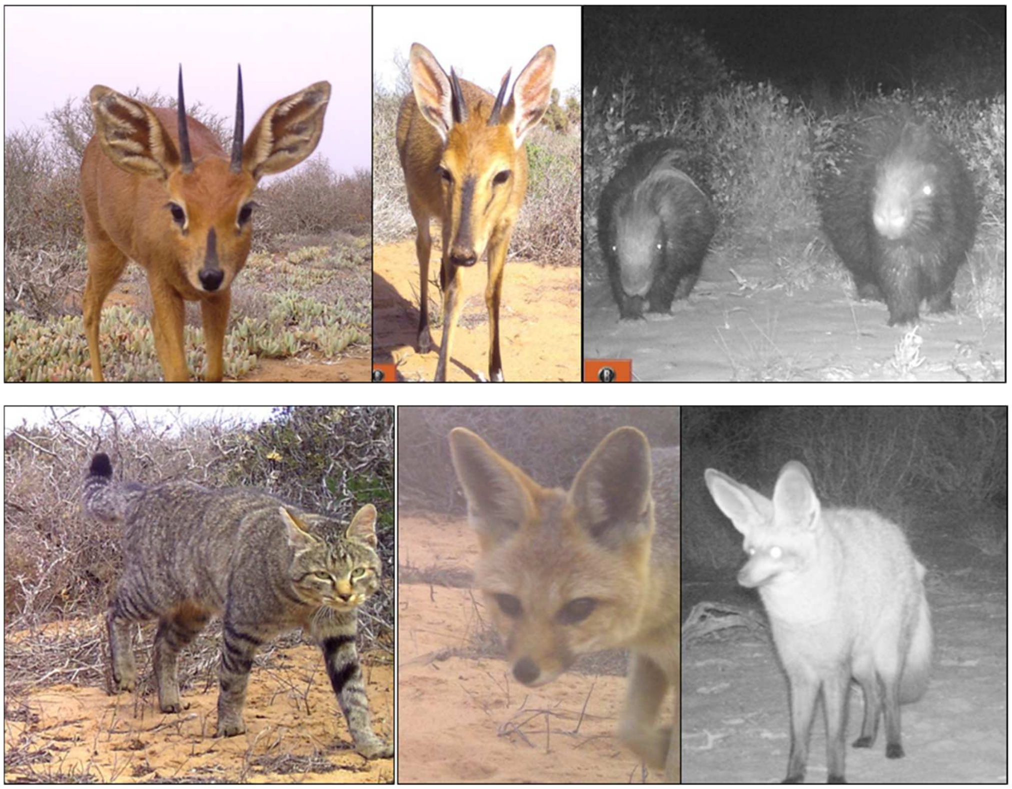


Figure 50: The most common herbivores at Farm Geelwal Karoo 262 are Steenbok, Duiker and Porcupine, and the most abundant predators are African Wild Cat, Cape Fox and Bat-eared Fox

Source: Simon Todd Consulting, 2017

Figure 51: Species that were not previously recorded in the area or which were unexpectedly abundant include the Honey Badger, Small-spotted Genet and Water Mongoose

Source: Simon Todd Consulting, 2017

6.9.2 Reptiles

According to the South African Reptile Conservation Assessment database and du Preez and Carruthers (2009), the study area falls within the distribution range of at least 58 reptiles, comprising 5 chelonians, 23 snakes, 24 lizards and skinks, 12 geckos and 1 chameleon. Of these, 11 were confirmed present including several of the West Coast endemics. Species observed include common tortoises, lizards and snakes such as Angulate Tortoise *Chersina angulata*, Cross-marked Grass Snake *Psammophis crucifer*, Karoo Girdled Lizard *Karusasaurus polyzonus*, Cape Skink *Trachylepis capensis*, Variegated Skink *Trachylepis variegata* and Spotted Sand Lizard *Pedioplanis lineoocellata*. Several West Coast endemics were also confirmed present including Gronovi's Dwarf Burrowing Skink *Scelotes gronovii*, Southern Blind Legless Skink *Typhlosaurus caecus*, Austen’s Gecko *Pachydactylus austeni* and the Western Dwarf Chameleon *Bradypodion occidentale* (Figure 6-36). While all of these species are restricted to sandy coastal habitats, Gronovi's Dwarf Burrowing Skink is of most significance and is listed as *Near Threatened*.

Figure 52: Notable reptiles and amphibians observed at the site include, clockwise from top left, Gronovi's Dwarf Burrowing Skink, Austen’s Gecko, Namaqua Rain Frog and Southern Blind Legless Skink

Source: Simon Todd Consulting, 2017

Species that have previously been recorded but were not observed include the Spiny Ground Agama *Agama hispida*, the Speckled Padloper *Homopus signatus*, and the Puffadder *Bitis arietans arietans*.

6.9.3 Amphibians

Only the Namaqua Sand Frog was detected at the site during fieldwork. Given the scarcity of surface water at the site and in the wider area, it is not surprising that only species independent of water were detected. The density of Namaqua Sand Frogs appears to be relatively high as it was captured multiple times in different pitfall traps. The only other species that is likely to be present is the Karoo Toad *Vandijkophrynus gariepensis* but, as this species requires standing water for breeding, it is not likely to be abundant in the study area as there are no suitable breeding sites near the study area.

6.9.4 Avifauna

Approximately 188 terrestrial and coastal bird species have been recorded in the study area and surrounds (including the Olifants River Estuary), based on data obtained from the Southern African Bird Atlas Project 1 (SABAP 1), and more recently the Southern African Bird Atlas Project 2 (SABAP 2,). Of this total, 19 species (10%) are considered endemic and 30 (16%) near-endemic to South Africa (Taylor et al., 2015), while 12 species (6%) are listed as *Threatened* and six (3%) as *Near Threatened*. A total of 60 bird species were recorded during the site visit.

The landscape of the area is dominated by a flat to slightly undulating coastal peneplain, with coastal areas featuring mostly small sandy beaches interspersed with low rocky shores. These distinguishable features of the landscape represent the two primary avifaunal habitats, namely (i) the Strandveld shrubland of the interior sandy plains, and (ii) the coastal shore (high-water mark to the offshore surf).

Avifaunal Community of the Strandveld

The interior plains of the study area support succulent-dominated Strandveld. The habitat supports a fair diversity of bird species (~ 80 species) comprising mostly small passerines (~ 52 species, 65%). While none of these passerines are red listed, 14 species are endemic and 19 near-endemic to South Africa (Taylor et al., 2015).

The most commonly encountered and typical species include the following: Bokmakierie *Telophorus zeylonus*, Karoo Prinia *Prinia maculosa*, Grey-backed Cisticola *Cisticola subruficapilla*, Karoo Scrub-robin *Cercotrichas coryphoeus*, Pied Starling *Lamprotornis bicolor*, African Stonechat *Saxicola torquatus*, Yellow Canary *Crithagra flaviventris*, Anteating Chat *Myrmecocichla formicivora*, Cape Long-billed Lark *Certhilauda curvirostris*, Southern Double-collared Sunbird *Cinnyris chalybeus*, Bar-throated Apalis *Apalis thoracica*, White-throated Canary *Crithagra albogularis*, Cape Weaver *Ploceus capensis*, Cape Bulbul *Pycnonotus capensis*, Karoo Lark *Calendulauda albescens*, and Chat Flycatcher *Bradornis infuscatus*.

Non-passerines make up a third (35%) of all shrubland species, with the following of particular importance (with red list status): the *Endangered* Ludwig's Bustard *Neotis ludwigii*, Black Harrier *Circus maurus* and Martial Eagle *Polemaetus bellicosus*, the *Vulnerable* Southern Black Korhaan *Afrotis afra*, Lanner Falcon *Falco biarmicus*, and Secretarybird *Sagittarius serpentarius*, and the *Near Threatened* Kori Bustard *Ardeotis kori* (Figure 6-37).

No sensitive or unique areas with respect to foraging, breeding or roosting were identified within the Strandveld habitat, although most of the above red listed species utilise the habitat to varying degrees. There are also no terrestrial Important Bird Areas (IBAs), Coordinated Avifaunal Roadcount routes (CAR) or Coordinated Waterbird Count sites (CWAC) in the vicinity of the proposed inland mining areas. The nearest IBA is the Olifants River Estuary approximately 20 km south, which is also a registered CWAC site. This would not be affected by the proposed project.

Figure 53: Kori Bustard (left) and Secretarybird (right)

Source: Simon Todd Consulting, 2017

Avifaunal Community of the Coastal Shore

The coastal zone is characterised mainly by low rocky shores (Figure 6-38) and associated kelp beds, interspersed by numerous sandy beaches. Approximately 35 bird species are almost exclusively associated with the coastal shore, including cormorants, gulls, terns, oystercatcher (Figure 6-39) and resident and migratory shorebirds. These are all non-passerine species with a very low incidence of endemism, yet a relatively high number are red listed (9 species, 25%).

The most commonly encountered species throughout the year include the Endangered Cape Cormorant *Phalacrocorax capensis*, White-breasted Cormorant *Phalacrocorax carbo*, Hartlaub's Gull *Larus hartlaubii*, Kelp Gull *Larus dominicanus*, White-fronted Plover *Charadrius marginatus*, Swift Tern *Sterna bergii*, Grey Heron *Ardea cinerea*, and African Black Oystercatcher *Haematopus moquini*. The latter is no longer red listed as numbers have increased by 37% since 1980, while its population has experienced an eastward range expansion (Taylor *et al*., 2015). Red listed species which are uncommon include the *Endangered* Bank Cormorant *Phalacrocorax neglectus*, the Vulnerable Cape Gannet *Morus capensis*, and the *Near Threatened* Crowned Cormorant *Phalacrocorax coronatus*.

Figure 54: Rocky shore habitat used for roosting and foraging

Source: Simon Todd Consulting, 2017

Figure 55: A pair of African Black Oystercatchers

Source: Simon Todd Consulting, 2017

In summer the local avifauna is augmented by a number of migratory shorebirds, the most common being Common Greenshank *Tringa nebularia*, Curlew Sandpiper *Calidris ferruginea*, Common Whimbrel *Numenius phaeopus*, Grey Plover *Pluvialis squatarola*, Little Stint *Calidris minuta*, Sanderling *Calidris alb*), Ruddy Turnstone *Arenaria interpres*, and Ruff *Philomachus pugnax*. These species use both sandy beaches and rocky shores for foraging during their annual migrations (Hockey *et al*., 2005). Migratory terns also use the rocky shores and beaches for loafing in mixed flocks. A flock of nearly 500 terns containing mostly Common Tern (~ 250), Swift Tern (~ 100) and Sandwich Tern (~ 50) was observed on Beach 7 during the site visit in May 2017 (Figure 6-40). However, such aggregations are of a temporary nature related to the proximity of dynamic food resources, and hence not restricted to specific sites.

Figure 56: A large mixed flock of terns resting on the beach, accompanied by Kelp Gulls

Source: Simon Todd Consulting, 2017

There are no known breeding colonies for any of the three cormorant species in the vicinity of the study area (Taylor et al., 2015). Only a few cormorant roosts were noted during the site visit, but these contained few birds and were recorded on low rocks near breaking waves (Figure 6-41). The largest and most prominent cormorant roost was located to the south of the proposed beach mining area, approximately 5 km north of the processing plant (S 31°31'00", E 18°03'00"). No highly sensitive avifaunal habitats were identified in the study area, particularly with respect to communal breeding sites. The absence of large boulders, separated from the mainland by inter-tidal waters at low tide, is perhaps the primary reason for the absence of cormorant breeding sites and permanent tern roosting sites.

Figure 57: A small group of Cape Cormorants perched on low rocks

Source: Simon Todd Consulting, 2017

The Olifants River Estuary to the south of the study area frequently supports the *Near Threatened* Greater Flamingo *Phoenicopterus ruber* and Lesser Flamingo *Phoenicopterus minor*, the *Vulnerable* Caspian Tern *Sterna caspia* and Great White Pelican *Pelecanus onocrotalus*, and the *Endangered* African Marsh Harrier *Circus ranivorus*. The *Critically Endangered* Damara Tern *Sterna balaenarum* has also been recorded foraging in the estuary (Marnewick *et al*., 2015), although has not been recorded breeding (Taylor *et al*., 2015). The proposed activities are, however, some distance from the Estuary. Sometimes flamingos use mining voids along the coast for foraging, but as the beach mining voids are short-lived, they are not likely to be attractive to flamingos.

6.10 Conservation Areas

Elephant Rock Island Reserve ("Robeiland"), located 9 km south of the processing plant, is a declared protected area managed by Cape Nature. No conservation areas are located on the area under application.

7 Socio-economic Environment

7.1 Socio-economic Setting

The WCDM is located on the west coast of the Western Cape Province, with a coastline on the Atlantic Ocean which stretches over 400 km. The WCDM borders the Northern Cape Province in the north and the Cape Metro and Cape Winelands District Municipalities of the Western Cape Province in the south and south-east.

The West Coast road (R27) is an important regional economic driver and links Cape Town to coastal towns such as Saldanha Bay and Paternoster. An equally significant economic corridor is the national road (N7) which bisects the WCDM and links Cape Town to towns such as Malmesbury, Moorreesburg, Piketberg, Clanwilliam, Vanrhynsdorp and Bitterfontein.

The Saldanha Bay export harbour falls within the WCDM, and the export market (including product from Tormin) forms an important aspect of the regional economy, and opportunities for future economic development. Tourism in the district is also viewed as an important growth sector.

Residents closest to the Mine comprise farmers and farmworkers, with the nearest formal communities located more than 13 km to the east of the Mine, along the Olifants River. The three main settlements of Vredendal, Lutzville and Koekenaap are described in more detail below due to their size and regional importance, as well as the large number of Tormin employees that reside in these towns. Other smaller communities located in the MLM include:

- Ebenhaeser – a mission settlement on the lower Olifants River;
- Strandfontein – a coastal town popular as a holiday destination;
- Doringbaai – a small coastal town south of Strandfontein;
- Klawer – a small agricultural town on the Olifants River; and
- Vanrhynsdorp – a small agricultural town located further inland on the banks of an Olifants River tributary.

Tormin Mine sustains more than 200 direct and many more indirect employment opportunities. A number of companies in surrounding towns, and in the district, provide services to the Mine.

7.1.1 Vredendal

Vredendal (Figure 42) is the largest town in the MLM with an estimated population in 2011 of approximately 19 000 and a population growth rate of 2.34% per year (Matzikama Municipality SDF, 2010). The town serves as the commercial and administrative centre for the region and is the seat of the MLM. The town's economy relies mainly on the agricultural sector, primarily wine production and, to a lesser extent, vegetable and fruit production. The town has well-developed infrastructure, including an airfield, shopping centres and has good road access. Vredendal also serves as a base from where trips to Namaqualand, coastal towns on the West Coast and the Cederberg mountains can be undertaken and as such has an active tourism industry with several guesthouses and a number of restaurants (SRK, 2014a).

Figure 58: Vredendal as seen from the north-east

7.1.2 Lutzville

The small town of Lutzville (Figure 43) experienced rapid population growth between 1991 and 2001, but the annual growth rate has reduced to around 1.43% per year in 2011 and the current population is estimated at 5 250 (Matzikama Municipality SDF, 2010). The town's population is employed mainly in the mining and agricultural sectors, the latter entailing largely viniculture and tomatoes (SRK, 2014a).

Figure 59: Lutzville as seen from the north-west

7.1.3 Koekenaap

The settlement of Koekenaap (Figure 44) had an estimated population of 1 380 in 2011. This included the population of immediately surrounding rural areas (Matzikama Municipality SDF, 2010). Koekenaap functions as an agricultural service centre for the surrounding farms and has experienced no economic growth over the past few years. Unemployment and poverty levels continue to remain high, with most of the employed population working elsewhere (SRK, 2014a).

Figure 60: Koekenaap's shops and post office

7.2 Economic and Social Indicators for West Coast District Municipality

7.2.1 Population

In 2007 the WCDM had an estimated population of approximately 280 000 (Figure 45). A very low population growth rate of 0.3% per annum was estimated for the District in 2009 (Provincial Treasury, 2010), and the population density is 9.06 people / km^2.

The population of the MLM was approximately 46 500 in 2007 and the population density was estimated at ~3.6 people / km^2 in 2009, lower than the district average of 9.06 people per km^2.

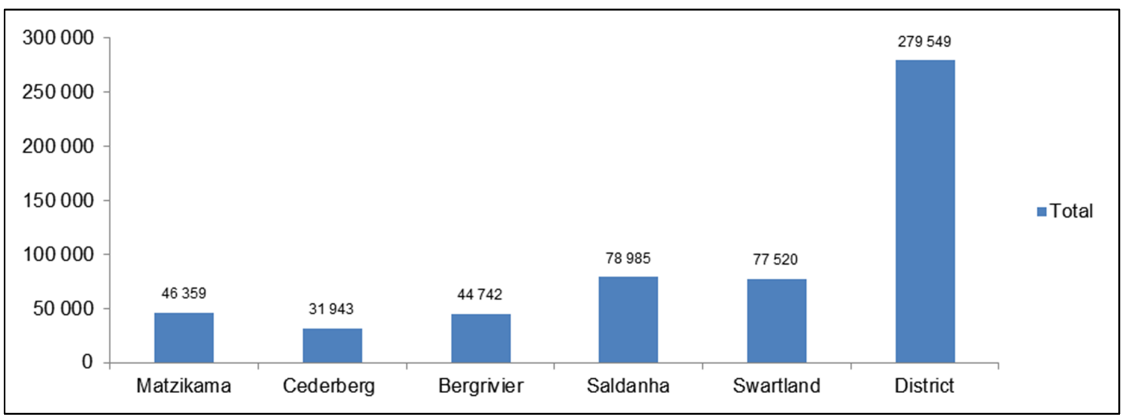


Figure 61: Regional population

Source: StatsSA, 2007

The Coloured population group (71 % of total population in WCDM) was by far the most populous group in the District (Figure 46). The White group made up 19 % of the total population in 2007, while Africans represented only 9 %. Between 2001 and 2007, the racial composition of the WCDM remained fairly constant; only minor changes in proportional representation of groups were experienced (Provincial Treasury, 2010).

The MLM had the highest proportion of Coloureds (87%) and consequently the lowest proportion of Africans (3%) and Whites (9%) compared to other local municipalities in the district (Figure 46).

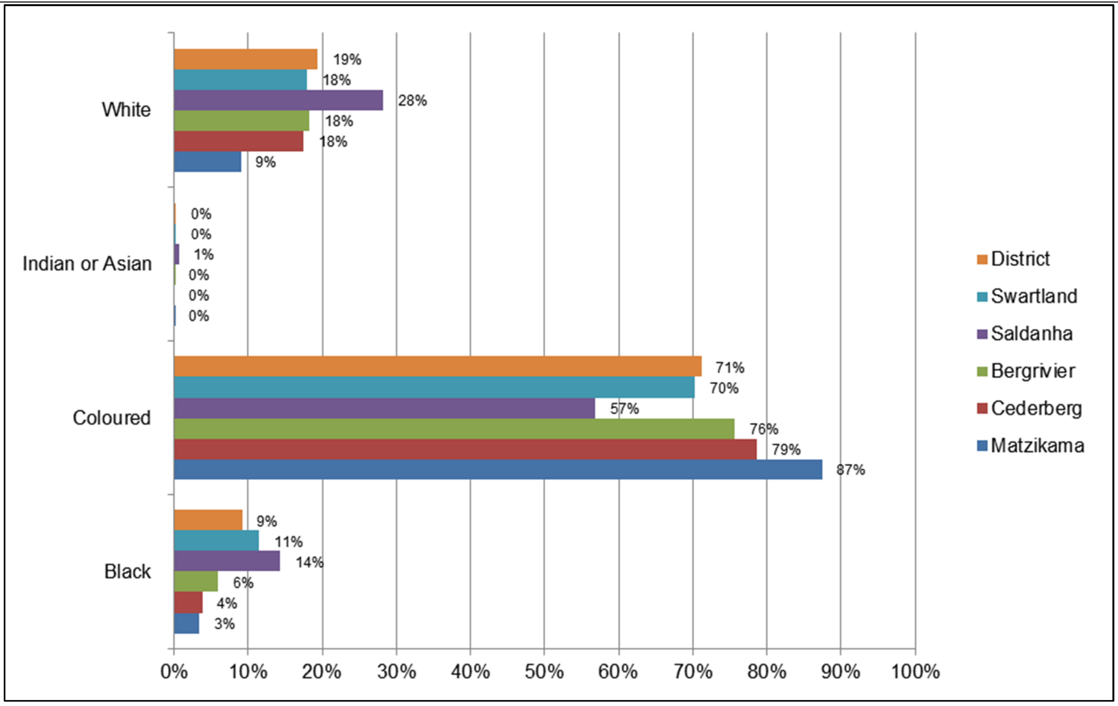


Figure 62: Breakdown of district population by race

Source: StatsSA, 2007

7.2.2 Size and Structure of the District and Local Economy

Figure 47 shows the regional Gross Value Added (GVA-R) for the WCDM (including local municipalities), and indicates that the value of production in the WCDM economy was R9.5 billion annually in 2009 prices. GVA-R is 4% of the provincial economy.

GVA-R and GVA-R per capita for the MLM were R1.4 billion and R30 160 respectively (~15% of district GVA-R from an area covering ~42% of the total district area). The low population density and GVA-R for the local municipality are indicative of this predominantly low carrying capacity, arid agricultural region with limited urbanisation. This inference is supported by the high contribution of the agricultural sector to the local economy (27.7% of GVA-R) (Figure 48). The Olifants River and its associated canal systems underpin the agricultural sector, which is dominated by orchards and viticulture.

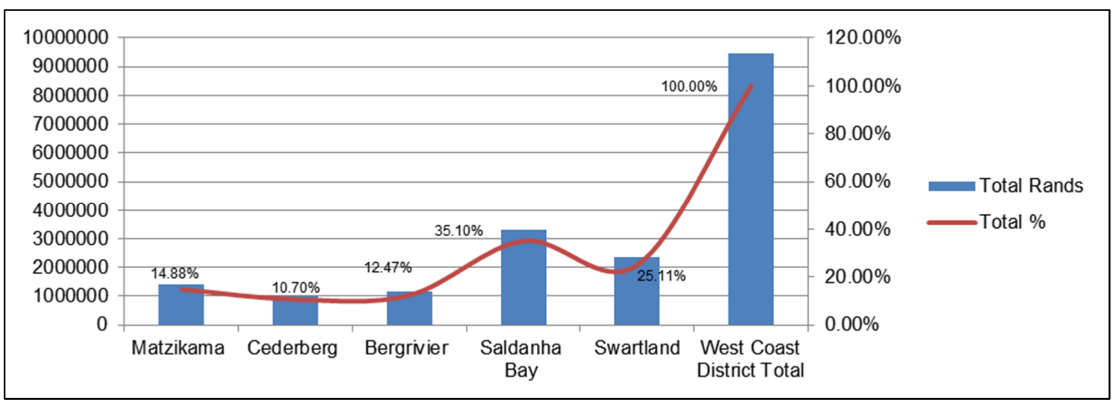


Figure 63: GVA-R for the West Coast District at 2009 prices (R 000's)

Source: Provincial Treasury, 2010

Figure 48 indicates the sectoral contribution to the GVA-R of WCDM and local municipalities. In 2009, at district level, agriculture (21.27%), manufacturing (19.75%) and finance (19.06%) contributed most to GVA-R.

A noteworthy feature of the local economy is the importance of the mining sector in the MLM compared to its profile in the district economy (4.7% and 0.9% respectively). Diamonds, heavy mineral (both of which are along the coast) and gypsum are mined in MLM. Mining makes the largest contribution to the MLM compared to other WCDM local municipalities and is therefore considered to be an important socio-economic driver.

Vredendal is a well-developed town and functions as MLM's administrative centre. The strength of the financial sector locally is largely accounted for by economic activities in this town (Figure 48).

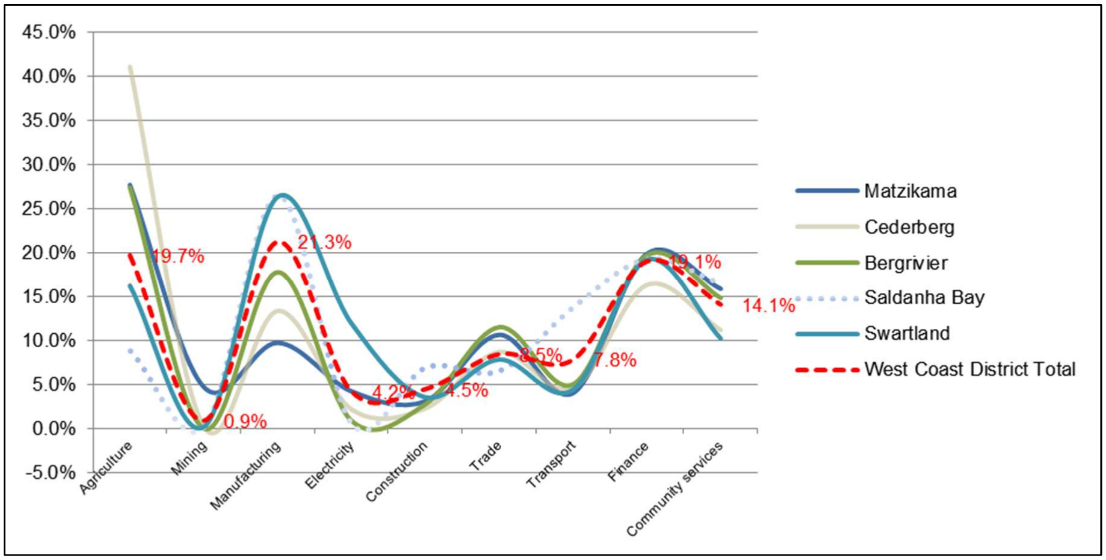


Figure 64: Contribution to West Coast District Municipality GVA-R by sector (2009)

Source: Provincial Treasury, 2010

Figure 49 indicates the population density and GVA-R per capita for the WCDM for 2009, and shows that district GVA-R per capita was estimated at ~R33 600 per annum and population density at 9.06 people per km^2 in 2009. The low population density is indicative of the low carrying capacity of this water scarce region. The GVA-R per capita for the MLM is estimated to have been ~R30 160 and that the population density is only 3.60 people per km^2 in 2009.

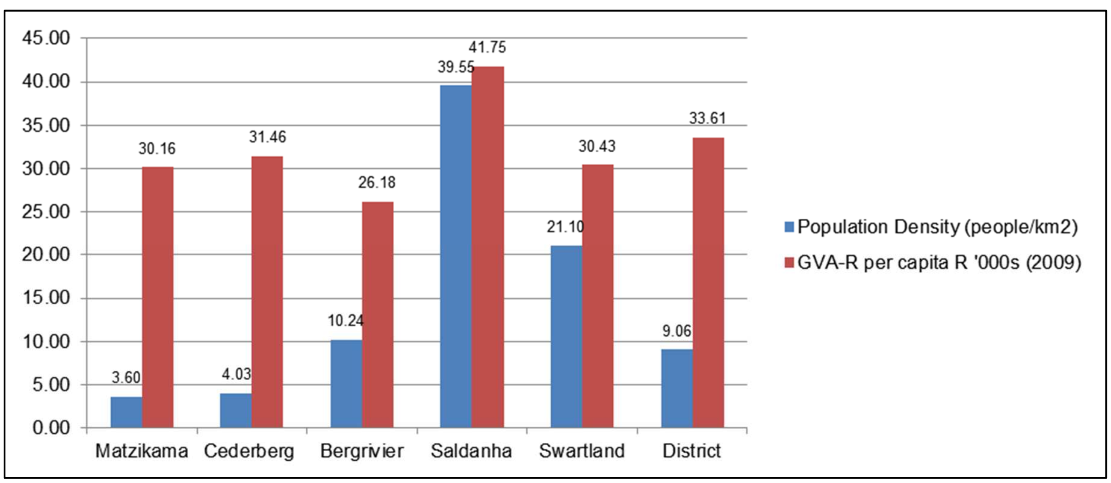


Figure 65: Population density and GVA-R for the WCDM (2009)

Source: Provincial Treasury, 2010 and StatsSA, 2007

7.2.3 Education, Employment and Income

Figure 50 shows the level of education of the population of the WCDM (including local municipalities) in 2007. Approximately 64% of WCDM's population over the age of 20 years either have no education (6%) or have not achieved grade 12 (58%). These figures indicate very low education levels in the district and, in response; a key developmental strategy in WCDM is skills development (IDP, 2011).

Education levels in the MLM are lower than the district average: 8% of the local population over the age of 20 years have no schooling (6% for WCDM) and 69% of those with an education did not achieve Grade 12 (58%) (Figure 50). Only 24% of the MLM population over 20 years old achieved a matric pass or better, the lowest of all local municipalities in WCDM.

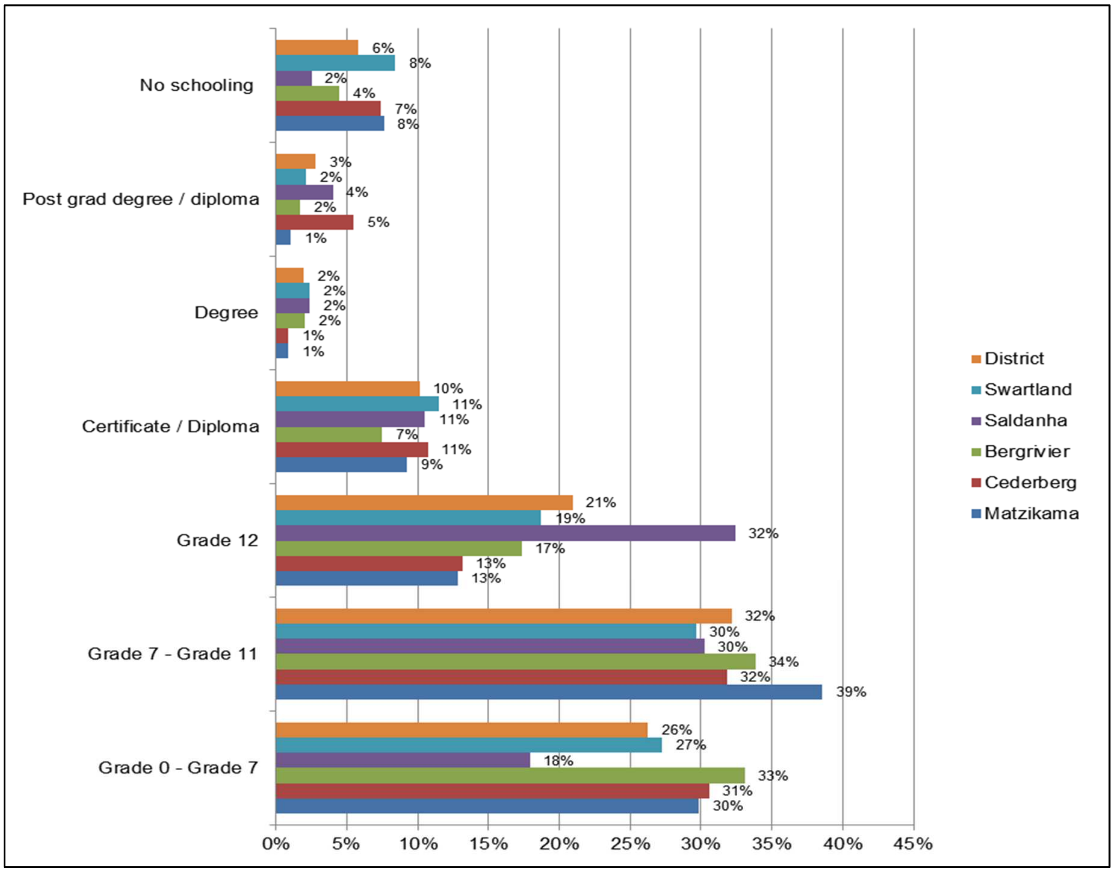


Figure 66: Education levels in WCDM (over the age of 20 years)

Source: StatsSA, 2007

Figure 51 indicates that the WCDM has an unemployment rate of 15% (i.e. 15% of the economically active population who are actively seeking jobs are unemployed), while 85% of those seeking employment are employed.

The MLM has the highest unemployment rate of all local municipalities (20%) (Figure 51), corresponding with poor levels of education.

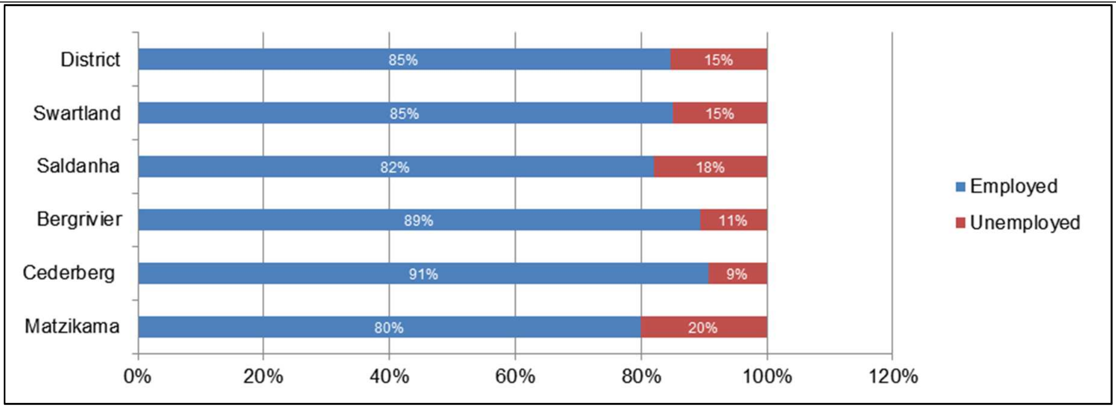


Figure 67: Employment in the WCDM

Source: StatsSA, 2007

Figure 52 indicates the sectoral contribution to employment in the WCDM for 2007. Nearly half of district employment was in the primary sector (47%), while the contributions to employment were 16%, 18% and 19% for the secondary, tertiary and quaternary sectors respectively. Figure 47 and Figure 52 show that the primary sector contributes proportionately more to employment than other sectors, although wages are expected to be correspondingly low.

The majority of employment opportunities in the MLM are in the primary sector (51%), reinforcing the importance of the agricultural and mining sectors to the local economy; although there is a relatively high level of employment in the tertiary sector in the MLM (20%) compared to other local municipalities and the WCDM (Figure 52).

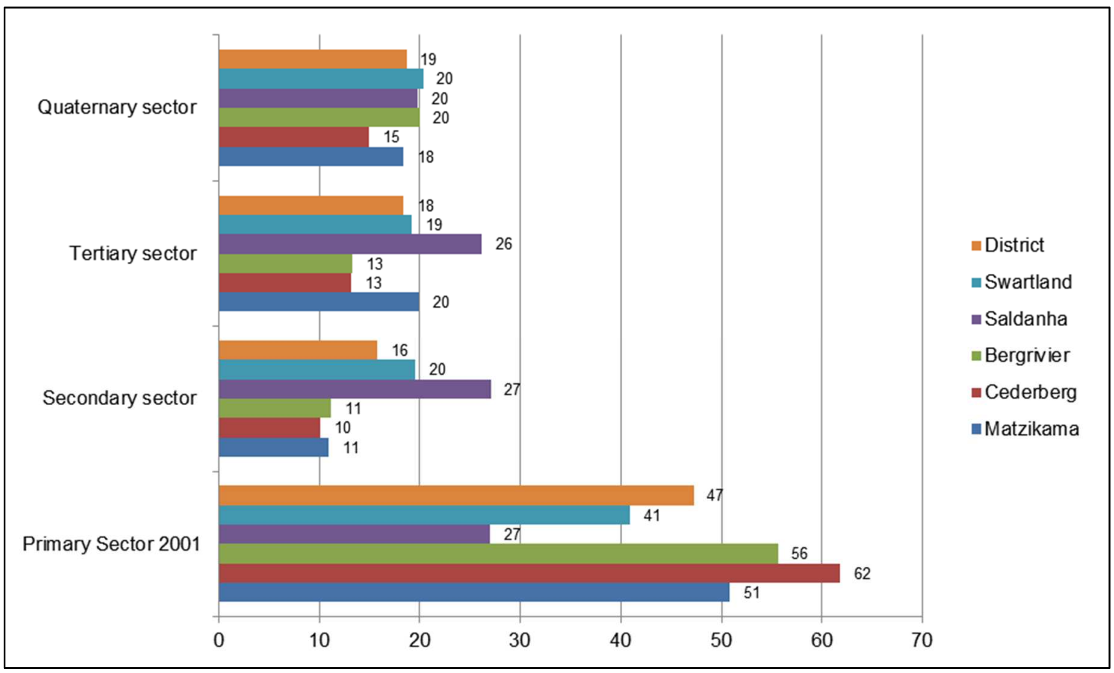


Figure 68: Sectoral contribution (% of total people employed) to WCDM employment (2007)

Source: StatsSA, 2007

Figure 53 demonstrates that the vast majority (81%) of the WCDM population between the ages of 15 and 65 earns less than R3 200 per month (R38 400 per annum).

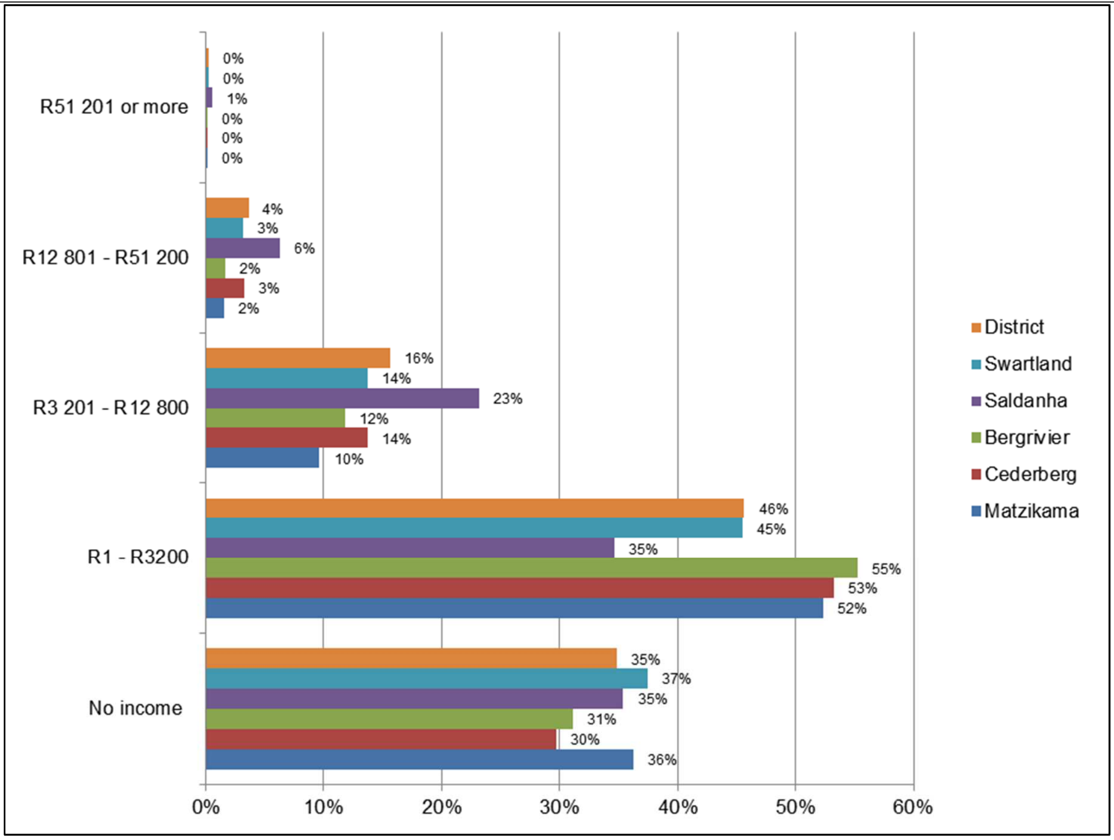


Figure 69: Income categories of persons in WCDM between the ages of 15 and 65 (2007)

Source: StatsSA, 2007

The GVA-R per capita for the WCDM in 2009 was ~R33 600 (Figure 49), compared to R45 654 for the Western Cape (both at 2005 prices). Gross Domestic Product (GDP) per capita for South Africa for the same year was estimated to be R36 212 (calculated based on Provincial Treasury, 2010 and StatsSA, 2007). This tends to indicate that the personal income of the WCDM is lower than in the Western Cape and similar to the national situation.

7.2.4 Poverty

The “Headcount Ratio” is a simple method of comparing poverty, and therefore welfare, in different regions. The Headcount Ratio simply indicates the proportion of people within a population group that is living below a certain predetermined poverty level or line (a threshold level of income below which people are considered to live in a condition of poverty). In South Africa the poverty line was estimated at ~R440 at 2007 prices (National Treasury, 2007).

From Figure 54 it can be seen that the Headcount Ratio for the WCDM is 22.3% indicating that more than 20% of the district population remain below the South African poverty line.

Although income levels are comparatively low in the MLM (36% of the population earned no income in 2007, while only 12% earned more than R3 200 per month) the Headcount Ratio indicates that welfare levels in the MCM (23.0%) are similar to those experienced at district level (22.3%) – see Figure 54.

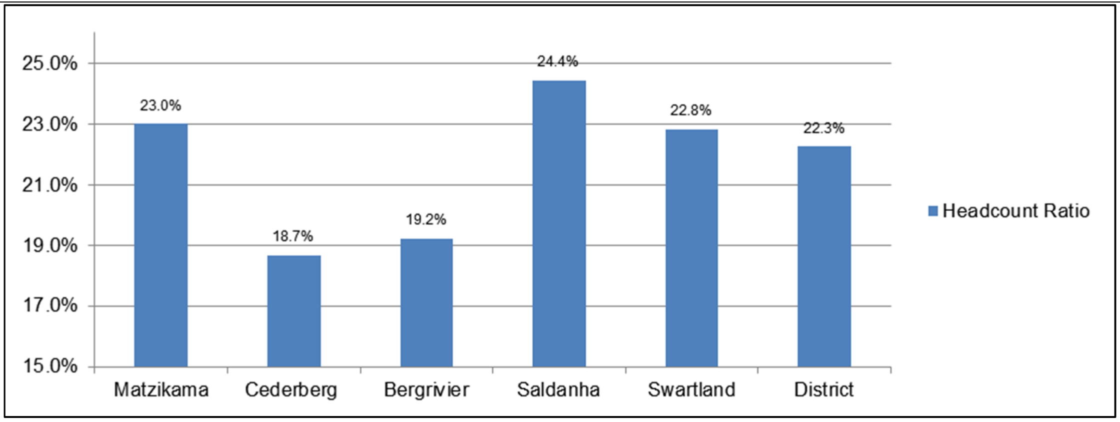


Figure 70: Headcount ratio of poverty in the WCDM (2007)

Source: StatsSA, 2007

7.2.5 Health

Access to Health Care Facilities

Table 14 indicates that there are a total of 77 and 14 health care facilities in the WCDM and MLM respectively.

Table 14 also shows that that there are more health care facilities per person in the MLM than in the WCDM, suggesting a slightly higher level of health service provision in the local municipality as compared to the district.

Table 26: Access to health care facilities

Health Care Facility	WCDM	Persons per Facility - WCDM	MLM	Persons per Facility
Clinics	27	10 353	5	9 271
Satellite Clinics	24	11 647	4	11 589
Mobile Clinics	19	14 713	4	11 589
District Hospitals	7	39 935	1	46 359
Regional Hospitals	0	0	0	0
Total	**77**	**3 630**	**14**	**3 311**

Source: Provincial Treasury, 2010

Burden of Disease

The immunisation (Tuberculosis and Measles) coverage for full immunisation in the MLM increased from 84.2 % in 2006/07 to 101.4 % in 2009/10. The immunisation rate in Matzikama Municipality is below the average immunisation rate for the WCDM which is at 109.1% in 2009/10.

While regional HIV/Aids infection rates are expected to be somewhat higher, Table 11 indicates that 0.77% of the regional and 0.59% of the local population are receiving antiretroviral treatment (Provincial Treasury, 2010). The HIV infection rate was estimated to be 3.6% locally and 4.3% in the WCDM in 2010 (Provincial Treasury, 2006). This tends to indicate that there is both a lower HIV infection rate and a higher treatment rate in the MLM when compared to district averages.

Table 27: Anti-Retroviral Treatment (ART) patient load

Health Care Facility	ART Patient Load	ART Patient Load % of pop.	ART Treatment Sites	Number of TB Clinics
WCDM	2 149	0.77	4	77
MLM	272	0.59	1	20

Source: Provincial Treasury, 2010

7.2.6 Service Provision

Access to Housing

Figure 7-14 indicates that 92% of household structures in the WCDM are formal and 7% are informal, while only 1% of households in the district are traditional. The MLM had the highest level of access to formal housing of all local municipalities in the district.

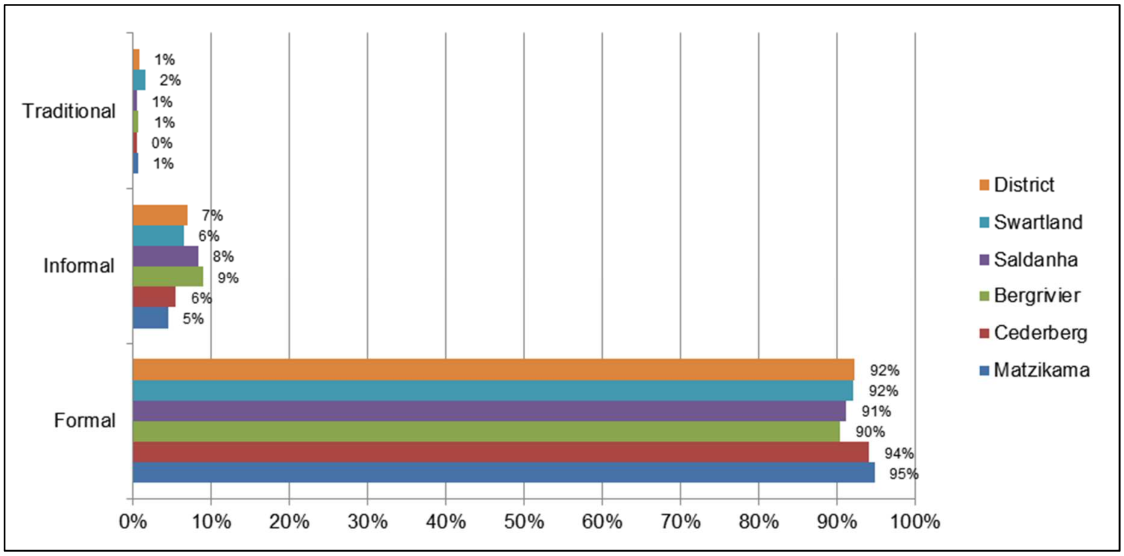


Figure 71: Household types in the WCDM (2007)

Source: StatsSA, 2007

Water

Figure 56 indicates that ~99% of all households in the WCDM and MLM have access to piped water, although only about 85% of households had access to water inside their dwelling. The proportion of households in WCDM with access to piped water inside their dwellings has increased significantly, from 67.2% in 2001.

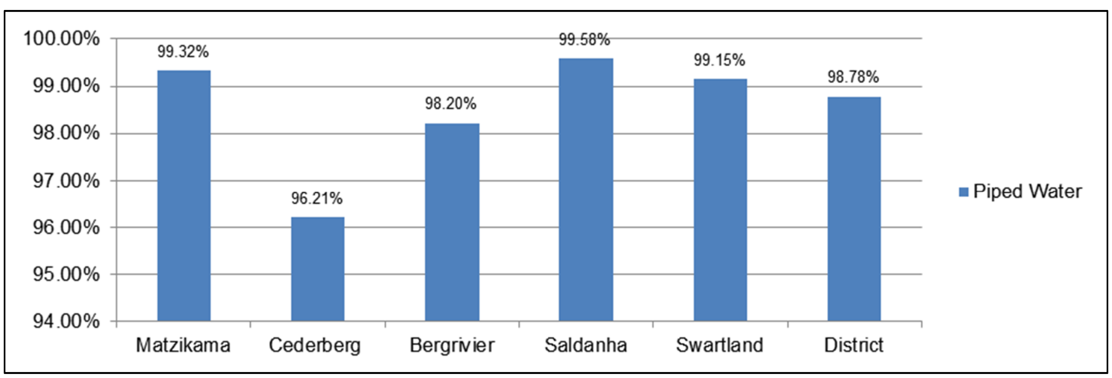


Figure 72: Household access to piped water in the WCDM (2007)

Source: StatsSA, 2007

Electricity

95.7% of households in the WCDM had access to electricity for cooking in 2007 (the highest level of access of all Western Cape districts). The proportion of households with access to electricity in WCDM has increased from 88.1% in 2001. Only ~90% of households in the MLM has access to electricity for cooking – the lowest of all local municipalities in the WCDM.

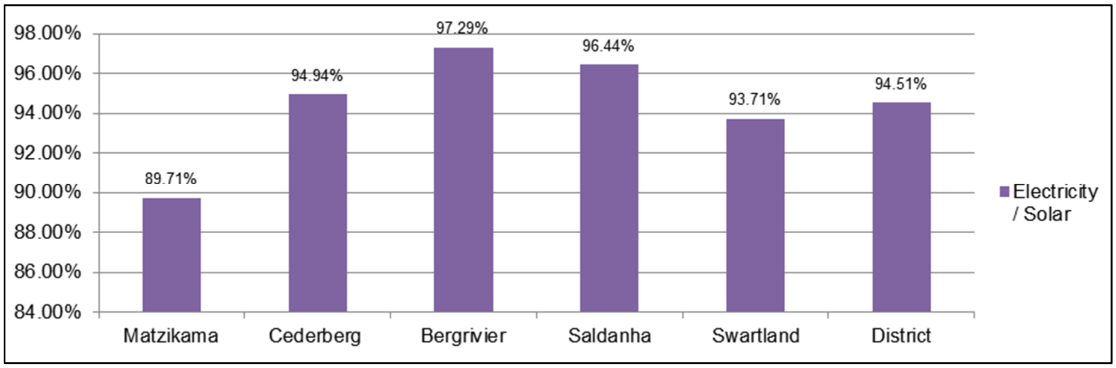


Figure 73: Household access to electricity for cooking in the WCDM (2007)

Source: StatsSA, 2007

Sanitation

Access to sanitation is a crucial basic service as it directly affects health and the dignity of human beings (Provincial Treasury, 2010). Figure 58 shows that ~94% of households in the WCDM had access to flush toilets in 2007. The proportion of households with access to sanitation in the WCDM has increased from 69.7% in 2001.

It is concerning that more than 3% of the district population, and almost 5% of households in the MLM had no access to sanitation whatsoever.

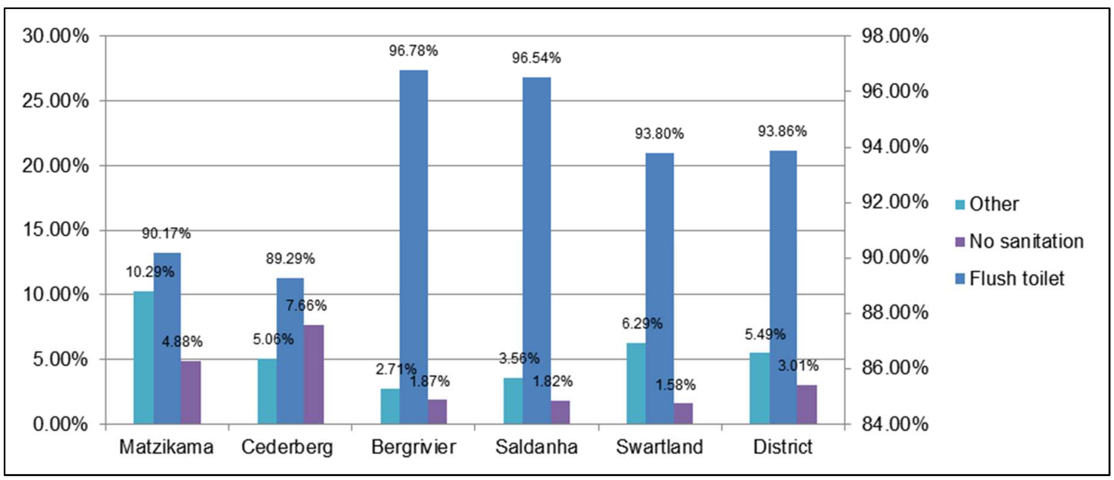


Figure 74: Household access to flushed toilets in the WCDM (2007)

Source: StatsSA, 2007

Solid Waste Management

There are four categories of refuse removal, *viz*.: 'removal by private company / local authority', 'communal refuse dump', 'own refuse dump' and 'other' forms of refuse disposal (StatsSA, 2007). The category of refuse disposal available to households is considered indicative of general welfare.

Figure 59 indicates that 84.2% of households in the WCDM had their refuse removed by the local authority or private company in 2007 (the highest level of access in the WCDM). The proportion of households with access to refuse removal in the WCDM has increased from 69.5% in 2001.

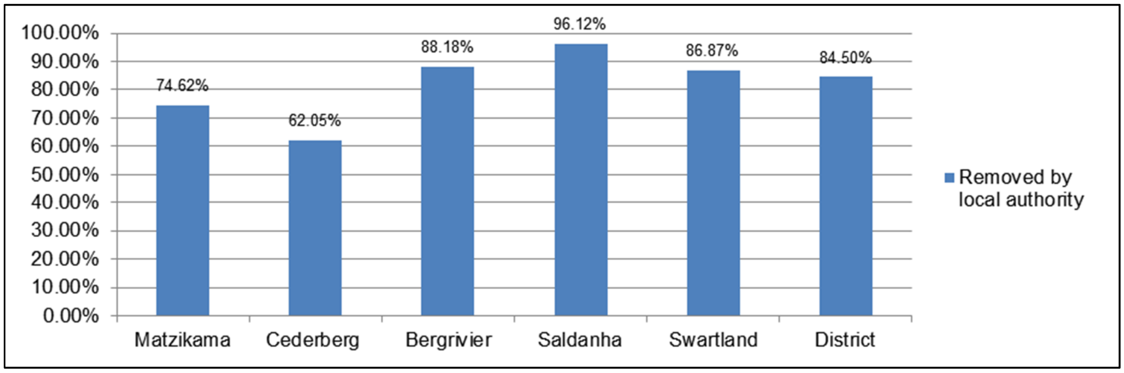


Figure 75: Household refuse removal by private company or local authority in the WCDM (2007)

Source: StatsSA, 2007

7.3 Coastal Access

According to Section 18(1) of NEM: ICMA, coastal access land is defined as strips of land adjacent to coastal public property that secure public access to public property along the coast. Coastal public property consists of the coastal waters, islands and submerged land along the seashore up to the continental shelf.

Coastal access along the West Coast is largely inequitable, with local residents having limited access points to marine resources they previously utilised. Thus, in order to ensure improved coastal access in the West Coast region, the Western Cape Government (2003) defined goals to help guide and direct utilisation of the coast and its resources. These goals included ensuring that all communities have the right of physical access to the sea to and along the seashore, on a managed basis, and that all communities have the right to equitable access to the opportunities and benefits of the coast on a managed basis (SRK, 2013).

In furtherance of these goals, the NEM:ICMA makes specific provision for:

- A District Municipality to develop a "by law that designates strips of land as coastal access land in order to secure public access to that coastal public property; and
- The establishment of a "public access servitude in favour of the local municipality within whose area of jurisdiction it is situated and in terms of which members of the public may use that land to gain access to coastal public property".

Coastal access in the MLM is largely centred on the coastal villages. Access to the coast is particularly limited north of the Olifants River Estuary. WCDM ICMP (SRK, 2013) identifies Gert du Toit-se-Baai as a key coastal access area north of the Olifants Estuary although the ICMP does identify illegal camping and refuse dumping as threats to the coastal environment.

Irregular access is also leading to various types of environmental degradation (Figure 60).

The development of tourism in the Municipal area is a key objective for the MLM and the provision of access to appropriate coastal areas and the management of such sites and any necessary access infrastructure will be important to facilitate the tourism trade.

Figure 76: Informal access routes to the coast north of Tormin Mine

7.4 Cultural and Historic

This section is based on information provided by the heritage specialist, ACO and Associates, and the palaeontology specialist, John Pether.

7.4.1 Palaeontological Environment

Koingnaas Formation

The white, kaolinitic quartz gravels and sands of this formation form the cliffs along most of the shore of Geelwal Karoo 262. Similar deposits have been intersected in boreholes inland on the farms Karoovlei 454 and Schaap Vley 158 and include lignitic peat beds with plant fossils and a fossil pollen assemblage of broadly early Miocene age (Cole & Roberts, 1996). Silicified fossil wood of tropical trees, including mahogany has been found in the Olifants River gravels near Vredendal and were presumably reworked from Koingnaas Formation deposits exposed somewhere in the valley.

The Koingnaas Formation on Geelwal Karoo 262 is basically a fluvial deposit resembling the “Channel Clays” encountered in palaeochannels elsewhere in Namaqualand, although not usually over such a wide expanse. The bedrock outcrops in places along the Geelwal shore, indicating an uneven erosional base and overall the formation thins to the north (Elferink, 2005).

The presence of organic-rich laminae in the Geelwal exposures is reported by Elferink (2005), but have apparently not been analysed for pollen content. There is a low possibility that fossil logs and other plant material may occur in the formation. Impressions of plants and trace fossils may be found in a silcrete layer of the formation.

The exposures of the Koingnaas Formation along Geelwal Karoo 262 are the most extensive available on the Namaqualand coastal plain. As largely natural exposures and although eroding slowly, their longevity relative to diamond-mine pits makes for their long-term importance for study into the future. Only general descriptions exist and the detailed observations, sampling and analyses required for palaeo-environmental diagnosis in terms of modern, multi-disciplinary approaches are yet to be done.

Pliocene Marine Formations

Avontuur Formation / 50 m Package

Visser & Toerien (1971) recorded a “27 m terrace” and an “18 m terrace” as “boulder lines” along the cliffs. At that stage the zone fossils shells were not well known and the deposits were not distinguished on a fossil basis. This was no longer the case when De Beer et al. (2002) recognized that the 50 m Package zone fossil *Donax haughtoni* (surf clam) occurred in exposures of the “27 m terrace”, while *Donax rogersi* (large surf clam) was characteristic of the "18 m terrace". Subsequently, Elferink (2005) mapped the marine formations on Geelwal Karoo 262 (as the 50 and 30 m packages) in terms of a combination of the occurrence of the zone fossils, or when fossils were absent, on elevation.

The early Pliocene Avontuur Formation is mainly exposed above the high cliffs in the southern portion of Geelwal Karoo 262. Here the formation is thickest and is overlain by a particularly thick accumulation of aeolianite formations. Fossil shells are quite common.

North of these exposures the marine deposits are mainly covered by aeolianites. It is expected that the 50 m Package deposits are present in places beneath the 30 m Package gravels.

Hondeklipbaai Formation / 30 m Package

North of the central part of Geelwal Karoo 262, the Hondeklipbaai Formation is continuously present beneath the aeolianites forming the coastal slope.

Fossil Preservation

Most of the marine deposits on the Namaqualand coast have been decalcified and lack fossils. The fossils which remain are the robust, calcitic oysters and thick, large shells. In places, more diverse assemblages with small forms may be preserved – these were originally very shelly beds that buffered themselves from dissolution by the sheer quantity of carbonate, or occur in thick deposits in upper layers where net exposure to groundwater was less.

The fossil shell content of both marine formations in the study area is typical of that found wider afield in Namaqualand. The gravels on the bedrock were host to aquifers in the past and rendered barren or with oysters and other big shells, nearly exclusively *D. rogersi*. Where shells occur higher in the section in thicker deposits more delicate shells are preserved.

Fossil shells selected from exposures in the area featured in the earliest palaeontological findings about the marine deposits (Haughton, 1926, 1928, 1932) and are kept at the IZIKO South African Museum, but lack precise locations. No systematic bulk sampling of the assemblages in shelly spots has been undertaken. Thus, the suspected biogeographic gradient in the fossil fauna southwards from the central Namaqualand sites towards the Saldanha area lacks material for study and enquiry.

Curlew Strand Formation Raised Beaches

Exposures of the Last Interglacial raised beach are present at Gert du Toit-se-Baai and at Skulpbaai. Other small occurrences may be preserved along the northern coastal stretch, but most have been mined away or are very disturbed.

The best example of the Holocene High raised beach is also preserved along Gert du Toit-se-Baai, where it forms the shelly terrace above the high-water mark upon which the holidaying campers set up their camps.

The older, mid-Quaternary, 8-12 m beach has not been recognized, and if preserved, is evidently under cover.

Aeolian Formations

Site CP537 of Stynder and Reed (2015) is a site near the northern boundary of Geelwal Karoo 262 where fossil bones are eroding out of a channel fill within the aeolianite succession (Figure 61). These fossils include *Numidocapra crassicornis*, a bovid found only in North Africa and Ethiopia where the age range for this fossil species is 2.5-1.7 Ma. Also found were teeth of *Dinofelis barlowi*, an extinct sabre-toothed felid, indicating an age range of 2.5-1.9 Ma.

Figure 77: The site CP537 exposure

The marine Hondeklipbaai Formation (late Pliocene ~3 Ma) is basal to the sequence at CP537. It is a residual shelly gravel on the cliff top, lacking cementing or an upper pedocrete. The capping pedocrete representing surface stabilization appears to have been eroded, with the succeeding channel fill "pluvial" fossiliferous deposits having been derived/re-deposited from sediments dating between 2.5 and 1.7 Ma. It may represent a potentially distinct "pluvial" unit" useful for correlation and for its fossil potential, with fossils from the surrounds flushed into concentrations in the run-off channels.

A notable feature of the Olifantsrivier Formation aeolianites is the occurrence of the spherical, crudely-laminated termitaria ("fungal gardens") which seem to be a feature of the upper part of the formation.

7.4.2 Archaeological Environment

Pre-Colonial

Early Stone Age (EStA) occurrences have been reported from Brand-se-Baai, Hondeklipbaai, Kleinsee and Koingnaas, Brand and Doringbaai. Many of the classic EStA forms, such as the handaxe and cleaver, have been found in isolated scatters, particularly along the coastal margin.

Dewar & Orton (2013) have reported that at least 90 Middle Stone Age (MSA) open sites have been recorded from northern Namaqualand. MSA artefacts deflate down through the red aeolian sands and collect on a hard compact surface known as the Dorbank, typical of the Namaqualand coastal plain. In southern Namaqualand MSA artefacts are frequently encountered in borrow pits or mining trenches where removal of the surface sands has exposed the harder deposits below. In general, like with EStA sites, the stone artefacts are found in open contexts and are not associated with bone, shell or ostrich eggshell. Their information is therefore of limited value except in indicating the distribution of MSA settlement.

However, of particular interest are those MSA sites which are associated with large numbers of ostrich egg shells, fossilised or mineralised bone fragments and amounts of shell, predominantly of *Scutellastra argenvillei.* Such sites have been reported from Kleinsee (Orton & Webley 2012), near the Groen River mouth (Halkett 2001) and at Brand-se-Baai (Parkington & Poggenpoel 1991, Halkett and Hart 1993, Parkington et al 2004). These sites are extremely rare and carry very high heritage significance because of their information content.

Many thousands of Later Stone Age (LSA) sites have been recorded on the Namaqualand coast during the last 30 years (Dewar & Orton 2013). The majority consist of shell middens or shell scatters with artefacts associated. Previous studies by ACO Associates have suggested that the bulk of the visible archaeological sites lie within 500 m of the coast. This spatial patterning reflects that people (typically in an arid environment) tend to focus their settlements, mostly of short duration, close to resource rich areas. Inland of the coast, archaeological sites are more scarce (Orton 2010), being limited to ephemeral scatters in occasional deflation hollows. Where there are rocky outcrops with shelters or overhangs, or any place with potential for providing water, evidence of occupation is prolific. Orton's (2010) assessment of a water pipeline along the DR2225 in the vicinity of Koekenaap, noted that while scatters of shell are found at the site of the Sere wind energy facility on the coast to the west, they diminish in frequency inland to the east.

Hart's (2007) survey of the Sere wind energy facility, immediately east of Tormin Mine, some 3 km from the coast, identified at least 65 occurrences of an archaeological nature and a number of LSA shell middens. While these were individually of low conservation status (Grade IIIB-C), Hart noted that they had high group value and were academically significant. He concluded that the shell middens were concentrated around an old pan, since dried up.

eThembeni Cultural Heritage's survey (2007) suggested that "the entire landward extent of the project area, between the beach and the gravel road running parallel to the shore, should be considered as an extended archaeological and palaeontological landscape, consisting of a palimpsest of discrete sites". They considered the archaeological sites in the study area to have medium to high significance at all levels due to their scientific values.

Graves

As they generally lack surface markers, the locations of pre-colonial graves cannot easily be precisely identified. Occasionally, graves may be marked by stone cairns, although these may be confused by later prospecting and surveying activities which have also resulted in similar features. Usually, however, these burials are more likely to be found in coastal dune areas in association with LSA shell middens than at random locations. Earlier human remains from the MSA and EStA are very rare and will most likely be found associated with MSA/EStA sites where bone is preserved, but also in palaeontological contexts, particularly those associated with brown Hyena accumulations.

Due to the difficulty in pre-identifying locations of pre-colonial burials, they are almost always uncovered by natural erosion processes or during the course of development, where they are often inadvertently, partly or wholly disturbed in the process, compromising the details of burial style and other forensic information.

More recent burials may be marked more conventionally with crosses or other grave furniture, but often are covered with rocks and perhaps marine shells and/or quartz stones. Simple head and/or footstones of local rocks may be present. These tend to be found close to old settlements or places where mining activity took place.

Alan Morris' (1992) Master Catalogue of Holocene Human Skeletons from South Africa was consulted, but no burials had been reported or collected along this section of the coast. eThembeni Cultural Heritage state that they did not identify any graves or human remains in their three day survey (2007).

Built Environment

Colonial period heritage is extremely scarce in the study area and immediate vicinity. An examination of the Surveyor General's maps for the farms in the area, indicate that:

- Geelwal Karoo 262 was surveyed in 1871 (S.G. 816/1871), prior to this date, it was Crown Land;
- To the north, Klip Vley Karoo Kop 153 was surveyed in 1871 (S.G. 818/1871). The northern portion of this narrow strip of land, bordering on Graauw Duinen, was called "Water Bak" indicating a source of fresh water which would have attracted pre-colonial and colonial settlement alike;
- To the east, Else Erasmus Kloof 158 was surveyed in 1878 (S.G. 1364/1878);
- To the south Elephant Rock Heights 171 was surveyed in 1871 (S.G. 817/1871); and
- To the south, at the mouth of the Olifants River, The Point 267, was also surveyed in 1871 (S.G. 815/1871) and was Crown Land prior to this. The "lease areas" of the diamond companies date to 1962.

Built structures are limited to the small farm werf on Geelwal Karoo 262 which appears to date to the late 19th/early 20th century (Figure 62). It is reported by eThembeni (2007) to have been used as a Police Station at some point but the specialist has been unable to confirm this.

Figure 78: The “Police Station” on Geelwal Karoo 262

Source: ACO, 2016

Cultural Landscape

There has been very little discussion in the literature about the cultural landscape of the Namaqualand coast.

Hart (2007:8) described the landscape on the adjoining property to the east (Sere wind energy facility) thus: “The cultural landscape qualities of the place are that of a relatively undisturbed landscape imprinted over by the archaeological sites of the Late Stone Age hunter gatherers, then within the last 2 000 years, the transhumant Khoekhoen pastoralists”. The landscape has an “unspoiled” character and is somewhat bleak with wide open spaces and uninterrupted views. A windfarm is now located to the east of the mine ~1.8 km from the coast and dominates the skyline of the area and so the “unspoiled” character of the landscape has changed somewhat. Although mining activities are ongoing at Farm Geelwal Karoo 262, the impacts to the landscape are limited to the plant, roads and beaches.

The scarring left by decades of diamond mining along the old raised beaches, along with the numerous associated coastal tracks, is inescapable and will remain this way as there are no funds available from the state to rectify the situation, and many of the original companies have long since ceased to function. The main coastal road and the numerous rough tracks continue to be used by members of the public who camp along this section of the coast (state land) and a number of informal beach huts are found at sheltered locations.

While the coastline to the north of Farm Geelwal Karoo 262 is of a more conventional West Coast nature, pronounced cliff lines are found along the coastline adjacent to Farm Geelwal Karoo 262 extending down as far as the Olifants River. These cliffs are composed of successions of overlapping coastal sediments and rocky areas and the erosion of these deposits exposes older palaeontological and archaeological traces.

eThembeni Cultural Heritage (2007) described the landscape in the vicinity of Tormin Mine as “typical of the West Coast rural coastline, characterised by large tracts of open farmland with the Atlantic Ocean as a backdrop. Infrastructure and buildings occur far apart. The terrain is typically characterised as plains with open low hills or ridges to the north of the property with open high hills and ridges to the south”. They considered the landscape in and around the study area to have medium heritage significance with respect to its historical, scientific and aesthetic value.

Heritage indicators are the few farming and mining structures (some derelict) found on the coastal strip. Occasional old cultivated fields are noted inland, but do not seem to come within ~2 km of the coast. Other features are typical farming related features such as fences, windmills and reservoirs.

The heritage specialist grades the landscape as Generally IIIC with some coastal areas perhaps graded as IIIB despite disturbance.

Site Finds

Northern Coastline

Archaeological resources, include EStA/MSA and LSA sites, are situated on higher ground (above the high water mark) and are often concentrated along rocky shores. The specialist's survey identified mainly LSA shell middens along the coastline, although this does not mean that MSA or EStA remains are not present below the cover sands.

It is unclear if any shipwreck material is located along any of these beaches. The South African Heritage Resources Agency (SAHRA) noted that the nearest recorded wreck is that of the Catherine Isabella which lies approximately 18 km south of Beach 1 off Robeiland. SAHRA indicated that there are no known shipwrecks within the development area.

The highest concentration of LSA shell middens are found inland of Beach 9 (Figure 7-22).

Figure 79: Shell middens near Beach 9

Source: ACO, 2016

Farm Geelwal Karoo 262

Archaeological sites tend to concentrate on rocky headlands, while fewer sites are found inland of sandy beaches since pre-colonial groups were attracted to the shell fish which could be gathered from the rocks. It must be emphasised, that this is a LSA distribution pattern and it is not yet known whether EStA and MSA groups followed a similar strategy with respect resource exploitation and settlement. LSA sites are easily visible, and may be more frequently recorded by archaeologists.

Fossil bone-rich archaeological sites have been recorded at Cliff Point (southern extent of Farm Geelwal Karoo 262) and adjoining areas in the past. These sites are extremely rare and considered to be valuable heritage resources.

A number of sites with fossilised bone were recorded both at Cliff Point (Figure 7-23), and further north on the boundary between Farm Geelwal Karoo 262 and Klip Vley Karoo Kop 153/RE. It was not always clear whether they were associated with nearby scatters of MSA material, or whether the association was fortuitous. Nevertheless, both Orton (2011) and Hart (2011) have highlighted the possibility of recovering MSA sites with preserved bone and possibly shell and the high significance these would have.

Figure 80: Fossilised bone from Cliff Point

Source: ACO, 2016

The surface fossilised bone and EStA and MSA artefacts in disturbed areas along the coastal margin is due to erosion or the mining of overburden resulting in the exposure of buried older land surfaces. Due to the large amounts of aeolian sands covering the study area, most of the earlier material, though invisible, is probably quite extensive throughout the area. The artefacts/bone/shell lies on the buried hardpan or Pleistocene “dorbank” horizon, where it has become conflated and concentrated by natural processes over thousands of years (Figure 7-24 and Figure 7-25). The depth of the dorbank horizon is variable but usually fairly shallow. Since the material tends to be conflated onto a single horizon, the provenance (context) and associations of different materials becomes problematic and as such, is generally considered of lower significance than material where context is secure.

Away from the coast around the Tormin processing plant, the cover sands do not appear calcareous or fossiliferous, but there is possibility that fossil bone and/or archaeological material may occur below.

The proposed footprints of the mining areas and infrastructure / plant expansion area were intensively surveyed by the specialist for traces of archaeological resources. Although the specialist had expected to find some LSA scatters with marine shell and artefacts (such as were present on the adjacent wind energy facility site), most of what was identified consisted of isolated stone artefacts of either LSA or MSA affiliation in either quartz or quartzite, with occasional silcrete being observed. In some places, the dorbank layer is very shallow at ~150 mm below surface. The dorbank layer is significant since archaeological material that has been subject to deflation will collect on its surface and may be exposed during mining. Although MSA or EStA material is expected, the specialist is unable to predict the density at this time, or if any fossilised organic remains may be found in association.

A single isolated quartzite flake was identified on the powerline route inside the Farm Geelwal Karoo 262 property. No sites were recorded by Orton and Hart (Hart 2007) along the section of powerline route inside the adjacent property.

None of the surface archaeological material observed on Farm Geelwal Karoo 262 has significant heritage value.

Figure 81: Distribution of stone artefacts on shallow dorbank

Source: ACO, 2016

Figure 82: Some of the EStA stone artefacts recovered from the dorbank

Source: ACO, 2016

7.5 Visual and Aesthetic

7.5.1 Visual Character

The basis for the visual character of the area is provided by the geology/topography, vegetation and land use of the area, giving rise to an undulating landscape under predominantly natural cover with significant influence from the ocean with limited rural and mining activities (Figure 7-26). Most of the area can therefore be defined as a *natural transition landscape* as it is mostly natural scenery but man-made elements (e.g. homesteads, wind turbines, mining infrastructure) are visible in the landscape.

Figure 83: Visual character of the study area

7.5.2 Visual Quality

The visual quality of the overall area is largely determined by the open, stark character of the landscape with limited human influence. Views over the Atlantic Ocean contribute to this sense of ‘openness’.

The dynamic coastline of coastal cliffs, rocky outcrops and sandy beaches increases the visual quality of the area.

The low-growing character of the vegetation does not add any visual interest although the predominantly natural state of the landscape and lack of human influence creates a sense of ‘starkness’.

The visual quality is enhanced by the wind turbines of the Sere wind energy facility (Figure 7-27) which add visual interest in the landscape. In some ways the Tormin processing plant provides interest in the landscape thereby increasing the visual quality. However, mining activities and mine infrastructure along the coast are incongruent when viewed in close proximity to these elements.

The scarring and erosion along the coast from current and historic mining / prospecting activities (Figure 68) and beach access roads detract from the visual quality of the area. Nevertheless, the visual quality of the study area is considered to be moderate.

Figure 84: Sere wind energy facility (left) and prior mining / prospecting (right)

7.5.3 Sense of Place

The region has scenic value in terms of its open stark setting and sense of wilderness and expansiveness invoked when visiting, partly due to the relatively limited human influence throughout the region. The study area possesses high visual-spatial qualities related to the rural character of the inland portion of the study area (farmsteads, small holdings along the river, windmills, rolling hills) and the predominantly natural landscape and the topographical features along the coastline (Olifants River Estuary, coastal cliffs, rocky promontories, sandy bays). The sense of place is also highly influenced by the coast, the views over the ocean and the harsh coastal conditions. Visitors are attracted to the coast for camping and other recreational uses.

There are elements that adversely affect the sense of place including the mining operations and mine infrastructure and visual scars on the landscape (cleared vegetation and erosion).

A person's connection or relationship to a place when defining sense of place is also important. Cross (2011) defines six categories of relationships with place (Table 7-3): biographical, spiritual, ideological, narrative, cognitive and dependent.

Table 28: Relationship to place

Type of Relationship	Process
Biographical (historical and familial)	Being born in and living in a place. Develops over time.
Spiritual (emotional, intangible)	Feeling a sense of belonging.
Ideological (moral and ethical)	Living according to moral guidelines for human responsibility to place. Guidelines may be religious or secular.
Narrative	Learning about a place through stories, family histories, political accounts and fictional accounts.
Cognitive (based on choice and desirability)	Choosing a place based on a list of desirable traits and lifestyle preferences.
Dependent	Constrained by lack of choice, dependency on another person or economic opportunity.

Source: Adapted from Cross, 2011

The relationship of receptors in the study area to place is likely to be predominantly biographical or spiritual. Visitors to, Gert du Toit-se-Baai, for example, may have a connection to this particular stretch of coastline because they and their families have been visiting the same campsite year after year. Or, a farmer whose farm has been in the family for generations will have an emotional attachment to the area. Other receptors may have decided to move to the area because they were attracted to the tranquil atmosphere or dramatic coastline (cognitive relationship).

7.5.4 Visual Receptors

Receptors are important insofar as they inform visual sensitivity. The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon (Table 7-4). Potential viewers include the following:

- **Holiday-makers and recreational users**: The coastline is used by campers and other recreational users. Coastal destinations including Brand-se-Baai, Duiwegat, Die Toring, Robeiland and Gert du Toit-se-Baai (Figure 7-28). Visibility of the project from the coast, particularly the beach mining extension, will be high;
- **Motorists**: Visibility to motorists on the R362 between Lutzville and Strandfontein and on the R363 between Lutzville and Nuwerus will be insignificant because of screening provided by topography and the distance from the project. The public (gravel) road OP9764 provides access to the coastline north of Tormin Mine. This road is used sporadically by farmers and is one of the few vehicular roads providing access to the coast for the public. This road will be used by the haul trucks and the public moving through this area will have a clear view of beach mining operations; and

- **Residents in surrounding settlements and farmsteads**: Visibility from many of the households in Koekenaap, Strandfontein, Papendorp, Ebenhaeser, and Olifantsdrift and smallholdings and farmsteads in the surrounding area is likely to be insignificant, as the topography (e.g. ridgelines) screens views of the mine extension areas.

Table 29: Receptor sensitivity criteria

Sensitivity	Criteria
Number of people that will see the project (exposure factor)	
High	Towns and cities, along major national roads (i.e. thousands of people)
Moderate	Villages, typically less than 1000 people
Low	Less than 100 people (i.e. a few households)
Receptor perception of the project and visual landscape (perceived landscape value factor)	
High	People attach a high value to aesthetics - in or around national parks, coastlines, pristine forest areas.
Moderate	People attach a moderate value to aesthetics - smaller towns where natural character is still plentiful.
Low	People attach a low value to aesthetics, when compared to employment opportunities, for example - industrial areas, cities, towns.

Source: Adapted from Golder Associates, 2012

The sensitivity of viewers or visual receptors potentially affected by the visual impact of the project is considered to be ***moderate*** because the remoteness of the project area ensures that there are only a limited number of receptors, but those receptors are likely to attach a high value to the visual landscape of the area.

Figure 85: Gert du Toit-se-Baai campsite

7.6 Traffic

This section is based on information provided by the traffic specialist, ITS Engineers.

7.6.1 Existing Road Network

The important characteristics of the major roadway facilities in the study area and roads impacted by the project are summarised in Table 7-5.

Table 30: Existing roadway facilities

Roadway	Classification	Posted Speed (km/h)	Road Surface
N7	National Road	120	Tar
R27(TR16/1)	Provincial Trunk Road	100/80/60	Tar
R362 (MR548)	Provincial Main Road	100	Tar
R362 (MR552)	Provincial Main Road	100	Tar
R363 (MR547)	Provincial Main Road	100	Tar
DR2225	Provincial Divisional Road	60	Gravel
OP9764	Provincial Minor Road	Not posted	Gravel

All the existing intersections in the study area are stop controlled intersections with stop-control on the minor roads. All the paved roads are two lane roads, one lane per direction.

The N7 has 3.7 m lanes with 2 m paved shoulders. All Provincial trunk roads and main roads have 3.3 m lanes with gravel shoulders. The gravel roads are typically 8 m wide with narrower sections in some areas. Refer to Figure 7-29 to Figure 7-32 for the typical cross-sections of the major roads in the study area.

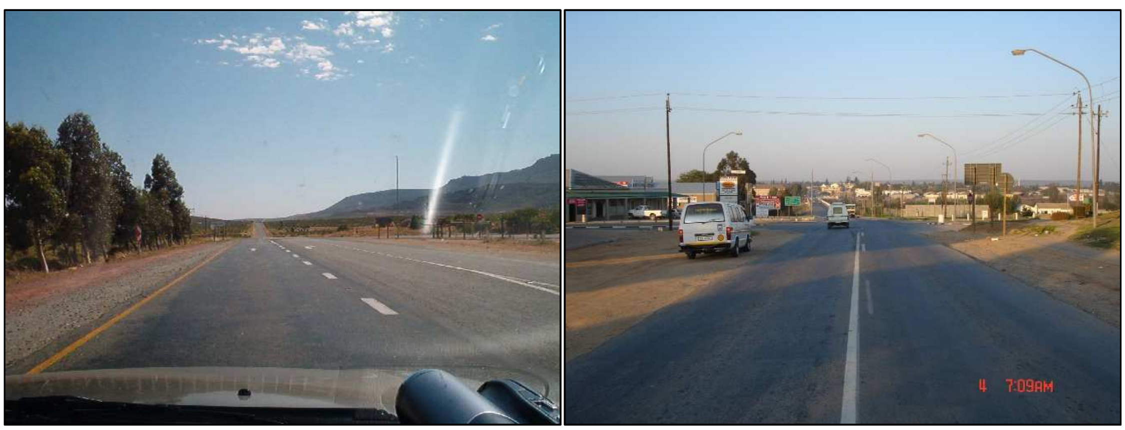


Figure 86: Northbound view along the N7 past the weigh bridge at Klawer (left) and southbound view along the R27 towards the town Vredendal (right)

Figure 87: Northbound view along the R362 (MR548) towards the R27 in Vredendal (left) and southbound view along R362 (MR552) towards the R27 in Vredendal (right)

Figure 88: Northbound view along the R363 (MR547) towards Koekenaap (left) and westbound view along the DR2225 from Koekenaap (right)

Figure 89: Westbound view along OP9764 from DR2225 (left) and northbound view along OP9764 (right)

Source: ITS Engineers, 2017

7.6.2 Existing Traffic Volumes

The table below shows the current annual average daily traffic volumes (AADT), the peak hour volumes and the percentage heavy vehicles on the road network in the study area.

Table 31: Traffic volumes

Road	AADT	Peak Hour Volume	% Heavy Vehicles
N7	3 000	240	19%
R27(TR16/1)	2 800	370	9%
R362(MR548)	1 500	100	13%
R362(MR552)	2 000	170	7%
R363(MR547)	800	140	6%
DR2225	<100	<50	50%
OP9764	<50	<10	30%

These volumes are low and there is sufficient spare capacity along the road network to accommodate increases in traffic volumes. Based on historic traffic count information along the roads in the study area, the traffic volumes along the roads in the study area have not changed much over the past 10 years. The bulk of the traffic volumes along DR2225 is traffic from Tormin Mine. During the December holiday period, and to a lesser extent the Easter weekend period, the traffic volumes along DR2225 and OP9764 (Figure 7-33) are significantly higher due to holiday makers camping along the coast line. However, it is clear that the traffic volumes on the roads in the study area are low and there is sufficient spare capacity on the road network with the current infrastructure to accommodate increased traffic volumes.

Figure 90: Typical cross-sections of OP9764

Source: ITS Engineers, 2017

(b) Description of the current land uses.

Tormin Mine is located on and adjacent to Farm Geelwal Karoo 262 on the West Coast of South Africa, north of the Olifants River Estuary and approximately 25 km west of Lutzville.

Mining and extensive agriculture are the primary land uses in the study area although tourism is of increasing significance in the region. Land cover within the study area is mostly natural because of limited urban development and the relative low impact of mining and agriculture. Low-intensity small stock farming is the primary agricultural activity in the study area although intensive (irrigated) crop farming occurs along the Olifants River to the south and east of Tormin Mine.

Both diamonds and heavy minerals have been successfully mined in the coastal zone north of the Olifants River since the 1960s. Mining at Brand-se-Baai (~ 30 km north) has had a large impact on the natural vegetation in the coastal zone.

The study area is sparsely populated with less than 10 people per km^2 mostly concentrated within the small towns and villages of the area (Savannah, 2008). Koekenaap is a rural village located ~ 20 km east of Tormin Mine. Strandfontein, ~ 26 km south of Tormin Mine is a holiday destination and therefore has a low residential density. Papendorp (~ 20 km), Ebenhaeser (~ 15 km) and Olifantsdrift (~ 15 km) are small isolated settlements located on the banks of the Olifants River.

Isolated farmsteads are scattered throughout the surrounding area. An extensive network of sandy/gravel farm roads connects the various farms. On some of the farms, tracts of land have been cleared of natural vegetation and planted with crops (strip cultivation). There is a higher concentration of farms (smallholdings) along the Olifants River which is the only reliable source of water in the region.

Although there are no mining activities on Farm Geelwal Karoo 262, the Tormin processing plant is located on the elevated coastal plain on Farm Geelwal Karoo 262 inland of MSR’s Mining Rights area (MR162 and MR163).

Areas along the coast have been disturbed from historical and current mining and/or prospecting activities, as well as by people accessing the coastline on a network of informal beach access roads. The public (gravel) road OP09764 provides access to the coastline north of Tormin Mine. This road is used by farmers and visitors to the coastline. The coastline is used by campers and other recreational users.

Eskom’s Sere wind energy facility, consisting of 46 turbines, is located on the ridgeline inland of Tormin Mine and is a prominent feature in the landscape.

(c) Description of specific environmental features and infrastructure on the site.

Refer to the Baseline Environment section above.

(d) Environmental and current land use map.

See Appendix 7.

ii) Impacts identified

(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.

Table 20 below identifies the potential impacts of the project. Current mining activities at Tormin Mine are not assessed in the EIA.

Table 32: Potential impacts of the proposed project *(without mitigation)*

Activities	Aspect	Potential Impact	Significance	Probability	Duration
CONSTRUCTION PHASE IMPACTS					
• Inland mining; • Haul roads; and • Infrastructure expansion area.	Soil and Land Capability	Soil compaction caused by construction traffic	Medium (-ve)	Definite	Long-term
		Loss of fertile topsoil	Medium (-ve)	Probable	Long-term
		Soil chemical pollution from construction activities	Very Low (-ve)	Possible	Medium-term
		Loss of land capability	Low (-ve)	Definite	Long-term
		Loss of soil ecosystem services	Medium (-ve)	Definite	Long-term
• Inland mining; • Haul roads; and • MSP.	Air Quality	Impaired Human Health from Increased Pollutant Concentrations Associated with Construction Activities	Low (-ve)	Probable	Short-term
		Increased Nuisance Dustfall Rates Associated with Construction Activities	Very Low (-ve)	Probable	Short-term
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Noise	Increased Noise and Vibration Levels during Construction	Very Low (-ve)	Probable	Short-term
• Beach mining; and • RO Plant.	Marine Ecology	Disturbance and/or mortality of marine life during construction of beach access roads	Low (-ve)	Definite	Short-term
		Disturbance and/or mortality of marine life during construction of brine discharge pipeline	Low (-ve)	Possible	Medium-term
		Mortality of marine fauna caused by construction waste	High (-ve)	Possible	Long-term
		Increased turbidity in the water column during construction of beach access roads	Insignificant	Possible	Short-term
		Increased turbidity in the water column during construction of brine discharge pipeline	Insignificant	Possible	Short-term
• Haul roads	Freshwater Ecology	Destabilisation of watercourses caused by beach access road widening and increased vehicle movements during construction	Very Low (-ve)	Probable	Short-term
• Inland mining; and • Infrastructure expansion area.	Hydrogeology	Groundwater contamination during construction of process water dams	Very Low (-ve)	Possible	Medium-term
		Groundwater contamination during construction of the infrastructure / plant expansion area	Very Low (-ve)	Possible	Medium-term

Activities	***Aspect***	***Potential Impact***	***Significance***	***Probability***	***Duration***
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Loss of vegetation and plant species of conservation concern (SCC) during construction*	*Medium (-ve)*	*Definite*	*Long-term*
		Disturbance to terrestrial fauna and loss of habitat during construction	*Medium (-ve)*	*Definite*	*Long-term*
		Disturbance to avifauna and loss of habitat during construction	*Medium (-ve)*	*Probable*	*Long-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy*	*Medium (+ve)*	*Probable*	*Short-term*
		Increased employment, income and skills development	*Low (+ve)*	*Definite*	*Short-term*
		Reduced access to the coast	*Insignificant*	*Improbable*	*Short-term*
		Possible decline of tourism	*Insignificant*	*Improbable*	*Short-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*Loss of archaeological resources during beach access road widening*	*Low (-ve)*	*Probable*	*Long-term*
		Loss of archaeological resources during construction of infrastructure / plant expansion area	*Low (-ve)*	*Possible*	*Long-term*
		Loss of fossil bones during beach access road widening	*High (-ve)*	*Possible*	*Long-term*
		Loss of fossil shells during beach access road widening	*Very Low (-ve)*	*Possible*	*Long-term*
		Loss of fossil bones during construction of infrastructure / plant expansion area	*High (-ve)*	*Possible*	*Long-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by construction activities*	*Very Low (-ve)*	*Definite*	*Long-term*
		Altered sense of place from increased traffic during construction	*Very Low (-ve)*	*Definite*	*Long-term*
• *Haul roads*	*Traffic*	*None.*			
OPERATIONAL PHASE IMPACTS					
• *Inland mining;* • *Haul roads; and* • *Infrastructure expansion area.*	*Soil and Land Capability*	*Soil compaction caused by operational activities*	*High (-ve)*	*Probable*	*Long-term*
		Soil compaction caused by hauling and stockpiles	*Medium (-ve)*	*Definite*	*Long-term*
		Soil chemical pollution from operational activities	*Medium (-ve)*	*Definite*	*Long-term*
		Loss of land capability	*Medium (-ve)*	*Definite*	*Long-term*
• *Inland mining;*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Mining and Processing Activities*	*Low (-ve)*	*Probable*	*Medium-term*

Activities	Aspect	Potential Impact	Significance	Probability	Duration
• Haul roads; and • MSP.		Increased Nuisance Dustfall Rates Associated with Mining and Processing Activities	Very Low (-ve)	Probable	Medium-term
		Impaired Human Health from Increased Pollutant Concentrations Associated with Increased Product Truck Movements	High (-ve)	Definite	Medium-term
		Increased Nuisance Dustfall Rates Associated with Increased Product Truck Movements	Low (-ve)	Probable	Medium-term
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Noise	Increased Noise and Vibration Levels during Operations	Medium (-ve)	Definitie	Medium-term
• Beach mining; and • RO Plant.	Marine Ecology	Shoreline erosion and altered beach profiles caused by beach mining	High (-ve)	Definite	Long-term
		Changes in macrofaunal community structure caused by beach mining	High (-ve)	Definite	Long-term
		Disturbance and/or mortality of marine life caused by beach mining	High (-ve)	Definite	Long-term
		Smothering of reefs and macrofauna caused by increased sedimentation from beach mining	Low (-ve)	Probable	Medium-term
		Increased turbidity in the water column caused by beach mining	Insignificant	Improbable	Medium-term
		Disturbance and/or mortality of marine life caused by increased seawater intake	Medium (-ve)	Definite	Long-term
		Sediment scouring and shifts in sediment movement patterns from brine discharge	Low (-ve)	Improbable	Long-term
		Disturbance and/or mortality of marine life caused by elevated salinity from brine discharge	High (-ve)	Definite	Long-term
		Disturbance and/or mortality of marine life caused by elevated temperature from brine discharge	Very Low (-ve)	Improbable	Long-term
		Disturbance and/or mortality of marine life caused by decreased dissolved oxygen concentration from brine discharge	Very Low (-ve)	Improbable	Long-term
		Disturbance and/or mortality of marine life caused by co-pollutants in backwash water from brine discharge	High (-ve)	Definite	Long-term
		Disturbance and/or mortality of marine life caused by reduced pH from brine discharge	Low (-ve)	Probable	Long-term

Activities	***Aspect***	***Potential Impact***	***Significance***	***Probability***	***Duration***
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by increased vehicle movements during operations*	*Medium (-ve)*	*Probable*	*Long-term*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during inland mining*	*Medium (-ve)*	*Probable*	*Long-term*
		Groundwater contamination from the infrastructure / expansion area	*Medium (-ve)*	*Probable*	*Long-term*
		Groundwater contamination from pipeline spills	*Medium (-ve)*	*Probable*	*Long-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Loss of Vegetation, Plant SCC and Ecological Connectivity during Inland Mining*	*High (-ve)*	*Definite*	*Long-term*
		Disturbance to the coastal environment and loss of ecological connectivity during beach mining	*Medium (-ve)*	*Definite*	*Medium-term*
		Disturbance to fauna and loss of habitat during mining	*High (-ve)*	*Definite*	*Long-term*
		Disturbance to avifauna and loss of habitat during mining	*Medium (-ve)*	*Probable*	*Long-term*
		Increased erosion during mining	*Medium (-ve)*	*Definite*	*Medium-term*
		Proliferation of alien and invasive species during mining	*Low (-ve)*	*Probable*	*Medium-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy*	*Low (+ve)*	*Possible*	*Medium-term*
		Increased employment, income and skills development	*Low (+ve)*	*Probable*	*Medium-term*
		Reduced access to the coast	*Very Low (-ve)*	*Definite*	*Medium-term*
		Possible decline of tourism	*Very Low (-ve)*	*Definite*	*Medium-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*Loss of maritime archaeological resources during beach mining*	*Low (-ve)*	*Improbable*	*Long-term*
		Loss of archaeological resources during strandline mining	*Medium (-ve)*	*Probable*	*Long-term*
		Loss of fossil bones during beach mining	*High (-ve)*	*Possible*	*Long-term*
		Loss of fossil shells during beach mining	*Very Low (-ve)*	*Possible*	*Long-term*
		Loss of fossil bones during strandline mining	*High (-ve)*	*Possible*	*Long-term*
		Loss of fossil shells during strandline mining	*Medium (-ve)*	*Probable*	*Long-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and*	*Visual*	*Altered sense of place and visual intrusion caused by mining activities and associated infrastructure*	*Low (-ve)*	*Definite*	*Medium-term*
		Altered sense of place from increased traffic during operations	*Medium (-ve)*	*Definite*	*Medium-term*
		Altered sense of place and visual quality caused by light pollution at night	*Low (-ve)*	*Definite*	*Medium-term*

Activities	Aspect	Potential Impact	Significance	Probability	Duration
• Infrastructure Expansion Area.					
• Haul roads; and • Regional roads	Traffic	Reduced traffic capacity on the haul roads	Low (-ve)	Definite	Medium-term
		Reduced traffic capacity on the regional road network	Insignificant	Definite	Medium-term
		Compromised Road Surface Integrity of the Haul Roads	High (-ve)	Definite	Long-term
		Compromised Road Surface Integrity of the Regional Road Network	Very Low (-ve)	Definite	Medium-term
DECOMMISSIONING PHASE IMPACTS					
• Inland mining; • Haul roads; and • Infrastructure expansion area.	Soil and Land Capability	Soil compaction caused by decommissioning activities	Very Low (-ve)	Probable	Short-term
		Soil chemical pollution from operational activities	Very Low (-ve)	Possible	Medium-term
• Inland mining; • Haul roads; and • MSP.	Air Quality	Impaired Human Health from Increased Pollutant Concentrations Associated with Decommissioning Activities	Low (-ve)	Probable	Short-term
		Increased Nuisance Dustfall Rates Associated with Decommissioning Activities	Very Low (-ve)	Probable	Short-term
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Noise	Increased noise and vibration levels during decommissioning	Very Low (-ve)	Probable	Short-term
• Beach mining; and • RO Plant.	Marine Ecology	Disturbance and/or mortality of marine life during decommissioning of beach access roads	Low (-ve)	Probable	Short-term
		Disturbance and/or mortality of marine life during removal of brine discharge pipeline	Low (-ve)	Possible	Medium-term
		Mortality of marine fauna caused by decommissioning waste	High (-ve)	Possible	Long-term
		Increased turbidity in the water column during rehabilitation of beach access roads	Insignificant	Possible	Short-term
		Increased turbidity in the water column during removal of brine discharge pipeline	Insignificant	Possible	Short-term

Activities	***Aspect***	***Potential Impact***	***Significance***	***Probability***	***Duration***
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by increased vehicle movements during decommissioning*	*Very Low (-ve)*	*Probable*	*Short-term*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during decommissioning of the process water dams*	*Very Low (-ve)*	*Possible*	*Medium-term*
		Groundwater contamination during decommissioning of the infrastructure / plant expansion area	*Insignificant*	*Possible*	*Short-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Disturbance to terrestrial fauna during decommissioning*	*Very Low (-ve)*	*Definite*	*Short-term*
		Disturbance to avifauna during decommissioning	*Very Low (-ve)*	*Probable*	*Short-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy*	*Very Low (+ve)*	*Probable*	*Short-term*
		Increased employment, income and skills development	*Very Low (+ve)*	*Probable*	*Short-term*
		Reduced access to the coast	*Insignificant*	*Improbable*	*Short-term*
		Possible decline of tourism	*Insignificant*	*Improbable*	*Short-term*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*None.*			
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by decommissioning and rehabilitation activities*	*Very Low (-ve)*	*Definite*	*Short-term*
• *Haul roads*	*Traffic*	*None.*			

iii) Methodology used in determining the significance of environmental impacts

(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).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

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

Table 33: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. *Extent* *– the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g. the development site and immediate surrounds)	1
Regional	The region (District Municipality or Quaternary catchment)	2
(Inter) national	Nationally or beyond	3
B. ***Intensity*** *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration*** *– the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years and reversible	1
Medium-term	2 to 15 years and reversible	2
Long-term	More than 15 years and irreversible	3

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

Table 34: Method used to determine the consequence score

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

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

Table 35: Probability classification

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

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

Table 36: Impact significance ratings

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

Finally the impacts were also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Table 37: Impact status and confidence classification

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

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

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

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

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

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

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

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

iv) 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 and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties)

Site layout alternatives will not be considered in the Impact Assessment Phase, but specific mining and infrastructure footprints within the expansion areas will take account of environmental constraints identified during the Impact Assessment Phase. Table 20 therefore provides the potential positive and negative impacts of the project as described in Section (2)(d)(ii).

v) 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).

The comments and concerns raised by stakeholders **during the previous EIA process** are included in Table 7. Comments from stakeholders, together with input from specialists and experienced SRK EAPs, have informed the high level mitigation measures outlined in Table 26. Detailed mitigation measures will be further developed as part of the Impact Assessment Phase.

Table 38: High level mitigation measures for potential impacts identified for the project

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
CONSTRUCTION PHASE IMPACTS			
• *Inland mining;* • *Haul roads; and* • *Infrastructure expansion area.*	*Soil and Land Capability*	*Soil compaction caused by construction traffic* *Loss of fertile topsoil* *Soil chemical pollution from construction activities* *Loss of land capability* *Loss of soil ecosystem services*	• *Limit construction activities to the project footprint areas.* • *Restrict vehicle movements to haul roads and construction areas and prohibit vehicle parking or storage of construction materials beyond these areas.* • *Minimise vegetation clearance and the footprint of construction activities to what is absolutely essential.* • *Restrict construction activities to the project footprint areas.* • *Strip the topsoil layer of the infrastructure / plant expansion area prior to construction and stockpile the topsoil in a demarcated area for land rehabilitation purposes.* • *Locate all topsoil stockpiles in areas where they will not have to be relocated prior to replacement for final rehabilitation.* • *Use appropriately sized drip trays for all refuelling, repairs done on vehicles / machinery or when vehicles are parked – ensure these are strategically placed to capture any spillage of fuel, oil, etc.* • *Ensure hazardous materials (especially fuel) are stored in suitable hazardous material storage facilities constructed from impermeable materials. The storage facilities must have bund containment capacity equal to 110% of the largest container.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.* • *Use conserved topsoil as soon as possible to maintain soil nutrient cycles.* • *Do not stockpile topsoil higher than 4 m to ensure that the nutrient cycles are maintained over a large surface to volume ratio.*
• *Inland mining;* • *Haul roads; and* • *MSP.*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Construction Activities* *Increased Nuisance Dustfall Rates Associated with Construction Activities*	• *Limit and phase vegetation clearance and the construction footprint to what is absolutely essential.* • *Avoid clearing of vegetation until absolutely necessary (i.e. just before earthworks).* • *Reduce airborne dust through e.g.:*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			o *Dampening dust-generating areas, roads and stockpiles with water; and* o *Utilise screens in high dust-generating areas.* • *Use high quality diesel for construction vehicles / equipment.* • *Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Noise*	*Increased Noise and Vibration Levels during Construction*	• *Limit noisy construction activities to daylight hours from Monday to Saturday or in accordance with relevant municipal bylaws, if applicable.* • *Comply with the applicable municipal and / or industry noise regulations.* • *Maintain all generators, vehicles, vessels and other equipment in good working order to minimise excess noise.* • *Enclose diesel generators used for power supply to reduce unnecessary noise.* • *Respond rapidly to complaints and take appropriate corrective action.*
• *Beach mining; and* • *RO Plant.*	*Marine Ecology*	*Disturbance and/or mortality of marine life during construction of beach access roads* *Disturbance and/or mortality of marine life during construction of brine discharge pipeline* *Mortality of marine fauna caused by construction waste* *Increased turbidity in the water column during construction of beach access roads* *Increased turbidity in the water column during construction of brine discharge pipeline*	• *Constrain the spatial extent of impacts to the minimum required to minimise disturbance within the coastal zone.* • *Limit duration of construction activities in the coastal zone.* • *Inform and empower all staff about sensitive marine habitats.* • *Ensure that a 10 m buffer zone from the toe of the dune/cliffs remains undisturbed outside of the construction footprint.* • *Inform all staff about sensitive marine species and the responsible disposal of construction waste.* • *Suitable waste handling and disposal protocols must be clearly explained and sign boarded.* • *Reduce, reuse, recycle all waste generated on site.* • *Ensure that stringent waste management practices are in place at all times.* • *Prohibit vehicle maintenance or refuelling on the beach.* • *Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use.* • *Use drip trays and bunding where losses are likely to occur.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Clean up hydrocarbon spills immediately.* • *Collect and dispose of polluted soil at a licensed waste disposal facility.* • *Subject mobile equipment, vehicles and power generation equipment to monthly noise tests.* • *Respond rapidly to complaints and take appropriate corrective action.* • *Rehabilitate the disturbed area.*
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by beach access road widening and increased vehicle movements during construction*	• *Plan for the management of water runoff during infrequent but potentially damaging storms.* • *Allow for the dissipation of runoff into the surrounding veld from multiple side drains, rather than for the concentration of flows along or off the road in major channels.* • *Install pipe culverts or similar at the road crossing points to allow for the uninterrupted flow of water across the road. Culvert design must include allowance for effective dissipation of flow downstream, and multiple pipes must be used to prevent concentration of flows.* • *Avoid piling graded vegetation and soils along the road edges, where they will contribute to blockage of surface runoff and add sources of loose sediment to enter watercourses. Incorporate this material into road fill or shape to ensure dissipation occurs.* • *Minimise the disturbance corridor during road widening.* • *Allow for ongoing maintenance of stormwater outlets / dissipation channels.* • *Ensure that construction-associated waste (e.g. plastic, rubble) is disposed of appropriately on a frequent and ongoing basis.* • *Ensure that vehicle and machinery refuelling / storage is managed to minimise pollution opportunities.*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during construction of process water dams* *Groundwater contamination during construction of the infrastructure / plant expansion area*	• *Discontinue excavations if groundwater or sidewall seep is intersected (so that the process water dams remain above the groundwater level).* • *Clean up hydrocarbon spills immediately.* • *Collect and dispose of polluted soil at a licensed waste disposal facility.* • *Store hazardous liquids in above ground containers in bunded areas or on drip trays.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Install monitoring boreholes up and down gradient of the infrastructure / plant expansion area.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Loss of vegetation and plant species of conservation concern (SCC) during construction* *Disturbance to terrestrial fauna and loss of habitat during construction* *Disturbance to avifauna and loss of habitat during construction*	• *Appoint a suitably qualified specialist to undertake a preconstruction walk-through to identify SCC and protected species within the construction footprint and oversee the rescue and relocation of these species.* • *Obtain a permit from CapeNature for the removal and/or destruction of SCC.* • *Limit vegetation clearance and the footprint of construction activities to the minimum required.* • *Clearly define the boundary of the construction footprint area and ensure that all activities remain within the defined footprint area.* • *Ensure all new haul and access roads on Farm Geelwal Karoo 262 are constructed within the boundaries of the proposed mining area or infrastructure / plant expansion area.* • *Locate laydown areas or other temporary use areas within the construction footprint or the existing approved processing area.* • *Erect wind screens along beach access roads in areas of mobile sands to limit and contain wind-blown sand.* • *Appoint a suitably qualified specialist to undertake a preconstruction walk-through of the construction footprint to demarcate and clear burrows.* • *Limit vehicle speeds on internal and haul roads to 40 km/hr.* • *Conduct environmental induction for all construction staff to increase awareness in fauna protection.* • *Prohibit trapping, collecting or hunting of fauna.* • *Flush any faunal species within the construction footprint towards more suitable habitat within the surrounding areas. Threatened fauna should be relocated by a suitably qualified environmental officer.* • *Ensure hazardous materials (especially fuel storage) are stored in suitable hazardous material storage facilities.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.* • *Do not leave trenches open for extended periods.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Check for nests within the construction footprint during the preconstruction walk-through.* • *Keep the construction site clear of litter and especially plastic, twine and string.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy* *Increased employment, income and skills development* *Reduced access to the coast* *Possible decline of tourism*	• *Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible.* • *Maximise use of local skills and resources through preferential employment of locals where practicable.* • *Develop and implement a fair and transparent labour and recruitment policy.* • *Ensure gender equality in recruitment, as far as possible.* • *Provide suitable training.* • *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.* • *Restrict construction activities to the development footprint.* • *Install appropriate signage and information regarding coastal access.* • *Install appropriate screening of construction sites in line with the scenic nature of the area.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*Loss of archaeological resources during beach access road widening* *Loss of archaeological resources during construction of infrastructure / plant expansion area* *Loss of fossil bones during beach access road widening* *Loss of fossil shells during beach access road widening* *Loss of fossil bones during construction of infrastructure / plant expansion area*	*For archaeology finds:* • *Limit clearance and the footprint of construction activities to what is absolutely essential.* • *Appoint an archaeologist to monitor construction activities and sample affected archaeological resources as required.* *For fossil bone finds:* • *Limit clearance and the footprint of construction activities to what is absolutely essential.* • *Construction personnel to be alert for rare fossil bones and follow "Fossil Finds Procedure".* • *Cease construction on (chance) discovery of fossil bones and protect fossils from further damage.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Send information and photographs to a palaeontologist for assessment and to determine preservation, collection and record keeping procedures.* *For fossil shell finds:* • *Limit clearance and the footprint of construction activities to what is absolutely essential.* • *Construction personnel to be alert for fossil shells and follow "Fossil Finds Procedure".* • *Cease construction on (chance) discovery of fossil shells and protect fossils from further damage.* • *Send information and photographs to a palaeontologist for assessment and to determine preservation, collection and record keeping procedures.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by construction activities* *Altered sense of place from increased traffic during construction*	• *Limit and phase vegetation clearance and the footprint of construction activities to what is absolutely essential.* • *Avoid excavation, handling and transport of materials which may generate dust under high wind conditions.* • *Prepare/review a detailed dust suppression/control management programme, such as regular wetting and/or use of non-contaminating agents, to reduce dust on dust-generating facilities (e.g. roads), especially during the dry season and when conditions are windy.* • *Ensure speed limits on all gravel roads are respected at all times.* • *Keep construction sites tidy and all activities, material and machinery contained within an area that is as small as possible.* • *Control litter and keep construction sites as clean and neat as possible.* • *Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.* • *Maintain all generators, vehicles and other equipment in good working order.* • *During construction, minimise the use of night-lighting. No high mast or spot-light security lighting or up-lighting allowed.* • *Set targets for the use of local labour to give the local community a sense of ownership and pride in the project.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Restrict construction deliveries to Mondays to Saturdays between the hours of 08h00 and 17h00.*
• *Haul roads*	*Traffic*	*None.*	*None.*
OPERATIONAL PHASE IMPACTS			
• *Inland mining;* • *Haul roads; and* • *Infrastructure expansion area.*	*Soil and Land Capability*	*Soil compaction caused by operational activities* *Soil compaction caused by hauling and stockpiles* *Soil chemical pollution from operational activities* *Loss of land capability*	• *Restrict hauling to designated haul roads and no additional roads or turn-around areas should be created.* • *Do not stockpile topsoil higher than 4 m.* • *Undertake vegetation clearance and soil stripping immediately prior to mining activities.* • *Implement drainage control measures and install culverts to manage the natural flow of surface runoff around the infrastructure / plant expansion area.* • *Use conserved topsoil as soon as possible or vegetate topsoil stockpiles if the topsoil cannot be used immediately.* • *Place geotextile layers on topsoil stockpiles to improve stabilization and to prevent erosion if vegetation cover is insufficient.* • *Use appropriately sized drip trays for all refuelling, repairs done on vehicles / machinery or when vehicles are parked – ensure these are strategically placed to capture any spillage of fuel, oil, etc.* • *Ensure hazardous materials (especially fuel) are stored in suitable hazardous material storage facilities constructed from impermeable materials. The storage facilities must have bund containment capacity equal to 110% of the largest container.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.* • *Design processing areas to effectively manage and dispose of contaminated storm water and process water.* • *Ensure equipment / vehicle maintenance and washdown areas are contained and appropriate systems provided for treating and disposing of contaminated liquids and solids.* • *Regularly inspect effluent and process systems for leaks.* • *Restrict activities to the project footprint areas.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Undertake concurrent rehabilitation to prevent stockpiled topsoil from losing its inherent fertility.*
• *Inland mining;* • *Haul roads; and* • *MSP.*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Mining and Processing Activities*	• *Reduce airborne dust through dampening roads with water (control efficiency of minimum 75%).* • *Partially enclose MSP product stockpiles (control efficiency of minimum 70%).* • *Use high quality diesel for vehicles / equipment.* • *Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.*
		Increased Nuisance Dustfall Rates Associated with Mining and Processing Activities	
		Impaired Human Health from Increased Pollutant Concentrations Associated with Increased Product Truck Movements	
		Increased Nuisance Dustfall Rates Associated with Increased Product Truck Movements	
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Noise*	*Increased Noise and Vibration Levels during Operations*	• *Limit noisy activities to daylight hours from Monday to Saturday or in accordance with relevant municipal bylaws, if applicable.* • *Comply with the applicable municipal and / or industry noise regulations.* • *Maintain all generators, vehicles, vessels and other equipment in good working order to minimise excess noise.* • *Enclose diesel generators used for power supply to reduce unnecessary noise.* • *Schedule beach mining near, for example Gert du Toit-se-Baai, during "off season" periods and communicate the mine schedule to the public.* • *Limit hauling operations from the northern beaches to Mondays to Fridays during Easter and "Christmas" holidays.* • *Limit product transport from Tormin Mine to the Port of Saldanha and Port of Cape Town to Mondays to Saturdays between the hours of 08h00 and 17h00.* • *Ensure speed limits are respected at all times.* • *Respond rapidly to complaints and take appropriate corrective action.*
• *Beach mining; and* • *RO Plant.*	*Marine Ecology*	*Shoreline erosion and altered beach profiles caused by beach mining*	• *Enforce a 10 m buffer zone from the toe of the sand dunes and cliffs towards the sea in which no mining or disturbance may take place.*
		Changes in macrofaunal community structure caused by beach mining	

Activities	**Aspect**	**Potential Impact**	**High level mitigation measures**
		Disturbance and/or mortality of marine life caused by beach mining *Smothering of reefs and macrofauna caused by increased sedimentation from beach mining* *Increased turbidity in the water column caused by beach mining* *Disturbance and/or mortality of marine life caused by increased seawater intake* *Sediment scouring and shifts in sediment movement patterns from brine discharge* *Disturbance and/or mortality of marine life caused by elevated salinity from brine discharge* *Disturbance and/or mortality of marine life caused by elevated temperature from brine discharge* *Disturbance and/or mortality of marine life caused by decreased dissolved oxygen concentration from brine discharge* *Disturbance and/or mortality of marine life caused by co-pollutants in backwash water from brine discharge* *Disturbance and/or mortality of marine life caused by reduced pH from brine discharge*	• *Undertake primary processing on the beach and distribute unwanted sediment (tailings) evenly above the mid-line of the beach from where it was mined.* • *Avoid discharging tailings from a centralised point.* • *Actively backfill mined beaches and profile the mining area to resemble the natural beach profile.* • *Remove sand berms (or similar) and any artificial structures on completion of each mining episode.* • *Rehabilitate all access roads built over coastal areas as soon possible, not necessarily waiting for the end of Life of Mine.* • *Minimise disturbance of the intertidal and subtidal areas.* • *PBCs must facilitate the efficient and effective return of tailings to the beach to allow for dispersion by tidal action. Should this not be effective, manual landscaping of the beach back to its original profile must be undertaken within a maximum of 24 hours of cessation of mining.* • *Reduce disturbance of beach habitat adjacent to mining pits through stringent environmental management and good house-keeping practices.* • *Prohibit mining closer than 10 m to rocky shore habitats.* • *Inform all staff about sensitive marine species and the responsible disposal of waste.* • *Suitable handling and disposal protocols must be clearly explained and sign boarded.* • *Reduce, reuse, recycle all waste generated on site.* • *Ensure that stringent waste management practices are in place at all times.* • *Maintain high safety standards and employ "good housekeeping". This should incorporate plans for emergencies.* • *Prohibit vehicle maintenance or refuelling on the beach.* • *Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use.* • *Use drip trays and bunding where losses are likely to occur.* • *Clean up hydrocarbon spills immediately.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Collect and dispose of polluted soil at a licensed waste disposal facility.* • *Subject mobile equipment, vehicles and power generation equipment to monthly noise tests.* • *Respond rapidly to complaints and take appropriate corrective action.* • *Maintain seawater intake velocities below 0.15 m.s-1 to ensure that fish and other organisms can escape the intake current.* • *Utilise velocity caps on the seawater intake point to change the predominant intake flow from vertical to horizontal, thereby significantly reducing impingement of fish.* • *Design the effluent discharge pipeline and outfall to facilitate rapid mixing and dilution of the effluent at the discharge point through a minimum diffuser angle of 30 degrees.* • *Adopt a robust effluent discharge pipeline design to avoid dislodgement or rupture.* • *Reduce effluent (brine) flow and consider lengthening the discharge pipeline should unacceptable environmental effects and high salinity concentrations be detected outside of the RMZ.* • *Record effluent flow rate daily using a flow rate meter fitted to the effluent discharge pipeline.* • *Ensure minimal dosing of co-pollutants in the RO Plant effluent.* • *Ensure that all metals used in RO Plant infrastructure have high resistance to corrosion by seawater.* • *Use low-toxicity chemicals in the RO Plant as far as is practicable.* • *Limit the use of scale-control additives in the RO Plant to minimum practicable quantities.* • *Monitor and record water quality (temperature, salinity, pH, DO) before effluent discharge once weekly using a portable water quality meter.* • *Monitor and record the concentration of additives (CIPs, anti-scalants etc.) before effluent discharge annually by sending samples to an accredited water quality laboratory. Repeat this process upon each change of dosage.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Neutralise extremely alkaline or acidic solutions (e.g. sulphuric acid) and treat additional cleaning agents in the RO Plant before effluent discharge to remove any potential toxicity.*
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by increased vehicle movements during operations*	• *Strictly control the passage of vehicles on the road. No vehicles should be allowed to turn in or pull over into areas abutting the road, other than where formally designated turning or pullover areas have been created and managed.* • *Allow for the dissipation of runoff into the surrounding veld from multiple side drains, rather than for the concentration of flows along or off the road in major channels.* • *Install multiple culverts or other appropriate structures at watercourse 2 to convey water runoff under / across the road and into the natural watercourse downstream of the road such that it does not result in erosion or channel constriction downstream.* • *Maintain culverts by removing sand and debris, and dispose material outside of the affected watercourse so that it does not create additional blockages.* • *Implement measures (adjusting the routing of flows, dissipating runoff and/or establishing vegetation) to address erosion nick-points along the roads.* • *Undertake annual auditing of access roads to assess erosion with a photographic record.* • *Compile a stormwater management plan that outlines a strategy for the management of stormwater flows off all hardened surfaces and off roads in particular to inform ongoing management.*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during inland mining* *Groundwater contamination from the infrastructure / expansion area* *Groundwater contamination from pipeline spills*	• *Inspect mining vehicles and equipment for oil/fuel leaks prior to entering the mining area and frequently in the mining area.* • *Regularly service mining vehicles and equipment.* • *Store hazardous liquids in above ground containers in bunded areas or on drip trays.* • *Clean up hydrocarbon spills immediately.* • *Collect and dispose of polluted soil at a licensed waste disposal facility.* • *Discontinue (inland) mining if groundwater or sidewall seep is intersected.*

Activities	Aspect	Potential Impact	High level mitigation measures
			• Undertake a geophysical survey south-east of the inland mining area to determine groundwater flow and install four boreholes in this zone for aquifer characteristic testing. • Install monitoring boreholes up and down gradient of the mining area. • Produce a numerical groundwater model prior to mining and update the model biannually based on groundwater monitoring results. • Line the process water dams. • Install monitoring boreholes up and down gradient of each process water dam. • Ensure pipelines are accessible along the entire length. • Implement measures to detect, contain and fix pipeline leaks within 48 hours.
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Terrestrial Ecology	Loss of Vegetation, Plant SCC and Ecological Connectivity during Inland Mining Disturbance to the coastal environment and loss of ecological connectivity during beach mining Disturbance to fauna and loss of habitat during mining Disturbance to avifauna and loss of habitat during mining Increased erosion during mining Proliferation of alien and invasive species during mining	• Appoint a suitably qualified specialist to undertake a pre-mining walk-through to identify SCC and protected species within the mining footprint and oversee the rescue and relocation of these species. • Obtain a permit from CapeNature for the removal and/or destruction of SCC. • Limit vegetation clearance and the footprint of mining activities to the minimum required. • Clearly define the boundary of the mining area and haul / access roads and ensure that all activities remain within the defined footprint area. • Confine vehicles, machinery and staff to designated areas and strictly prohibit the indiscriminate movement of vehicles, machinery and staff outside of the designated roads and mine areas • Rehabilitate disturbed areas incrementally and as soon as possible. • Only clear vegetation when a new area is to be mined. Remove the vegetation and soil simultaneously and, where possible, immediately place this material on the mined area prepared for rehabilitation to reduce the duration of topsoil storage. • Apply a 10 m setback from the toe of the cliffs and/or dunes on the back beach. • Appoint an independent and appropriately qualified specialist (e.g. geologist or coastal geomorphologist) to inspect the back beach interface within one week of commencement of mining on each beach. The upper limit of mining

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			on the beach should be clearly demarcated and no disturbance allowed above this point. • *Level and contour beach tailings material to allow the sea to restore the natural beach profile. Do not dispose tailings material beyond the setback line or on the foredunes.* • *Ensure hazardous waste is stored in suitable hazardous material storage containers and is removed from the beaches every day.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.* • *Prohibit unnecessary driving at night.* • *Limit vehicle speeds on internal and haul roads to 40 km/hr.* • *Conduct environmental induction for all construction staff to increase awareness in fauna and avifauna protection.* • *Prohibit trapping, collecting or hunting of fauna / avifauna and egg collecting.* • *Flush any faunal species within the mining footprint towards more suitable habitat within the surrounding areas. Threatened fauna should be relocated by a suitably qualified environmental officer.* • *Do not leave trenches open for extended periods.* • *Undertake avifaunal monitoring of the powerline according to the Birdlife-developed Guidelines.* • *Install bird flight diverters along the length of the powerline.* • *Insulate the pylons and other exposed infrastructure to avoid avifauna electrocution.* • *Keep the operational areas clear of litter and especially plastic, twine and string.* • *Limit the number of beaches mined simultaneously.* • *Undertake counts at regular roosting sites to determine impact on avifauna.* • *Monitor rehabilitated areas and, if wind erosion is evident, install wind barriers.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Erect wind screens along beach access roads in areas of mobile sands to limit and contain wind-blown sand. Maintain the wind screens in place three years after beach mining is complete.* • *Install runoff control measures on all roads and hardened surfaces.* • *Compile an Alien Plant Management Plan.* • *Undertake regular monitoring for alien plants within the development footprint.* • *Conduct regular alien clearing using the best-practice methods for the species concerned. Avoid using herbicides as far as possible.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy* *Increased employment, income and skills development* *Reduced access to the coast* *Possible decline of tourism*	• *Establish and support projects and / or networks that provide training and support for small and medium enterprises in the local municipality to benefit from the opportunities generated by the project. Initiate such programmes as early as possible.* • *Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible.* • *Procure ancillary services for goods purchased overseas, such as installation, customisation and maintenance, from South African companies as far as possible.* • *Maximise use of local skills and resources where practicable.* • *Provide suitable training.* • *Develop and implement a fair and transparent labour and recruitment policy.* • *Ensure gender equality in recruitment, as far as possible.* • *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.* • *Implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use OP9764 to access this stretch of coast.* • *Schedule beach mining near, for example, Gert du Toit-se-Baai during "off season" periods and communicate the mine schedule to the public.*

Activities	Aspect	Potential Impact	High level mitigation measures
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Heritage	Loss of maritime archaeological resources during beach mining Loss of archaeological resources during strandline mining Loss of fossil bones during beach mining Loss of fossil shells during beach mining Loss of fossil bones during strandline mining Loss of fossil shells during strandline mining	For archaeology finds: • Machine operators to be alerted to possibility of finding archaeological resources. • Appoint an archaeologist to assist with monitoring of strandline mining activities. • Monitor mining for archaeological resources. Initially this will need to be semi-permanent until such time as it can be established if any resources are present or not. Based on the initial observations, work out a program for ongoing or regular monitoring. • Collect any archaeological resources that are exposed using appropriate methods to record provenance. • Archaeologist must assess the material and propose the way forward. • Establish protocol if any material is found, including reporting the find/s to Heritage Western Cape or SAHRA. For fossil bone finds: • Identify and appoint a stand-by palaeontologist should paleontological finds be uncovered by mining. • Personnel to be alert for rare fossil bones and follow “Fossil Finds Procedure”. • Cease mining on (chance) discovery of fossil bones and protect fossils from further damage. • Contact appointed palaeontologist providing information and images. • Palaeontologist will assess information and establish suitable response, such as the importance of the find and recommendations for preservation, collection and record keeping. • Record and sample exposed fossiliferous sections in earthworks by appointed palaeontologist. For fossil shell finds: • Identify and appoint a stand-by palaeontologist should paleontological finds be uncovered by earthworks.

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Personnel to be aware that a substantial temporary exposure of marine shelly beds may require sampling and recording.* • *Notify the appointed palaeontologist in the event of a large exposure of shell beds, and provide the palaeontologist with information and images.* • *Palaeontologist will assess information and establish suitable response, such as the importance of the find and recommendations for sample collection and record keeping.* • *Record and sample selected exposed fossiliferous sections in earthworks by appointed palaeontologist.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by mining activities and associated infrastructure* *Altered sense of place from increased traffic during operations* *Altered sense of place and visual quality caused by light pollution at night*	• *Limit and phase vegetation clearance and the footprint of mining activities to what is absolutely essential.* • *Keep all areas neat, clean and organised in order to portray a general tidy appearance.* • *Keep material and machinery contained within an area that is as small as possible.* • *Progressively and continually rehabilitate mined out areas and project components.* • *Maintain all generators, vehicles and other equipment in good working order.* • *Schedule beach mining near, for example, Gert du Toit-se-Baai during "off season" periods and communicate the mine schedule to the public.* • *Reduce the footprint of the infrastructure areas to a workable minimum.* • *Restrict infrastructure along the coast to the north of Tormin Mine as far as possible.* • *Consolidate or cluster structures together at the infrastructure expansion area to avoid the visual scatter of structures.* • *Avoid excavation, handling and transport of materials which may generate dust under high wind conditions.* • *Set targets for the use of local labour to give the local community a sense of ownership and pride in the project.* • *Limit hauling operations from the northern beaches to Mondays to Fridays during Easter and "Christmas" holidays.*

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Limit product transport from Tormin Mine to the Port of Saldanha and Port of Cape Town to Mondays to Saturdays between the hours of 08h00 and 17h00.* • *Ensure speed limits are respected at all times.* • *Limit lighting only to essential activities and facilities.* • *Direct lighting inwards and downwards towards activities and facilities to avoid light spillage and trespass. External lights should be fitted with reflectors ("full cut-off" luminaires) to direct illumination downward and inward to the specific illuminated areas.*
• *Haul roads; and* • *Regional roads*	*Traffic*	*Reduced traffic capacity on the haul roads* *Reduced traffic capacity on the regional road network* *Compromised Road Surface Integrity of the Haul Roads* *Compromised Road Surface Integrity of the Regional Road Network*	• *Widen the northern haul route (OP9764) to at least 8 metres wide.* • *Upgrade OP9764 with a suitable surface material (gravel).* • *Widen OP9764 to 8 m.* • *Ensure that vehicle axle loads do not exceed the technical design capacity of the road.* • *Maintain and repair roads damaged by trucks.* • *Maintain and repair DR2225 damaged by trucks.*
DECOMMISSIONING PHASE IMPACTS			
• *Inland mining;* • *Haul roads; and* • *Infrastructure expansion area.*	*Soil and Land Capability*	*Soil compaction caused by decommissioning activities* *Soil chemical pollution from operational activities*	• *Limit decommissioning activities to the project footprint areas.* • *Restrict vehicle movements to haul roads and decommissioning areas and prohibit vehicle parking or storage of materials beyond these areas.* • *Use appropriately sized drip trays for all refuelling, repairs done on vehicles / machinery or when vehicles are parked – ensure these are strategically placed to capture any spillage of fuel, oil, etc.* • *Ensure hazardous materials (especially fuel) are stored in suitable hazardous material storage facilities constructed from impermeable materials. The storage facilities must have bund containment capacity equal to 110% of the largest container.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.*
• *Inland mining;* • *Haul roads; and*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Decommissioning Activities*	• *Reduce airborne dust through e.g.:* o *Dampening dust-generating areas, roads and stockpiles with water; and*

Activities	Aspect	Potential Impact	High level mitigation measures
• MSP.		Increased Nuisance Dustfall Rates Associated with Decommissioning Activities	o Utilise screens in high dust-generating areas. • Use high quality diesel for vehicles / equipment. • Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Noise	Increased noise and vibration levels during decommissioning	• Limit noisy activities to daylight hours from Monday to Saturday or in accordance with relevant municipal bylaws, if applicable. • Comply with the applicable municipal and / or industry noise regulations. • Maintain all generators, vehicles, vessels and other equipment in good working order to minimise excess noise. • Enclose diesel generators used for power supply to reduce unnecessary noise. • Respond rapidly to complaints and take appropriate corrective action.
• Beach mining; and • RO Plant.	Marine Ecology	Disturbance and/or mortality of marine life during decommissioning of beach access roads Disturbance and/or mortality of marine life during removal of brine discharge pipeline Mortality of marine fauna caused by decommissioning waste Increased turbidity in the water column during rehabilitation of beach access roads Increased turbidity in the water column during removal of brine discharge pipeline	• Constrain the spatial extent of impacts to the minimum required to minimise disturbance within the coastal zone. • Limit duration of decommissioning activities in the coastal zone. • Inform and empower all staff about sensitive marine habitats. • Ensure that a 10 m buffer zone from the toe of the dune/cliffs remains undisturbed outside of the affected footprint. • Inform all staff about sensitive marine species and the responsible disposal of waste. • Suitable waste handling and disposal protocols must be clearly explained and sign boarded. • Reduce, reuse, recycle all waste generated on site. • Ensure that stringent waste management practices are in place at all times. • Prohibit vehicle maintenance or refuelling on the beach. • Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use. • Use drip trays and bunding where losses are likely to occur. • Clean up hydrocarbon spills immediately. • Collect and dispose of polluted soil at a licensed waste disposal facility.

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Subject mobile equipment, vehicles and power generation equipment to monthly noise tests.* • *Respond rapidly to complaints and take appropriate corrective action.* • *Rehabilitate the disturbed area.*
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by increased vehicle movements during decommissioning*	• *Rehabilitate eroded areas (e.g. eroded channels, dongas).* • *Plan for the management of water runoff during infrequent but potentially damaging storms.* • *Avoid piling graded vegetation and soils along the road edges. Incorporate this material into road fill or shape to ensure dissipation occurs.* • *Allow for ongoing maintenance of stormwater outlets / dissipation channels.* • *Ensure that waste (e.g. plastic, rubble) is disposed of appropriately on a frequent and ongoing basis.* • *Ensure that vehicle and machinery refuelling / storage is managed to minimise pollution opportunities.*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during decommissioning of the process water dams*	• *Clean up hydrocarbon spills immediately.* • *Collect and dispose of polluted soil at a licensed waste disposal facility.* • *Store hazardous liquids in above ground containers in bunded areas or on drip trays.*
		Groundwater contamination during decommissioning of the infrastructure / plant expansion area	
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Disturbance to terrestrial fauna during decommissioning*	• *Limit the footprint of decommissioning activities to the minimum required. Prohibit the indiscriminate movement of vehicles and staff through vegetation outside of the affected footprint.* • *Limit vehicle speeds on internal and haul roads to 40 km/hr.* • *Conduct environmental induction for all staff to increase awareness in fauna protection.* • *Prohibit trapping, collecting or hunting of fauna.* • *Ensure hazardous materials (especially fuel storage) are stored in suitable hazardous material storage facilities.* • *Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility.* • *Do not leave trenches open for extended periods.*
		Disturbance to avifauna during decommissioning	

Activities	***Aspect***	***Potential Impact***	***High level mitigation measures***
			• *Keep the site clear of litter and especially plastic, twine and string.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy* *Increased employment, income and skills development* *Reduced access to the coast* *Possible decline of tourism*	• *Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers where possible.* • *Maximise use of local skills and resources through preferential employment of locals where practicable.* • *Develop and implement a fair and transparent labour and recruitment policy.* • *Ensure gender equality in recruitment, as far as possible.* • *Provide suitable training.* • *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.* • *Restrict construction activities to the development footprint.* • *Install appropriate signage and information regarding coastal access.* • *Install appropriate screening of construction sites in line with the scenic nature of the area.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*None.*	*None.*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by decommissioning and rehabilitation activities*	• *Use dark green or black (non-glossy) wind screens.* • *Remove rehabilitation wind screens as soon as vegetation is viable.*
• *Haul roads*	*Traffic*	*None.*	*None.*

vi) The outcome of the site selection Matrix. Final Site Layout Plan

(Provide a final site layout plan as informed by the process of consultation with interested and affected parties)

A final site layout plan is shown in Appendix 5, Figures 1 - 5 and this map will be presented as part of the Scoping Phase stakeholder engagement process.

vii) Motivation where no alternative sites were considered.

Alternatives have been considered for this project, as listed above in Section 2 (h)(i) above.

Where alternatives will not be considered in the Impact Assessment Phase, reasons have been provided in Section 2 (h)(i) above.

viii) Statement motivating the preferred site.

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

Refer to Section 2 (h)(i).

(i) Plan of study for the Environmental Impact Assessment process

i. Description of alternatives to be considered including the option of not going ahead with the activity.

Refer to Section 2 (h)(i).

ii. Description of the aspects to be assessed as part of the environmental impact assessment process

(The EAP must undertake to assess the aspects affected by each individual mining activity whether listed or not, including activities such as blasting, Loading, hauling and transport, and mining activities such as Excavations, stockpiles, discard dumps or dams, water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.).

The aspects to be assessed are included in Table 20 and Table 26.

iii. Description of aspects to be assessed by specialists

A number of specialist studies will be undertaken in the Impact Assessment Phase to investigate the key potential direct, indirect and cumulative impacts (negative and positive) identified during Scoping. These specialist impact studies are as follows:

- Soil and Land Capability Impact Assessment;
- Air Quality Impact Assessment;
- Groundwater Impact Assessment;
- Marine Ecology Impact Assessment;

- Freshwater Ecology Impact Assessment;
- Terrestrial Ecology Impact Assessment;
- Heritage Impact Assessment;
- Visual Impact Assessment; and
- Traffic Impact Assessment.

The Terms of Reference (ToR) for each of the specialist studies is provided in Table 27. The ToR are subject to review on conclusion of the Scoping Study, taking into account issues raised by stakeholders and authorities through the Scoping Phase.

The specialist studies shall be based on the procedure outlined below.

Approach to the Study

Provide an outline of the approach used in the study. Assumptions, limitations and sources of information must be clearly identified. The knowledge of local people should, where possible, be incorporated in the study. The description of the approach shall include a short discussion of the appropriateness of the methods used in the specialist study. The assessment of the data shall, where possible, be based on accepted scientific techniques, failing which the specialist is to make judgments based on professional expertise and experience.

Description of the Affected Environment or Baseline

A description of the affected environment must be provided, both at a site-specific level and for the wider region, the latter to provide an appropriate context and cumulative impact analysis. The focus of this description shall be relevant to the specialists' field of expertise.

It is essential that the relative uniqueness or irreplaceability of the area be understood in the context of the surrounding region at a local, regional (and, if necessary, national) scale. This will largely be based on a comparison to existing data sources, where available.

The baseline should provide an indication of the sensitivity of the affected environment. Sensitivity, in this instance, refers to the ‘ability’ of an affected environment to tolerate disturbance (given existing and expected cumulative impacts).

Lastly, the baseline should provide a sufficiently comprehensive description of the existing environment in the study area to ensure that a detailed assessment of the potential impacts of the proposed development can be made. The baseline should include data collected through a thorough literature review as well as field surveys (where applicable).

Impact Identification and Assessment

Clear statements identifying the potential environmental impacts of the proposed project must be presented. This includes potential impacts of the upgrade and operation of the project. The specialist shall clearly identify the suite of potential direct, indirect and cumulative environmental impacts[14] in his/her study. The assessment of these impacts should take into account any other existing proposals in the surrounding area.

[14] An **indirect** impact is an effect that is related to but removed from a proposed action by an intermediate step or process. **Cumulative** impacts occur when: Different impacts of one activity or impacts of different activities on the natural and social environment take place so frequently in time or so densely in space that they cannot be assimilated; or impacts of one activity combine with the impacts of the same or other activities in a synergistic manner.

Direct impacts require a quantitative assessment which must follow the impact assessment methodology laid out in Table 21. The significance of impacts must be assessed both without and with assumed effective mitigation. Indirect and cumulative impacts should be described qualitatively.

The specialist shall comparatively assess environmental impacts of the development (and each alternative if applicable), and shall indicate any fatal flaws, i.e. very significant adverse environmental impacts which cannot be mitigated and which will jeopardise the project and/or activities in a particular area. All conclusions will need to be thoroughly backed up by scientific evidence.

Mitigation Measures

Specialists must recommend practicable mitigation measures or management actions that effectively minimise or eliminate negative impacts, enhance beneficial impacts, and assist project design. If appropriate, specialists must differentiate between essential mitigation and optimisation measures (i.e. implicit in the 'assuming mitigation' rating), and best practice measures (which reduce impacts, but do not affect the impact rating).

Specialists are also required to recommend appropriate monitoring and review programmes to track the efficacy of mitigation measures (if appropriate).

Specialists must indicate the environmental acceptability of the proposal (and alternatives if applicable), i.e. whether the impacts are acceptable or not. A comparison between the No-Go alternative and the proposed development alternative(s) must also be included.

Table 39: Specialist ToR

Study	ToR for specialist studies
Soil and Land Capability TerraAfrica Consult	• Undertake a desktop study to establish broad baseline soil conditions and areas of environmental sensitivity; • Conduct a site survey focusing on sensitive areas and those areas considered to have high land capability; • Describe soils using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991); • Analyse a maximum of 16 soil samples for pH, electrical conductivity, cations, phosphorus, organic carbon and texture classes; • Group soil units into the different land capability classes as stipulated by the South African Chamber of Mines; • Determine the impact of the proposed project on baseline land capability; and • Propose mitigation measures to reduce the loss of land capability and compile a land capability management plan.
Air Quality Airshed Planning Professionals	• Identify and describe the existing air quality of the project area, as well as climatic patterns and features (i.e. the baseline); • Assess (model) the impact on air quality and human health and biota resulting from the proposed Mine extension (including impacts associated with the construction, operations, decommissioning and post-closure phases of the project); • Prepare an Atmospheric Emission Licence (AEL) application form and Atmospheric Impact Report (AIR) for the MSP; • Identify and describe potential cumulative air quality impacts resulting from the proposed project in relation to proposed and existing developments in the surrounding area; • Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the project; • Recommend and draft a monitoring campaign to ensure the correct implementation and adequacy of recommenced mitigation measures, if applicable; and • Make recommendations for rehabilitation and closure planning.
Groundwater GEOSS	• Undertake a hydrocensus to obtain background information on, inter alia, existing borehole/well locations, groundwater levels, water quality, groundwater use; • Identify, describe and map groundwater resources (i.e. the baseline) in the area that may be affected by the project and obtain a holistic understanding of the interactions with surface water resources in the area; • Develop a numerical flow and contaminant transport model to identify and assess potential impacts on groundwater resources and implications for aquatic biota (if applicable), including impacts associated with the construction, operations [including tailings disposal], decommissioning and post closure phases of the project; • Propose practicable measures to mitigate potentially negative impacts and enhance positive impacts of the project; • Recommend monitoring measures to ensure the correct implementation and adequacy of recommenced mitigation measures, if applicable; and • Make recommendations for closure planning, if appropriate.
Marine Ecology Anchor Environmental	• Undertake a site visit to the study area in order to gather general information on the sandy beach and rocky intertidal ecology of the area; • Describe the baseline marine ecology characteristics of the study area, emphasising but not limited to sensitive and threatened habitats and threatened or rare marine fauna and flora; • Describe pertinent characteristics of the marine environment; • Undertake dispersion modelling for discharge of brine from the RO Plant into the marine environment; • Identify and assess the suite of potential direct and indirect environmental impacts of the extension of beach mining operations and the discharge of brine; • Identify and assess the potential cumulative impacts of the project and existing mining activities at Tormin and regionally; and • Recommend mitigation measures to avoid and/or minimise impacts and enhance benefits associated with the proposed project

Study	ToR for specialist studies
Freshwater Ecology Freshwater Consulting Group	• Undertake a desktop sensitivity screening study to a distance of ~1 km inland of the proposed beach mining area and all areas proposed for conventional surface mining and map ecological sensitivity; • Undertake a site survey in order to characterise and delineate wetlands, pans and aquatic ecosystems (including watercourses) and assess their function, present ecological state and recommended ecological category, • Place freshwater ecosystems in a regional context with regard to biodiversity importance; • Describe wetland-dependant fauna and flora species present; • Map wetlands in terms their ecological sensitivity and functional value, in consultation with the soil, faunal and botanical specialists; • Comment on sensitivity in terms of ecologically important habitats, ecological corridors and linkages with other ecological systems on and adjacent to the site; • Identify and assess the suite of potential direct and indirect environmental impacts of the project; • Identify and assess the potential cumulative impacts of the project and existing mining activities at Tormin and regionally; and • Recommend mitigation measures to avoid and/or minimise impacts and enhance benefits associated with the proposed project.
Terrestrial Ecology Simon Todd Consulting	• Undertake a desktop sensitivity screening study for the terrestrial environment to a distance of ~1 km inland of the proposed beach mining area and all areas proposed for conventional surface mining and map biophysical sensitivity; • Undertake a site survey / surveys to supplement existing data and to describe the baseline characteristics (including species and habitats) of the refined area of assessment; • Describe and map the sensitivity and distribution of habitats and sensitive areas (including ecological corridors and linkages with other ecological systems); • Identify and assess the suite of potential direct and indirect environmental impacts of the project; • Identify and assess the potential cumulative impacts of the project and existing mining activities at Tormin and regionally; • Recommend mitigation measures to avoid and/or minimise impacts and enhance benefits associated with the proposed project; and • Provide a high level revegetation / rehabilitation plan.
Heritage ACO Associates and John Pether	• Undertake a sensitivity screening study for all project areas and map sensitivity; • Undertake site surveys to identify and analyse the heritage resources in the refined area of study and place these in a regional context, including a more detailed assessment of any specific points of interest or/and relevance; • Formulate statements of heritage significance in terms of the heritage criteria; • Identify and assess the suite of potential direct and indirect heritage impacts of the project; • Identify and assess the potential cumulative impacts of the project and existing mining activities at Tormin and regionally; • Recommend mitigation measures to avoid and/or minimise impacts and enhance benefits associated with the proposed project; and • Specify management and monitoring requirements/guidelines for use as conditions.
Visual SRK	• Collect and review required data, including data on topography, vegetation cover, and land-use, and other background information; • Conduct fieldwork, comprising a reconnaissance of the study area, in order to identify key viewpoints / corridors, and groundtruth existing visual character and quality; • Map the site to describe the visual character of the study area including sensitive areas; • Develop a GIS model to delineate the viewshed of the proposed expansion and extension; • Identify and assess potential visual impacts (including impacts associated with the construction, operation, decommissioning and post-closure phases of the project);

Study	ToR for specialist studies
	• Identify and describe potential cumulative visual impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area; and • Recommend mitigation measures to minimise impacts and/or optimise benefits associated with project.
Traffic ITS Engineers	• Visit the site and identify the existing physical and operational characteristics of the roadways near the site; • Obtain and review relevant background information for the study area; • Evaluate the operation of the existing road elements in terms of standard measures, such as volume/capacity ratio, delay per vehicle and level-of-service; • Estimate the construction and operational phase peak hour traffic that would be generated by the development by evaluating the character and nature of the development as well as comparing it where possible with similar developments; • Evaluate the road network in the site vicinity in terms of the expected traffic impact during the construction phase and the operations phase; and • Recommend road upgrades and mitigation measures based on the findings of the impact evaluation.

iv. Proposed method of assessing the environmental aspects including the proposed method of assessing alternatives

The impact assessment method SRK and the specialists will use during the Impact Assessment Phase is described in Section 2 (h)(vi).

v. The proposed method of assessing duration significance

Refer to Section 2 (h)(vi).

vi. The stages at which the competent authority will be consulted

The competent authority (Western Cape Department of Mineral Resources) will be consulted in each phase of the EIA process. This includes:

- Pre-application;
- Scoping Phase; and
- Impact Assessment Phase.

vii. Particulars of the public participation process with regard to the Impact Assessment process that will be conducted

1. Steps to be taken to notify interested and affected parties.

(These steps must include the steps that will be taken to ensure consultation with the affected parties identified in (h) (ii) herein).

The stakeholder engagement process initiated during the Scoping Phase (see Section 2(h)(ii)) will continue in the Impact Assessment Phase of the EIA. The key activities planned during the Impact Assessment Phase are outlined in Table 28.

Table 40: Stakeholder engagement activities planned during the Impact Assessment Phase

Task	Objectives	Dates
Update stakeholder database	To register additional stakeholders identified throughout the S&EIR process	Throughout S&EIR process
Compile and release EIA Report for public comment period	To assess the impacts of the project and formulate mitigation measures and management plans.	Impact Assessment Phase
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Impact Assessment Phase.	Impact Assessment Phase
Public open day/focus group meetings with key stakeholder groups	To discuss potential impacts of the project and findings of the studies. Key stakeholder groups will be identified based on findings of specialist studies and interest from stakeholders and include groups that might be significantly affected by the project as well as local and regional authorities.	Before and/or after the release of the EIA Report for public comment
Finalise EIA Report	To present the findings of the EIA process and incorporate stakeholder comment in the final report which provides DMR with information for decision-making.	Impact Assessment Phase

2. Details of the engagement process to be followed.

(Describe the process to be 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 and records of such consultation will be required in the EIA at a later stage).

See Table 28.

3. Description of the information to be provided to Interested and Affected Parties.

(Information to be provided must include the initial site plan and sufficient detail of the intended operation and the typical impacts of each activity, to enable them to assess what impact the activities will have on them or on the use of their land).

See Table 28.

viii. Description of the tasks that will be undertaken during the environmental impact assessment process

The Impact Assessment Phase can be divided into key steps, namely:

- Consultation with relevant authorities;
- Specialist studies;
- Compilation of an EIA Report and an EMPr;
- Stakeholder engagement; and
- Submission of the Final EIA Report and EMPr to the competent authority, in this case DMR.

These are outlined in more detail below.

Consultation with the Relevant Authorities

Consultation will be conducted with DMR and other relevant authorities to clarify their requirements for the Impact Assessment Phase of the proposed development, other permit and licence applications for the project and to ensure that comments from the key authorities can be received in time to allow for them to be addressed in the EIA. The authorities (and other organs of state) that will be consulted include:

- DEA&DP;
- DWS;
- DEA: O&C;
- HWC;
- Department of Public Works;
- Western Cape Department of Transport and Public Works;
- CapeNature;
- Western Cape Department of Agriculture;
- West Coast District Municipality; and
- Matzikama Local Municipality.

Specialist Studies

Specialist assessments will be undertaken as part of the Impact Assessment Phase to investigate the key potential environmental issues and impacts identified during Scoping. These key issues and impacts have been identified based on:

- The legal requirements;
- The nature of the proposed activity;
- The nature of the receiving environment; and
- The professional experience of the EIA team.

The specialist studies are discussed in Section 2(i)(iii).

Compilation of the Environmental Impact Assessment Report

The compilation of the EIA Report and EMPr will include the following tasks:

- Assimilation of the specialist studies / input into the EIA Report and EMPr;
- Identification and assessment of environmental impacts based on the results of the specialist studies / input and professional judgment of the EIA team. This will entail an assessment of the duration, extent, probability and intensity of the impacts to determine their significance;
- Identification of mitigation measures and recommendations for the management of the proposed project to avoid and minimise environmental impacts and maximise benefits; and
- Collation of the above information into an EIA Report and EMPr for the design, construction and operational phases of the project.

Stakeholder Engagement

The key stakeholder engagement activities planned during the Impact Assessment Phase are outlined in Table 28.

Submission of the Final EIA Report and EMPr to DMR

All comments received will be incorporated into the Issues and Responses Summary. The Final EIA Report (including the EMPr) will then be submitted to DMR to inform their decision regarding environmental authorisation of the proposed development.

(ix) Measures to avoid, reverse, mitigate, or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

The potential residual risks post-mitigation are presented in Table 29.

Table 41: Potential residual risk post-mitigation

Activities	Aspect	Potential Impact	Significance Without Mitigation	Significance With Mitigation
CONSTRUCTION PHASE IMPACTS				
• Inland mining; • Haul roads; and • Infrastructure expansion area.	Soil and Land Capability	Soil compaction caused by construction traffic	Medium (-ve)	Medium (-ve)
		Loss of fertile topsoil	Medium (-ve)	Low(-ve)
		Soil chemical pollution from construction activities	Very Low (-ve)	Insignificant
		Loss of land capability	Low (-ve)	Low(-ve)
		Loss of soil ecosystem services	Medium (-ve)	Low(-ve)
• Inland mining; • Haul roads; and • MSP.	Air Quality	Impaired Human Health from Increased Pollutant Concentrations Associated with Construction Activities	Low (-ve)	Very Low (-ve)
		Increased Nuisance Dustfall Rates Associated with Construction Activities	Very Low (-ve)	Insignificant
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Noise	Increased Noise and Vibration Levels during Construction	Very Low (-ve)	Insignificant
• Beach mining; and • RO Plant.	Marine Ecology	Disturbance and/or mortality of marine life during construction of beach access roads	Low (-ve)	Very Low (-ve)
		Disturbance and/or mortality of marine life during construction of brine discharge pipeline	Low (-ve)	Very Low (-ve)
		Mortality of marine fauna caused by construction waste	High (-ve)	Medium (-ve)
		Increased turbidity in the water column during construction of beach access roads	Insignificant	Insignificant
		Increased turbidity in the water column during construction of brine discharge pipeline	Insignificant	Insignificant
• Haul roads	Freshwater Ecology	Destabilisation of watercourses caused by beach access road widening and increased vehicle movements during construction	Very Low (-ve)	Insignificant
• Inland mining; and	Hydrogeology	Groundwater contamination during construction of process water dams	Very Low (-ve)	Insignificant

Activities	***Aspect***	***Potential Impact***	***Significance Without Mitigation***	***Significance With Mitigation***
• *Infrastructure expansion area.*		*Groundwater contamination during construction of the infrastructure / plant expansion area*	*Very Low (-ve)*	*Insignificant*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Loss of vegetation and plant species of conservation concern (SCC) during construction*	*Medium (-ve)*	*Medium (-ve)*
		Disturbance to terrestrial fauna and loss of habitat during construction	*Medium (-ve)*	*Medium (-ve)*
		Disturbance to avifauna and loss of habitat during construction	*Medium (-ve)*	*Medium (-ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy*	*Medium (+ve)*	*Medium (+ve)*
		Increased employment, income and skills development	*Low (+ve)*	*Low (+ve)*
		Reduced access to the coast	*Insignificant*	*Insignificant*
		Possible decline of tourism	*Insignificant*	*Insignificant*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Heritage*	*Loss of archaeological resources during beach access road widening*	*Low (-ve)*	*Low (+ve)*
		Loss of archaeological resources during construction of infrastructure / plant expansion area	*Low (-ve)*	*Low (+ve)*
		Loss of fossil bones during beach access road widening	*High (-ve)*	*High (+ve)*
		Loss of fossil shells during beach access road widening	*Very Low (-ve)*	*Very Low (-ve)*
		Loss of fossil bones during construction of infrastructure / plant expansion area	*High (-ve)*	*High (+ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by construction activities*	*Very Low (-ve)*	*Very Low (-ve)*
		Altered sense of place from increased traffic during construction	*Very Low (-ve)*	*Very Low (-ve)*
• *Haul roads*	*Traffic*	*None.*		
OPERATIONAL PHASE IMPACTS				
• *Inland mining;* • *Haul roads; and*	*Soil and Land Capability*	*Soil compaction caused by operational activities*	*High (-ve)*	*Very Low (-ve)*
		Soil compaction caused by hauling and stockpiles	*Medium (-ve)*	*Low (-ve)*
		Soil chemical pollution from operational activities	*Medium (-ve)*	*Low (-ve)*

Activities	***Aspect***	***Potential Impact***	***Significance Without Mitigation***	***Significance With Mitigation***
• *Infrastructure expansion area.*		*Loss of land capability*	*Medium (-ve)*	*Low (-ve)*
• *Inland mining;* • *Haul roads; and* • *MSP.*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Mining and Processing Activities*	*Low (-ve)*	*Very Low (-ve)*
		Increased Nuisance Dustfall Rates Associated with Mining and Processing Activities	*Very Low (-ve)*	*Very Low (-ve)*
		Impaired Human Health from Increased Pollutant Concentrations Associated with Increased Product Truck Movements	*High (-ve)*	*Medium (-ve)*
		Increased Nuisance Dustfall Rates Associated with Increased Product Truck Movements	*Low (-ve)*	*Low (-ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Noise*	*Increased Noise and Vibration Levels during Operations*	*Medium (-ve)*	*Low (-ve)*
• *Beach mining; and* • *RO Plant.*	*Marine Ecology*	*Shoreline erosion and altered beach profiles caused by beach mining*	*High (-ve)*	*Low (-ve)*
		Changes in macrofaunal community structure caused by beach mining	*High (-ve)*	*Medium (-ve)*
		Disturbance and/or mortality of marine life caused by beach mining	*High (-ve)*	*Medium (-ve)*
		Smothering of reefs and macrofauna caused by increased sedimentation from beach mining	*Low (-ve)*	*Very Low (-ve)*
		Increased turbidity in the water column caused by beach mining	*Insignificant*	*Insignificant*
		Disturbance and/or mortality of marine life caused by increased seawater intake	*Medium (-ve)*	*Low (-ve)*
		Sediment scouring and shifts in sediment movement patterns from brine discharge	*Low (-ve)*	*Low (-ve)*
		Disturbance and/or mortality of marine life caused by elevated salinity from brine discharge	*High (-ve)*	*Low (-ve)*

Activities	***Aspect***	***Potential Impact***	***Significance Without Mitigation***	***Significance With Mitigation***
		Disturbance and/or mortality of marine life caused by elevated temperature from brine discharge	*Very Low (-ve)*	*Very Low (-ve)*
		Disturbance and/or mortality of marine life caused by decreased dissolved oxygen concentration from brine discharge	*Very Low (-ve)*	*Very Low (-ve)*
		Disturbance and/or mortality of marine life caused by co-pollutants in backwash water from brine discharge	*High (-ve)*	*Low (-ve)*
		Disturbance and/or mortality of marine life caused by reduced pH from brine discharge	*Low (-ve)*	*Very Low (-ve)*
• *Haul roads*	*Freshwater Ecology*	*Destabilisation of watercourses caused by increased vehicle movements during operations*	*Medium (-ve)*	*Low (-ve)*
• *Inland mining; and* • *Infrastructure expansion area.*	*Hydrogeology*	*Groundwater contamination during inland mining*	*Medium (-ve)*	*Very Low (-ve)*
		Groundwater contamination from the infrastructure / expansion area	*Medium (-ve)*	*Very Low (-ve)*
		Groundwater contamination from pipeline spills	*Medium (-ve)*	*Very Low (-ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Terrestrial Ecology*	*Loss of Vegetation, Plant SCC and Ecological Connectivity during Inland Mining*	*High (-ve)*	*Medium (-ve)*
		Disturbance to the coastal environment and loss of ecological connectivity during beach mining	*Medium (-ve)*	*Low (-ve)*
		Disturbance to fauna and loss of habitat during mining	*High (-ve)*	*Medium (-ve)*
		Disturbance to avifauna and loss of habitat during mining	*Medium (-ve)*	*Low (-ve)*
		Increased erosion during mining	*Medium (-ve)*	*Low (-ve)*
		Proliferation of alien and invasive species during mining	*Low (-ve)*	*Very Low (-ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Socio-economic*	*Investment in and contribution to the economy*	*Low (+ve)*	*Medium (+ve)*
		Increased employment, income and skills development	*Low (+ve)*	*Low (+ve)*
		Reduced access to the coast	*Very Low (-ve)*	*Very Low (-ve)*
		Possible decline of tourism	*Very Low (-ve)*	*Very Low (-ve)*
• *Beach mining* • *Inland mining;*	*Heritage*	*Loss of maritime archaeological resources during beach mining*	*Low (-ve)*	*Very Low (+ve)*
		Loss of archaeological resources during strandline mining	*Medium (-ve)*	*Low (+ve)*

Activities	***Aspect***	***Potential Impact***	***Significance Without Mitigation***	***Significance With Mitigation***
• *Haul roads; and* • *Infrastructure Expansion Area.*		*Loss of fossil bones during beach mining*	*High (-ve)*	*High (+ve)*
		Loss of fossil shells during beach mining	*Very Low (-ve)*	*Very Low (+ve)*
		Loss of fossil bones during strandline mining	*High (-ve)*	*High (+ve)*
		Loss of fossil shells during strandline mining	*Medium (-ve)*	*Medium (+ve)*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by mining activities and associated infrastructure*	*Low (-ve)*	*Very Low (-ve)*
		Altered sense of place from increased traffic during operations	*Medium (-ve)*	*Low (-ve)*
		Altered sense of place and visual quality caused by light pollution at night	*Low (-ve)*	*Very Low (-ve)*
• *Haul roads; and* • *Regional roads*	*Traffic*	*Reduced traffic capacity on the haul roads*	*Low (-ve)*	*Very Low (-ve)*
		Reduced traffic capacity on the regional road network	*Insignificant*	*Insignificant*
		Compromised Road Surface Integrity of the Haul Roads	*High (-ve)*	*Low (-ve)*
		Compromised Road Surface Integrity of the Regional Road Network	*Very Low (-ve)*	*Very Low (-ve)*
DECOMMISSIONING PHASE IMPACTS				
• *Inland mining;* • *Haul roads; and* • *Infrastructure expansion area.*	*Soil and Land Capability*	*Soil compaction caused by decommissioning activities*	*Very Low (-ve)*	*Insignificant*
		Soil chemical pollution from operational activities	*Very Low (-ve)*	*Insignificant*
• *Inland mining;* • *Haul roads; and* • *MSP.*	*Air Quality*	*Impaired Human Health from Increased Pollutant Concentrations Associated with Decommissioning Activities*	*Low (-ve)*	*Very Low (-ve)*
		Increased Nuisance Dustfall Rates Associated with Decommissioning Activities	*Very Low (-ve)*	*Insignificant*
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Noise*	*Increased noise and vibration levels during decommissioning*	*Very Low (-ve)*	*Insignificant*

Activities	Aspect	Potential Impact	Significance Without Mitigation	Significance With Mitigation
• Beach mining; and • RO Plant.	Marine Ecology	Disturbance and/or mortality of marine life during decommissioning of beach access roads	Low (-ve)	Very Low (-ve)
		Disturbance and/or mortality of marine life during removal of brine discharge pipeline	Low (-ve)	Very Low (-ve)
		Mortality of marine fauna caused by decommissioning waste	High (-ve)	Medium (-ve)
		Increased turbidity in the water column during rehabilitation of beach access roads	Insignificant	Insignificant
		Increased turbidity in the water column during removal of brine discharge pipeline	Insignificant	Insignificant
• Haul roads	Freshwater Ecology	Destabilisation of watercourses caused by increased vehicle movements during decommissioning	Very Low (-ve)	Insignificant
• Inland mining; and • Infrastructure expansion area.	Hydrogeology	Groundwater contamination during decommissioning of the process water dams	Very Low (-ve)	Insignificant
		Groundwater contamination during decommissioning of the infrastructure / plant expansion area	Insignificant	Insignificant
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Terrestrial Ecology	Disturbance to terrestrial fauna during decommissioning	Very Low (-ve)	Insignificant
		Disturbance to avifauna during decommissioning	Very Low (-ve)	Insignificant
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Socio-economic	Investment in and contribution to the economy	Very Low (+ve)	Very Low (+ve)
		Increased employment, income and skills development	Very Low (+ve)	Very Low (+ve)
		Reduced access to the coast	Insignificant	Insignificant
		Possible decline of tourism	Insignificant	Insignificant
• Beach mining • Inland mining; • Haul roads; and • Infrastructure Expansion Area.	Heritage	None.		

Activities	***Aspect***	***Potential Impact***	***Significance Without Mitigation***	***Significance With Mitigation***
• *Beach mining* • *Inland mining;* • *Haul roads; and* • *Infrastructure Expansion Area.*	*Visual*	*Altered sense of place and visual intrusion caused by decommissioning and rehabilitation activities*	*Very Low (-ve)*	*Very Low (-ve)*
• *Haul roads*	*Traffic*	*None.*		

j) Other Information required by the competent Authority

i) Compliance with the provisions of sections 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 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 **Appendix 2.19.1** and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6.and 2.12.herein).*

Potential socio-economic impacts will be assessed by SRK specialists in the Impact Assessment Phase. High level socio-economic impacts and mitigation measures are included in Table 29.

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 that 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).*

A Heritage Impact Assessment will be undertaken in the Impact Assessment Phase.

k) Other matters required in terms of sections 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 if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as **Appendix 4)**.*

Section 2 of NEMA sets out a number of principles that are relevant to the:

- EIA process, e.g.:
  - Adopt a risk-averse and cautious approach;
  - Anticipate and prevent or minimise negative impacts;
  - Pursue integrated environmental management;
  - Involve stakeholders in the process; and
  - Consider the social, economic and environmental impacts of activities; and
- Project, e.g.:
  - Place people and their needs at the forefront of concern and serve their needs equitably;
  - Ensure development is sustainable, minimises disturbance of ecosystems and landscapes, pollution and waste, achieves responsible use of non-renewable resources and sustainable exploitation of renewable resources;
  - Assume responsibility for project impacts throughout its life cycle; and

- Polluter bears remediation costs. This EIA process complies with the principles set out in section 2 of NEMA through its adherence to the EIA Regulations, 2014, and associated guidelines, which set out clear requirements for, inter alia, impact assessment and stakeholder involvement, and through the assessment of impacts and identification of mitigation measures during the Impact Assessment Phase. Alternative will be considered in the Impact Assessment Phase (see Section 2 (h)(i)). The potential social and environmental impacts of the project will be identified, assessed and evaluated using SRK's standard impact assessment methodology (Section 2 (h)(vi)) to understand the significance of each positive and negative impact. An EMPr will be compiled to ensure that potential environmental impacts are prevented or minimised. Mitigation measures will be recommended in the Impact Assessment Phase to allow for unavoidable impacts on the environment and people's environmental rights to be minimised and remedied. Multiple opportunities for public participation are allowed for in the EIA process. The needs and interests of IAPs will be taken into account, with comments made by potentially affected property owners guiding the EIA process. All relevant information will be made available for public comment before submission to DMR, as part of the public participation process. Intergovernmental coordination for the purposes of this project will be facilitated by consultation with various government departments. Comments made by these departments will inform the decisions taken by DMR regarding Environmental Authorisation of the project.

l) UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I ____________________ herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected parties have been correctly recorded in the report.

____

Signature of the EAP

DATE:

m) UNDERTAKING REGARDING LEVEL OF AGREEMENT

I __________________ herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with interested and Affected Parties and stakeholders has been correctly recorded and reported herein.

____

Signature of the EAP

DATE:

-END

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