 

KAMIESBERG PROJECT, NAMAQUALAND, SOUTH AFRICA

FINAL ENVIRONMENTAL IMPACT ASSESSMENT

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Prepared for:	Prepared by:
ZIRCO RESOURCES (SA) (Pty) Ltd.	CES
Zirco Roode Heuwel (Pty) Ltd Brandwacht Manor House Ben du Toit Street Stellenbosch 7600	**Coastal & Environmental Services** GRAHAMSTOWN P.O. Box 934, Grahamstown, 6140

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Name	Responsibility	Signature	Date
Dr Chantel Bezuidenhout	Report Production		
Kim Brent	Report Production		
Dr Ted Avis	Reviewer		23 October 2014

EXECUTIVE SUMMARY

BACKGROUND TO THE STUDY

The Kamiesberg Project, the purpose of which is to exploit proven heavy mineral sand deposits, is situated 35 km to the southwest of the town of Garies in the Northern Cape Province of South Africa.

Zirco Roode Heuwel (Pty) Ltd holds the prospecting rights to the Roode Heuvel (6 314 ha) and Leeuvlei (6 005 ha) deposits, and are also in the process of acquiring prospecting rights for a further deposit immediately east of and adjacent to Roode Heuvel, referred to as "Sabies" (8 600 ha). This report deals with all three areas which combined form Zirco's Kamiesberg Project. Information regarding the deposits has been based on a drilling programme on the Roode Heuvel and Leeuvlei portions, as Zirco has not drilled the Sabies deposit yet. To date Zirco has completed 12 843 m of air core drilling and fully delineated the deposits on Roode Heuvel and Leeuvlei. Drilling was extended to the basement rock to fully define the depth of the deposit. Global total heavy mineral grades (THM) are in the order of 3%, with both deposits together projected to contain some 1 400 million tons of mineralised sand. These sands consist of surface aeolian sand (referred to as Red Aeolian Sands - RAS), and higher slimes, mineralised sand (referred to as Orange Feldspathic Sands – OFS). These make up the bulk of the deposit. Basal grits and conglomerates are locally developed immediately above the basement.

EOH Coastal & Environmental Services (EOH CES), a well-established specialist environmental consulting firm with offices in South Africa and Mozambique, were appointed by Zirco as the Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA).

LEGAL REQUIREMENTS

In accordance with the requirements of the National Environmental Management Act 107 of 1998 (NEMA), relevant EIA regulations made in terms of this Act and promulgated in August 2010 (Government Notice No 543), and listed activities (Government Notice No's 544, 545 and 546), the activities that will be undertaken during the construction and operation of the proposed project require a full Scoping and Environmental Impact Assessment (EIA).

The relevant competent authority is as stipulated in the Listing Notices, and is the provincial environmental authority unless the application is for an activity/ies contemplated in section 24C(2) of the Act. In this case the competent authority would be the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act. Based on the information provided (and subject to the ***MSP facility being located at the mine site***), the relevant competent authority for the Zirco environmental authorisation application is the ***Northern Cape Department of Environment and Nature Conservation***. This has been confirmed by the National Department of Environmental Affairs.

Additional licensing requirements may include, but not be limited to the following:

- **Northern Cape Provincial Heritage Resources Agency:** The resources of heritage, archaeological and/or paleontological significance (these include national and provincial heritage sites, protected areas, heritage areas, and archaeological and paleontological sites, including wrecks and meteorites) located on site that will be impacted upon by the proposed development, will require a permit for removal. This will need to be obtained from SAHRA (South African Heritage Resources Agency). Should any buildings/structures, graves, etc. be found during construction, with heritage value, a permit will need to be obtained from Ngwao Boswa Kapa Bokoni (Provincial Heritage Resources Authority of the Northern Cape Province). A heritage impact assessment has been done for the proposed site. The archaeologist will need to apply for a permit from SAHRA for mitigating archaeological sites. Mitigation and licensing is done prior to construction.

- **Department of Water Affairs:** The proposed pipeline and associated infrastructure will cross the Groen River and thus a water use licence will be required from the Department of Water Affairs. The water use authorisation in terms of the National Water Act (Act 36 of 1998) sections 21 (c) and (i) will be applied for. Section (c) is relevant to impeding or diverting the flow of water in a watercourse, while section (i) is relevant to altering the beds, banks, course or characteristics of a watercourse, in this case, the Groen River. The water use licenses will be submitted in parallel with the submission of this Final EIR. Additional water use licences will be required should there be any additional crossings of water resources, including: rivers, wetlands, drainage areas and estuaries.
- **Department of Agriculture Fisheries and Forestry:** There is a range of legislation that list species of special concern. These include but are not limited to The National Forestry Act, NEM: Biodiversity Act, and provincial ordinances. A number of species of special concern have been identified on site. Application to the DAFF or the Northern Cape Department of Environment and Nature Conservation for the relevant permits for their removal prior to construction and operation of the mine will be required.
- **Air Quality:** An Atmospheric Emissions Licence application was submitted to the Northern Cape Department of Environment and Nature Conservation on the 20th of August 2014. The application submission was acknowledged by the Northern Cape Department of Environment and Nature Conservation on the same day (Ref Number: NC/AEL/NDM/ZRH01/2014).
- **Department of Environmental Affairs:** The construction of the on-site landfill site may require a waste management licence if thresholds are above those listed in terms of the National Environmental Management: Waste Act 59 of 2008. The waste license (if required) will be applied for prior to the construction of the landfill site.
- **Department of Mineral Resources:** A Mining Right application has been submitted to the Department of Mineral Resources (DMR). Since acceptance of the application on 4 June 2014, a Scoping report has been compiled and submitted to DMR on 3 July 2014. The final EMPr is due to DMR on the 3rd of December 2014.
- **Land Use Planning Ordinance:** The proponent with the assistance of a town planner will have to apply for a LUPO application should a change in land use be required for the proposed project. In accordance with the Subdivision of Agricultural Land Act (Act 70 of 1970) this rezoning application must also be submitted to the Department of Agriculture. This application will be done once a mining right has been granted, and prior to construction.

THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The EIA process is divided into two main phases, which are the Scoping Phase and the Environmental Impact Assessment Phase. The overall aims of these phases are –

(a) ***Scoping*****:** To identify in broad terms the most important environmental issues and project alternatives that must be assessed in the subsequent EIA phase. Explicit provision is made in the Scoping Phase for the involvement of interested and affected parties (I&APs) in the EIA process.

(b) ***Environmental Impact Assessment*****:** To undertake a comprehensive study of the natural and social environment that may be impacted by the proposed development. During the EIA Phase the significance of these impacts is assessed, and

recommendations made on how negative impacts may be mitigated and benefits enhanced.

A detailed description of the scoping phase for the proposed Kamiesberg Project and the outcomes thereof are included in **Volume 1: “Coastal & Environmental Services, January 2014: *Final Environmental Scoping Report: Proposed Kamiesberg Project, Namaqualand, South Africa*”.**

Following review of the FSR, DENC issued their approval of the FSR and Plan of Study (PoS) for EIA and instructed the EAP to proceed with the EIA Process as contemplated in the PoS on the 3rd of April 2014.

This EIR phase includes the following steps -

1. **Specialist Studies,** which include the specialist assessments identified in the Scoping Report and any additional studies required by the authorities. This required the appointment of specialists to gather baseline information in their fields of expertise, to assess the impacts and make recommendations to mitigate negative impacts and optimise benefits.
2. **Environmental Impact Assessment Report**. The main purpose of this report, the EIR, is to gather and evaluate environmental information, so as to provide sufficient supporting arguments to evaluate overall impacts, consider mitigation measures and alternative options, and make a value judgement in choosing the best development alternative.
3. **Comments Report,** which compiles comments, issues and concerns raised by I&APs during the EIR review period and the authorities and the relevant responses to these comments.
4. **Environmental Management Programme,** which informs the client and the technical team of the guidelines which will need to be followed during construction and operation to ensure that there are no lasting or cumulative negative impacts of these processes on the environment.

PROJECT DESCRIPTION

Zirco currently holds the prospecting right to the Roode Heuvel and Leeuvlei deposits, located approximately 500 km north of Cape Town in the Northern Cape Province of South Africa. They are also in the process of acquiring prospecting rights for a further deposit immediately east of and adjacent to Roode Heuvel, referred to as “Sabies”.

In addition to the mining and associated infrastructure (mineral separation plant, primary concentrator plant, tailings dam, offices, workshops and stores, for example.), the project will also require the construction of various ancillary infrastructure such as, but not limited to, the following:

- Seawater intake, desalination plant, pumping station and pipeline
- Waste water treatment works
- Product transfer stations
- Airstrip
- Upgrade of the provincial road to and junction with the N7 road
- Fuel Depot
- Construction and operation accommodation

DESCRIPTION OF AFFECTED AREA

Topography

The project area is characterised by flat to moderately flat relief with a general east-southeast slope toward the Atlantic Ocean. The highest and lowest points in the project area are at 275 masl and 25 masl respectively. The western region borders the start of low hills and the eastern region coastal plains. The northern region borders the Bitter River and the Groen River forms the southern border of the mining area.

Geology and Soils

The underlying geology consists of quaternary unconsolidated to cemented sand overlaying Kamieskroon leucocratic gneisses (Zirco, 2012).

The surface aeolian sand varies in thickness over the project area from a few centimetres up to 25 m. Dune systems are predominantly orientated NNE to SSW due to prevailing wind conditions (Zirco, 2012). The surface sands are part of a typical silicic soil structure, the distribution of which is associated exclusively with arid landscapes (Fey, 2010).

Air Quality

The main activities in the vicinity of the Kamiesberg Project site is sheep farming and with associated residences. This land-use contributes to baseline emission sources via vehicle particulate entrainment on unpaved and paved roads and vehicle tailpipe emissions. Due to the low population density (0.9 people/km^2), these are not likely to be significant emission sources. Wind erosion of sparsely vegetated surfaces is likely to be an additional source of fugitive[1] particulate emissions.

Noise

The current ambient noise for the proposed study area is within the guideline limits for rural areas. It was noted during the field survey that there was very little traffic on the DR2938 during the measurement periods.

Radiation

It is expected that the contribution of the Kamiesberg Project to a total effective dose to members of the public will be below the dose constraint of 250 µSv per annum, which is well below the dose limit of 1,000 µSv per annum. Given that the Kamiesberg Project will be the only operating mine in the area, the dose limit in all likelihood will apply.

The regulatory framework defines criteria for the radiation protection of workers, which generally allows much higher level of radiation exposure than to members of the public. It was concluded that the mining area would in all likelihood be classified as an uncontrolled area, while the processing plant will be a supervised area.

Groundwater Resources

According to local landowners, groundwater use is almost exclusively for livestock watering, with minor use for domestic purposes such as washing and cleaning. The high salinity of the groundwater makes it unsuitable for human consumption, and all drinking water is obtained from rainwater harvesting from the roofs of the farmsteads. All existing boreholes in the area were equipped with wind pumps, which pump water to storage dams. From the dams, water is generally distributed to livestock watering points by gravity flow.

Surface Water Resources

More recent studies by Schlumberger Water Services (SWS 2015) have provided a more

[1] Emissions that are not discharged to the atmosphere in a confined flow stream.

detailed characterisation of the Groen River estuary and its relationship to other surface and groundwater resources in the area. The studies showed that the spring identified by CSIR (Heydorn & Grindley, 1981a), which is located at the lower limit of a natural wetland in the river channel, approximately 1 km (shown as 2.5km upstream by the CSIR study) upstream of the head of the estuarine lagoon (see Plate 4.2), can reasonably be supposed to be the only source of perennial discharge into the lagoon. In February 2014 the flow rate from the spring was estimated to be 1 litre per second.

The possibility that groundwater beneath the proposed mine site could contribute to the discharge from the spring was investigated by the use of hydrochemical ‘fingerprinting’, which is a comparison of high-resolution hydrochemical data for three boreholes in the mining area and equivalent data for the spring discharge. Data for all waters was compared statistically, and using conventional hydrochemical ‘typing’ plots. The results of the comparisons were:

- The TDS level of the estuarine spring water (approximately 8 000 mg/l) is markedly higher than all the groundwaters of the mining area (a range of between 3 300 and 7 300 mg/l)
- While all waters are NaCl dominated, a clear distinction exists with regard to the remaining major ion balance of the groundwater suite and spring water. This is particularly pronounced with respect to the contributions of Ca+, Mg and SO_4 to the ion balance. In all instances, levels of Ca and Mg in the Kamiesberg groundwaters range up to approximately 150 and 200 mg/l respectively, while in the spring water the concentrations of these cations are 594 and 423 mg/l respectively. In the case of SO_4, enrichment by a factor of 2 to 3 is evident in the spring water relative to the groundwater suite.
- Relative enrichment of Sr is evident in the spring at the head of the estuary at a magnitude analogous to that described above for SO_4.
- Groundwater samples of the Kamiesberg district are routinely high in fluoride (F). Despite the conservative nature of F in solution, there is no evidence of fluoride enrichment in the spring water. This provides strong evidence of a lack of direct hydraulic inter-connection.

Key distinctions between the groundwater data and that of the spring strongly support the conclusion that a direct hydrogeological connection between them is highly unlikely.

In addition to this the possibility of subsurface flow was investigated by SWS by conducting a survey of the Groen River bed to identify any springs, seeps, sumps or any other features which may indicate that sub-surface flow occurs along the channel. Seven locations - referred to as ‘sumps’ – were identified over a distance of about 17km along the channel in which standing water was identifiable, or at which some evidence of the recent presence of water was inferred. Electrical conductivity levels in these sumps were higher by up to a factor of two than those recorded in water sampled from boreholes in the immediate vicinity of the river, indicating significant evapo-concentration in the sumps. It was concluded from these observations that subsurface flow along the channel bed is negligible, and also that there is negligible discharge, as base flow or interflow, of groundwater to into the river bed.

Based on the above information, it is clear that there is no hydrological connectivity between the mine site and the estuary downstream. Thus it is highly unlikely that the estuary will be impacted upon by mining activities.

Estuarine Habitat

This Estuarine Assessment assessed the present ecological state of the Groen Estuary based on macrophytes, invertebrates and birds. In February 2015 the estuary could be divided into a lower hypersaline lagoonal area with abiotic characteristics very different to the narrow and shallow (<50 cm deep) channel in the middle and upper reaches. A salinity of 223 ppt was recorded in the lower reaches which dropped to 70 ppt at approximately 0.7 km upstream from the mouth of the estuary. Reeds were abundant in the upper reaches indicating brackish conditions as they grow best at salinity less than 20 ppt. Freshwater springs at the head of the estuary are an important source of water to the estuary and at the time of the visit in February 2015, spring water recorded a salinity of around 10 ppt.

The dominant habitat at the Groen Estuary was supratidal salt marsh with the dominant species *Sarcocornia pillansii* that covered 8 ha. Intertidal salt marsh represented by *Sarcocornia natalensis* and *Salicornia meyeriana* occurred along the banks of the estuary mostly along the lower reaches of the northern bank. Terrestrial species including *Lampranthus* sp., *Lycium strandveldense* and *Mesembryanthemum guerichianum* were present in the ecotone between the suptratidal zone and terrestrial habitat. The reed and sedge habitat, represented by common reed (*Phragmites australis*), fringed the steeper channel in the upper reaches of the estuary. Filamentous macroalgae with the dominant species *Rhizoclonium riparium* are an important feature of the estuary. The filamentous cyanobacteria *Lyngbya* sp. was abundant in the estuary forming dense floating mats. Windblown algal mats were observed on the surrounding vegetation. This can increase salt load causing die-back but it is also a source of organic material to the surrounding supratidal salt marsh area. Salt pans were present in the middle and upper reaches of the estuary. These waterlogged areas were devoid of vegetation. Much of the vegetation surrounding the estuary was dead at the time of sampling in February 2015.

The only zooplankton found were insect larvae collected in the upper reaches at a salinity of 26 ppt. These larvae were associated with the floating algal mats. Extremely high salinity and anoxic sediment in the lower estuary excluded macroinvertebrates and mesozooplankton, while anoxic sediment in the channel area of the estuary (where salinity was lower) became the main limiting factor impacting the biota. Overall conditions were too stressful for invertebrates to thrive.

Most birds feeding in the estuary were either on the expansive sandflat in the lagoonal area of the lower reaches or present on or around the algal carpets floating on the water surface in the upper estuary. There were 15 different bird species and the total number of individuals was 109. Approximately one-third of the bird numbers were utilizing the estuary as a roosting area and not for feeding purposes. Long-billed benthic feeders and piscivores were not recorded on the estuary.

The absence of benthic macroinvertebrates, mesozooplankton, fish and low bird counts (mainly short-billed waders) support the conclusion that the Groen Estuary was a stressed ecosystem in February 2015. Main stressors were extreme hypersalinity, relatively low water volume, anoxic sediments and a mouth that had remained closed for a relatively long period of time (years).

Marine Environment

The study site is subject to semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. The tidal variation in the vicinity of Groenriviersmond usually ranges between 0.28 m (relative to the chart datum) at mean low water springs to 1.91m at mean high water springs; with the highest and lowest astronomical tide being 2.25m and 0.056m respectively.

Another factor which greatly influences marine ecology and human activities along the coastline is wave energy. The west coast of South Africa typically experiences high wave energy and is dominated by south-westerly swells with a long fetch and a period of 10-15+ seconds (Branch and Griffiths 1988).

The marine ecology in close proximity to the proposed study area includes the following:

Sandy Beaches: Sandy beaches are important for the filtering and decomposition of organic matter in sea water. As water percolates down through the sand the organic particles are trapped and decomposed by bacteria, which in turn release nitrates and phosphates that are returned to the sea. Continual flow of water through the sand maintains oxygen levels and aids bacterial decomposition, and thus sandy beaches act as water purifiers (Branch 1981).
Rocky Reefs and Kelp Forests: Kelp washed ashore forms an important food source for scavengers and provides shelter for numerous isopods (sea lice), which are in turn preyed upon by birds. Filter feeders such as mussels, red bait and sea cucumbers comprise 70-90% of the faunal community on rocky shores and their principal food source is kelp (Branch et al. 2010). Kelp thus forms an integral part of the rocky shore and sandy beach ecosystems. Kelp also produces large quantities of mucus, which encourages bacterial growth upon which protozoa feed.

Rocky Shore: The diversity of intertidal macroalgal species is relatively low in the region (Bustamante et al. 1997). Filter feeders such as mussels and the Cape reef worm comprise ~70% of the faunal community on rocky shores and their principal food source is kelp particulates together with various microorganisms, kelp spores, phytoplankton and other fragments of organic matter (du Toit & Attwood 2008).

Flora

Five (5) key vegetation types occur on the Zirco prospecting areas, namely:

1. Strandveld (Namaqualand Strandveld)
2. Sand Fynbos (Namaqualand Sand Fynbos)
3. Heuweltjieveld (Namaqualand Heuweltjieveld)
4. Riparian vegetation (Namaqualand Riviere)
5. Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)

Strandveld (9544 ha) is the dominant vegetation unit in the study area and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas. It is also found scattered throughout Sabies, and extends into Leeuvlei. Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld (181 ha) occurs along the southern section of Roode Heuvel. The cause of degradation is overgrazing, resulting from water points and livestock pens (kraals) which occur along the road, and incidentally along the Groen River.

Relatively few **Species of Conservation Concern (SCC)** are known to occur in true Strandveld, but nevertheless six SCC were recorded in this unit (24% of those in the total study area).

- *Leucoptera nodosa* is Red Listed as Vulnerable (Helme & Raimondo 2006). This is a succulent shrub in the daisy family, previously known from only five definite localities in the Strandveld between Hondeklipbaai and Lamberts Bay. The species was recorded at three new localities within the study area, and at various other new localities within the Namaqua National Park during the August 2014 survey. The species seems to usually occur as scattered individual plants, although one of the localities (Leeuvlei area) supported what is to date the largest known population of the species (about 150 plants).

- *Arctotis* sp nov.1 is an undescribed perennial daisy known only from this unit, and although widespread (Brand se Baai to Hondeklipbaai) it may be threatened by mining (pers. obs.). As it is yet to be described the species has not been assessed for the Red List.
- *Calobota lotononoides* (Near Threatened; Helme et al. 2008) is common in this habitat, often on the ecotone with Sand Fynbos.
- *Helichrysum tricostatum* (Near Threatened) is also fairly common in this habitat, but is a very widespread species (Saldanha to Orange River).
- *Hermannia* sp nov. is common in this unit, but has not yet been assessed. The species is common in the region from Brand se Baai to Hondeklipbaai.
- *Wahlenbergia asparagoides* (Vulnerable) is most common in Sand Fynbos, but may also occur in this unit.

Sand Fynbos (6072 ha) is the second largest vegetation unit in the area. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei. Sand Fynbos occurs on slightly undulating plains and is often dominated by restios (typically *Thamnochortus bachmanii* and *Restio macer*) in the dune slacks (troughs), and asteraceous fynbos or restios (*Willdenowia incurvata*) on the dune ridges. The vegetation on the dune ridges often includes Strandveld elements.

This habitat unit is known to support at least **15 SCC**, and is the richest vegetation type in the study area in terms of number of threatened plant species. This is a highly significant number of SCC for a single vegetation unit, being 60% of all SCC recorded in the total study area. Only the most significant are outlined below.

The unit includes a number of undescribed or only recently described species, which is indicative of how poorly known the unit is, or at least was until recently.

- *Elegia* sp nov is a striking, undescribed restio that is only known from the northern Sandveld. Originally (in 2009) recorded close to Kotzesrus, it was found to be fairly common on site (the second known locality) only on the northern edge of Roode Heuvel. The August 2014 fieldwork showed that it also occurs in about a 20 ha patch of the adjacent Namaqua National Park, and again in a small area north of the Bitter River, where new cultivation had already resulted in loss of about half this population.
- *Lachenalia* sp nov is a bulb that was first discovered in September 2012 close to Koekenaap, and was then found to be fairly common in the study area, where the Type collection was made, and the species will be described in 2014 (as *L. arenicola* MS). The August 2014 fieldwork revealed this species to be present but never common as far north as Riethuis (giving it a total known range of about 170 km), and is fairly well represented within the Namaqua National Park.
- *Lampranthus procumbens* is a creeping vygie that was described in 2009, and is known from Kommagas south to Kotzesrus, and the species is common on site only in the northern areas of Roode Heuvel. It was found to be common in the adjacent parts of the Namaqua National Park, but was rare elsewhere in the Park.
- *Agathosma elata* is a buchu that was previously only known from near Vanrhynsdorp and Klawer, some 150 km to the southeast, and its discovery here was thus a major surprise. The species is Red Listed as Endangered, and the population in the study area is small. In August 2014 the species was found at various other localities as far north as Riethuis (40km NW of the site), including 3 within the Namaqua National Park, but it is never common, and the total population is small (estimated at <500 plants).
- *Caesia sabulosa* is a common geophyte in Sandveld, but was also only recently described, and is here at or close to its northernmost distribution.

Fallow cereal (oats, rye and wheat) fields (308 ha) occur scattered throughout large sections of the Sand Fynbos communities, especially in the north western sections of Roode Heuvel. The Pilot mine (5 ha) is located on Roode Heuvel on the ecotone between Sand Fynbos and Strandveld. These disturbed areas support a limited number of widespread, pioneer species, and generally do not support any SCC. However, a population of *Wahlenbergia asparagoides* (Vulnerable) was observed in the rehabilitated portion of the pilot mine, suggesting that this shrubby species is tolerant of disturbance, and is perhaps a pioneer species. Similar observations from Namakwa Sands support this idea, but it does seem to be the only SCC readily able to colonise the mined areas. Alien invasive species are rare, even in these disturbed areas.

Rehabilitation potential of these old fields is fairly good, as they are generally narrow strips surrounded by extensive areas of natural vegetation which could act as a seed source. Rehabilitation success would be significantly better in the absence of livestock grazing, as heavy grazing of recovering veld promotes the abundance and dominance of unpalatable species such as *Galenia africana* (kraalbos).
Heuweltjieveld (3798 ha) may be found all along the eastern extent of Leeuvlei, and a large part of north eastern Sabies. It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld (252 ha) occurs in the south eastern sections of Sabies adjacent to alluvial corridors, and is dominated by the unpalatable shrub *Galenia africana* (kraalbos). This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals.

This unit is relatively poorly researched, but at least six ***SCC were recorded here, two of which are undescribed species discovered for the first time*.** The conservation value of the poorly known quartz patches within this unit (the habitat of 4 of the 6 SCC) is thus Very High.

Both the new species were discovered on an isolated quartz patch in the Leeuvlei area, near the Outeep River, and both are vygies. The two new species are a species of *Jacobsenia* and a species of *Cheiridopsis*. Both species are being sequenced and described by Dr C. Klak of the Bolus Herbarium. Both seem to be restricted to this isolated quartz patch, which is less than 5 ha in extent, and other suitable looking quartz patches in the region (not all within the study area) were surveyed for these species, with no success. This pattern of extreme endemism is not uncommon amongst quartz patch specialists in the region.

Othonna lepidocaulis is a rare, perennial, tuberous daisy known previously only from the Knersvlakte, some 150 km to the south, and its occurrence here, on the same quartz patch, is both very interesting and highly significant. *Aloe krapohliana* is a dwarf aloe that was also observed primarily in the vicinity of this quartz patch, and the species is Red Listed as Data Deficient and, according to the available data, should be listed as Threatened (von Staden 2008).

Riparian (564 ha) areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also includes tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins. The vegetation varies from *Acacia* thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species.

No SCC were recorded in this unit, and no such species are likely to occur here in significant numbers.

Klipkop Shrubland (251 ha) vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies. These serve as important sites for local reptile populations.

No SCC are likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively, and it is known to support many SCC in nearby areas.

It is important to note that due to the botanical sensitivity of the site, a number of ecological corridors have been proposed, these corridors incorporate the following:

- 54% of the northern sand fynbos
- 100% of the Outeep Quartz
- 91% Klipkop Shrubland
- The Bitter River
- The Groen River (with the exception of the area where the pipeline and servitude crosses the Groen River)
- Small drainage lines in the eastern section of Leeuvlei and Sabies
- The Outeep River (tributary of the Bitter River)
- 100% Soutfontein Calcrete
- 100% of the main population of Leucoptera nodosa

Fauna
Few amphibians occur in the project area, with a maximum of seven species likely, and only three recorded. None are endemic or of conservation concern. The most sensitive habitat for amphibians are perennial pools of water in the Groen River valley, which are essential for two of the three species.

Reptile diversity in the region is much greater, with 18 species known in the region and probably another 20 species also occurring. Only one threatened sea turtle (the Leatherback Turtle, *Dermochelys coricaea*; Regional En, Globally CE) is recorded from coastal waters, but the coastal section of the project area is not suitable for either nesting or feeding for the turtle. Ten reptiles are CITES listed although no commercial exploitation of all of these species occurs in South Africa.

The Karoo supports a particularly high diversity of bird species endemic to southern Africa. Its avifauna characteristically comprises ground-dwelling species of open habitats. Eighty Three (83) were observed during the dry season survey and 92 were observed during the wet season survey, together accounting for 112 of the 246 possible species. Fourteen (14) bird SCC were recorded on site. Three bird species (Southern Black Korhaan, Cape Long-billed Lark and Cape Bulbul) are endemic South African species, all of which were recorded during the site visit. The most significant avian SCC recorded on site includes the Ludwig's Bustard (En), Secretary bird (Vu) and Black Harrier (Vu).

In the Succulent Karoo, large mammals are not generally common, with the majority of mammals present being small to medium-sized. Sixteen (16) mammals were observed during the dry season survey, and 16 were observed during the wet season, accounting for 21 species. These were all small mammals such as rodents and small carnivores, with the exception of Steenbok, Springbok, Grey Duiker, and Bat-eared Fox as well as a Cape Fur Seal which was observed along the coast. The project area is highly relevant in terms of the golden moles. Coastal Duneveld and sandy Strandveld areas are important habitats for the three golden mole species which may occur in the project area: Cape Golden Mole (*Chrysochloris asiatica*), Van Zyl's Golden Mole (*Cryptochloris zyli:* EN), and Grant's Golden

Mole (*Eremitalpa granti*). In addition, the Namaqua Dune Molerat (Near Threatened) also inhabits areas of coastal sand dunes, and consolidated alluvial soils with mean annual rainfall less than 400 mm. Evidence of mole-rat and golden mole were recorded.

Socio-Economic Profile

The proposed mining site is not in close proximity to any community. The Kamiesberg Local Municipality consists of four wards. The 16 towns of these wards (including the largest town of Garies in Ward 2) are considered to be the proposed mine's labour-sending communities. In addition, two towns on the northern border of the Western Cape Province, namely Molsvlei and Stofkraal, are also considered, as most of the affected farmers employ farm labour from these two communities.

The proposed mining deposits and pipeline servitude are comprised of seven private landholdings which are currently farmed and subdivided into 15 separate farm portions. Few are the lessees of the land. Most of the farms affected by the project range from 4.5 ha to 6,420 ha in size, with a mean of 1,196ha. Many of these farms have been in family holdings since the early or middle 1900s, and therefore feel a strong social connection to the land from a heritage perspective.

The farms are sparsely populated. On some farms, one or two residential buildings have been observed. Many farmers do not live on these farms, whilst few farm labourers are employed (some on a casual basis). Most workers are sourced from Stofkraal and Molsvlei to the south of the project area. Most farm workers are accommodated on the farms (normally between one and five workers), whereas some return to their homes on a daily basis. The table below summarises the key socio-economic factors.

Variable	Dominant Finding
Land-Use and household dynamics	➢ The area is largely comprised of residential-based households; ➢ About 96% of all households live in a formal dwelling; ➢ The area has approximately 3,141 households; ➢ The average household size is around 3.2 members; and ➢ Around 40% of households are female-headed.
Educational Status	➢ Each of the possible labour-sending wards has one primary school (Gr1-7), with high school located in Garies and Kharkams; ➢ The largest section of the population have some secondary schooling; ➢ A small percentage of the population does not have any schooling (5.02%); ➢ Around 68% of children (roughly in the age-bracket of 5 to 24) attend school; ➢ The high schools have a problem with a high drop-out rates (often related to teenage pregnancies and drug- and alcohol-abuse); and ➢ Few children are sent to Further Educational Training (FET) facilities, such as colleges or universities.
Water	➢ The bulk of the households in each ward have access to piped water services; ➢ The project area is drained by the Bitter and Outeep rivers to the north of the Leeuvlei prospecting area these rivers are ephemeral, meaning that they only flow temporarily after heavy rainfall; and ➢ Most farmers have boreholes.
Sanitation and Waste Disposal	➢ Around 67% of households in the district have a flush toilet that is connected to a sewage system; and ➢ Many community members complained about poor sanitation services.
Energy	➢ Around 39% of households have access to electricity; and ➢ Most affected farms have their own solar and wind power generators and are supplied with government electricity.
Transport	➢ Few households own cars; and ➢ Some use local taxis or lift clubs.
Culture, recreation and social ailments	➢ The predominant religion in the area is the Christian faith; ➢ A patriarchal system exists amongst the households (based on the authority of male heads of households); ➢ The communities have few cultural or recreational activities especially for the youth;

Variable	Dominant Finding
	➢ Drug- and alcohol-abuse is said to be one of the most serious challenges in the area; and ➢ Alcohol-abuse is said to be tied to household violence (particularly women abuse) and is said to aggravate this.

Health
Access to the Healthcare facilities is a challenge for the communities in the proposed project area as many reside more than 20 km from a health service point and have to rely on public or private transport to access care. In the area surrounding the proposed project footprint healthcare provision is mainly in the form of mobile clinics which visit the communities once in two weeks. Emergency services are limited, especially after clinic operating hours (4 pm). Services are free, substantiated by more than 90% of respondents claiming not to pay for medical services. Some respondents claimed to have to pay for the state ambulance. The communities have a relatively high dependency ratio due to the high levels of poverty and unemployment.

Cultural Heritage
The baseline heritage assessment has captured a good record of the archaeological heritage present in the Roode Heuvel and Leeuvlei application areas. Sites of particular importance include rare wind deflated sites with stone implements, decorated pottery, marine shellfish and ostrich eggshell, all attributes of domestic campsites. If prospecting rights are approved, the area known as Sabies will be assessed for archaeological heritage ahead of any mining or development activity.

KEY FINDINGS OF THE SPECIALIST STUDIES

Surface and Groundwater Assessment
Six potential impacts were identified to have a significant impact on the surface and groundwater resources of the proposed site and its surrounds. These impacts include activities associated with the tailings storage facility and backfill; groundwater abstraction from Groenrivier and infrastructure constructed to cross rivers, including pollution by direct contact with contaminants. The majority of the potential impact significance can be reduced to low negative after mitigation measures are implemented.

Soils and Agricultural Assessment
The two major impacts identified during the construction phase are soil disturbance and the resultant decrease in soil capability; and increased erosion potential due to wind ablation. The predicted impacts are rated as low and medium significance respectively if all mitigation measures are adhered to.

Faunal Assessment
Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics due to storm water flow. However, most frogs in the region are widespread and have rapid colonizing abilities. The reptile fauna comprises some species relatively tolerant of agricultural development. All reptile and amphibian species are well protected elsewhere (e.g. Namaqua National Park) and need no further special treatment.

Many of the bird species are tolerant of low to medium disturbance. The remaining mammal diversity in the region consists of small mammals. With the exception of introduced rodents and bats, most mammals in the region are poor colonizers and require protected habitats to maintain viable population levels. Due to disturbance resulting from habitat loss there will also be an increase in animal mortality as animals move away from the region.

No fatal flaws were identified. The proposed mitigation measures for this project effectively reduce high and moderate impacts to that of moderate and low significance.

Vegetation Assessment

Impacts associated with current land use activities on vegetation loss ranges from moderate to low for the various vegetation types. ll vegetation loss and biodiversity impacts associated with the proposed mining activity is reduced to low or very low significance with the exception of the loss of Naqualand Strandveld and Sand Fynbos. The impacts on these vegetation types may be reduced to medium-high with mitigation. The implementation of a biodiversity offset area may further reduce the impacts to low. Vegetation fragmentation is also reduced to medium-high significance.

Estuarine Assessment

The Groen Estuary is a unique system nationally. It is hypersaline in the lower reaches, but salinity decreases in the middle-upper reaches. This part of the estuary maintains a functional role that persists during the dry season, unlike the expansive lagoonal part of the system that becomes hypersaline. This is made possible because of freshwater seepage from a spring at the head. Although the area of open water surface fluctuates, it remains an important perennial water body along a very arid coastline, where the next estuary (the Orange), is 267 km further north.

The Groen Estuary is one of the most variable estuaries in South Africa in terms of its physico-chemical attributes. Consequently, a once-off field survey would only reflect prevailing conditions at that time (February – summer dry season) and would not capture seasonal or longer term shifts (between years) along a physico-chemical continuum. Extreme states are represented by an open mouth following a flood (low salinity) and extreme hypersaline conditions following a long period (years) of mouth closure. Field surveys in February 2015 were undertaken at the end of summer when extreme hypersaline conditions prevailed in the lower reaches.

The conservation value of the salt marsh vegetation at the Groen Estuary lies in the fact that halophytes are the only plants adapted to grow in these harsh environments, and the loss of this vegetation would lead to the formation of bare, dry salt pans that are more easily eroded by wind and water. Conservation of the Groen Estuary is essential to maintain connectivity for water birds and other coastal biota. It is recommended that SANParks develop an estuary management plan for the Groen Estuary. This is a requirement of the Integrated Coastal Management Act (Act 24 of 2008). Monitoring of the estuary should be initiated as soon as possible. The management plan should also incorporate ways of enhancing spring water supply should this supply be reducing because of direct anthropogenic activities.

Marine Assessment

All construction impacts relating to loss of biota, barotrauma of marine fauna, impared water quality and effects of construction litter is predicted to be of low significance with the appropriate mitigation measures in place. Other than the loss of biota, the same impacts and significance is predicted for the decommissioning phase.

Operational phase impacts include the entrainment and impingement of organisms. This impact is predicted to be of low significance with appropriate mitigation in place.

Visual Impact Assessment

The three impacts identified were: (1) the impact of introducing mine infrastructure into a rural and undeveloped landscape, (2) visual impacts due to mine construction, and (3) mine construction and operation in light of the Department of Environmental Affairs‟ Strategy on Buffer Zones for National Parks". Mitigation measures have been suggested which will reduce the significance of both impacts (1) and (2) to low significance. Assignment of an impact rating to impact (3) is not relevant, but it has been highlighted that it will be necessary to liaise closely with representatives from SANParks to ensure a mutually beneficial outcome.

Socio-Economic Impact Assessment
The general conclusion is that the proposed mining activity could ultimately uplift communities, which are in need of employment, skills transfer and learnership opportunities. Through the mine's Social and Labour Plan (SLP), the Kamiesberg LM would be supported with LED projects and possibly basic social service provision. With regard to the affected farm-owners, further discussion and engagements are needed to resolve further land acquisition issues, especially if one or more farmers desire to remain living on their land. Many impacts can be sustainably mitigated and managed through proper stakeholder engagement and the involvement of farm-owners from the inception of the project.

Economic Assessment
According to the Economic Assessment, it is considered most likely that the proposed project would achieve an overall positive impact provided the financial projections of the applicant prove reasonably accurate, and provided adequate mitigation measures are instituted, including rigorous rehabilitation. It would present a significant opportunity for increased economic activity and associated job creation in the local area and region.

The achievement of a net benefit at a local and sub-regional scale would be particularly dependent on extensive mitigation as the key societal risks of the project would be felt at these spatial scales. Significant attention will need to be paid to mitigating air quality, visual, noise, water, social and botanical impacts as these have the potential to result in highly significant economic impacts on tourism, surrounding land owners and on the provision of ecosystem services in general. An appropriate biodiversity offset which is integrated into the Namaqua National Park also has the potential to reduce impacts on ecosystem services, including tourism.

Heritage Assessment
The results of the study indicate that the proposed activity (i. e. mining of mineral sands) and associated infrastructure (mineral separation and primary concentrator plant, tailings dam, airstrip, offices, workshops and stores, for example), will not have an impact of great significance on the archaeological heritage, as these are expected to be limited.

In archaeological terms, no fatal flaws have been identified and any sites that cannot be avoided could be easily mitigated if required. Mitigation also provides opportunities for better understanding pre-colonial land use patterns in this region of Namaqualand.

Health Assessment
In total, 9 potential impacts on the health status of the local community were identified that may be caused by the proposed project. With mitigation measures in place these impacts were reduced to low and moderate significance from potential moderate to very high significance.

Waste Assessment
A total of 13 impacts were identified and of these, with mitigation, 11 were considered to be of low negative significance and one of moderate negative significance. One impact was considered beneficial and of moderate significance with mitigation. However, due to the potential long-term nature of waste-related impacts, it is essential that the developer adhere to national legislative requirements and international best practice with regards the management of all waste streams.

Air Quality Assessment
The pollutants of concern as a result of these activities were: airborne particulates (including total suspended particulates (TSP), particulate matter of less than 10 µm in diameter (PM10) and particulate matter of less than 2.5 µm in diameter (PM2.5)) and gaseous emissions from the dryers (i.e. sulfur dioxide (SO_2), nitrogen dioxide (NO_2)).

The atmospheric dispersion modeling simulations show that the emissions from the proposed mining operations and processing plant are likely to result in air quality in compliance with NAAQS for PM2.5, SO_2 or NO_2 in the short-term.

Exceedances of the daily PM10 NAAQS were simulated to be localized near the unpaved district road; however a watering programme will be effective in minimizing the area of impact.

Dustfall rates are likely to exceed the National Dustfall Regulation standard for residential areas outside of the Prospecting Right boundary, even if emissions were mitigated through a watering programme, mainly as a result of vehicle entrainment. Further mitigation through paving the road surfaces is recommended.

Traffic and Transport Assessment
Nine potential impacts where identified by the Traffic and Transport Assessment. Two impacts (one for construction and one for operation) were rated as High without mitigation, and one (operation) was rated Very High without mitigation. With diligent and sustained implementation of mitigation measures all identified impacts can be reduced to Moderate or Low.

Radiation Assessment
The purpose of the radiation specialist report was to present a preliminary qualitative radiation impact assessment as input into the ESIA process for the Kamiesberg Project.
In general, the way in which members of the public may be exposed to radioactivity from a specific operation, facility or activity, is evaluated through the development of site-specific public exposure conditions. Since the proposed project is still in early stages of planning, very little site-specific information is available that can be used as basis to define exposure conditions and assess the radiation safety. The scope of the assessment is therefore limited to a qualitative description of situations that could lead to public exposure conditions, in order to highlight those aspects that should be included in a comprehensive site-specific radiological public safety assessment. Consequently, unlike the other specialist studies, this specialist report does not include a detailed assessment, based on a standardised impact assessment methodology, of the specific radiation-related impacts potentially associated with the project radiation. Similarly, the identification and description of specific mitigation measures is also considered premature at this early stage. A comprehensive baseline radiation study and mitigation measures will, however, need to be included in the Authorisation Change Request (ACR) submission to the National Nuclear Regulator (NNR). Approval of this ACR will be required before operation of the mine or processing facility.

Based on the description of the development, the proposed mining and mineral processing operations will have the potential to alter the radiation background. Although specific information required for the characterisation of the sources or pathways (source-pathway-receptor analysis) is not yet available, one can assume that and water airborne radionuclides will be released from the operational facilities of the Kamiesberg Project into the environment through the atmospheric and groundwater pathway. Depending on the radioactivity concentrations of the material released, as well as the nearby human behavioural conditions, one can expect a radiological impact to members of the public. Although the focus of the study is the impact on humans, there is sufficient demonstrated evidence, which shows that by protecting humans against exposure to ionising radiation according to dose limits, non-human species are also provided adequate protection.

The impact through the atmospheric pathway is expected to be highest close to the facilities and generally decreases to insignificant levels at distances of 5 to 10 km from the site. The radiological impact through the groundwater pathway tends to be limited, mainly due to slow leaching and subsequent groundwater flow rates to receptor points. The potential radiological impact through the groundwater pathway tends to be visible during the post-closure period (hundreds of years after closure). It is expected that the contribution of the Kamiesberg Project to a total effective dose to members of the public will be below the dose constraint of 250 µSv per annum, which is well below the dose limit of 1,000 µSv per annum. Given that the Kamiesberg Project will be the only operating mine in the area, the dose limit in all likelihood will apply.

The regulatory framework defines criteria for the radiation protection of workers, which generally allows much higher level of radiation exposure than to members of the public. Within these criteria, workers are protected based on the activity that will be performed within specific work areas, and the associated total effective dose expected for that area. This allows for the classification of work areas into uncontrolled, supervised, controlled or restricted. Specific radiation control measures apply for each area classification. It was concluded that the mining area would in all likelihood be classified as an uncontrolled area, while the processing plant will be a supervised area. What is important to note as far as worker radiation exposure is concerned, is that workers will be exposed, but that the level of exposure can be controlled and managed to ensure compliance with regulatory limits for the protection of workers.
A comprehensive radiation baseline survey and site characterisation will have to be performed before operation commences and this, together with specific mitigation measures will need to be submitted to the NNR. It is recommended that the baseline be established at least a year before the operations commence. Continuous monitoring will be required during the operational phase.

Noise Assessment
The impact of the noise pollution that can be expected during the operational phase will largely depend on the number of trucks that use the transport routes per day. Noise pollution is based on two main factors, namely the intensity of the noise and the number of occurrences per day.

The results indicate the following:

- The noise will increase along both transport routes (DR 2938 and N7).
- Community action can be expected if the trucks use the DR 2938 during the night.
- The noise from the processing plants will not impact the residents in the noise sensitive areas along the DR 2938 due to the distance from the processing plants.

The following is recommended:

a. All vehicles should be fitted with silencers and the use of exhaust brakes along the DR 2938 of the transport route be severely curtailed.
b. The speed of the trucks should not exceed 60km/hr along DR 2938 until it is upgraded and then should not exceed 80km/hr. This will reduce the noise impact even further.
c. The drivers should receive training in terms of sensitizing them to the noise issues.
d. It is highly recommended that Global Positioning System trackers be fitted to the vehicles in order to monitor vehicle speeds along the routes.

e. The hauling of final product along the DR 2938 is curtailed to day light hours only.

Rehabilitation Assessment

The recommended decision is to rehabilitate the entire site to natural vegetation. In doing so, recommendations made in the vegetation specialist report, and the need to establish ecological corridors are important considerations. The overall rehabilitation plan for the mine site is therefore to achieve an indigenous vegetation cover, and to focus the rehabilitation programme on re-establishing the type of vegetation that occurred before mining. The primary focus of the rehabilitation programme would therefore be focused on re-establishing Sand Fynbos. A secondary focus would be to re-establish Standveld in the eastern portions of the area to be affected by mining. The rehabilitation will be facilitated by the presence of various ecological corridors, as these areas will act as seed banks and a possible a source of plants which could be transplanted from these areas. They also support various faunal groups, which play an important role in pollination and seed dispersal.

The rehabilitation programme will need to be guided by the mine plan. Once an area has been mined out, rehabilitation can start shortly thereafter, since mining activities (essentially bulk earth works) will move onto the next parcel of land. Thus, a rolling rehabilitation process can take place, and at the end of the mine life, the area mined in year one will support vegetation close to 20 years old. The sequence of rehabilitation will need to closely follow the sequence of mining.

Mining will be initiated in the south-western section of the Roode Heuvel deposit, and will then proceed south-west and then north-west. In the first year of mining a void will be created, as there is no area to backfill. The coarse tailings will be used to construct the walls of an off mine path tailings storage facility (TSF). In year 2 coarse tailings will continue to be used to construct the TSF, and hence there will be no or limited backfilling in years 1 and 2. It is only likely that rehabilitation could begin on the year 1 and 2 parcels (100 and 130ha respectively) after year 2, as sufficient space would be required for mining operations. Thus, it is anticipated that rehabilitation will lag 2 years behind excavation and mining.

Impact Assessment

The tables below below sumarise the significance of all impacts identified in all phases of the project. All but two negative impacts can be effectively mitigated to either MODERATE or LOW signidicance, and if a biodiversity offset is implemented for two impacts on vegetation, no residual impacts of HIGH significance are anticipated. Positive socio-economic impacts of HIGH and VERY HIGH significance will take place if recommended optimization strategies are implemented.

SUMMARY OF ISSUES

Residual impacts as a result of the construction phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Impacts on topography and geology	Long Term	Localised	Slight	LOW -	N/A	N/A
Soil profile disturbance	Short Term	Localised	Severe	**MODERATE**	Slight	**LOW**
Soil erosion	Long Term	Study Area	Severe	**HIGH**	Moderate	**MODERATE**
Groundwater abstraction	Long term	Local	Moderate	**LOW**	Slight	**LOW**
Impacts on groundwater of pollution by contaminants	Short Term	Study Area	Severe	**MODERATE**	Moderate	**LOW**
Impact on surface water of groundwater abstraction from the Groenrivier valley	N/A	N/A	N/A	**NO IMPACT**		
Impacts of river crossing infrastructure	Short Term	Local	Moderate	**MODERATE**	Slight	**LOW**
Direct losses of intertidal and infratidal biota	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Barotrauma of marine fauna as a result of blasting	Short term	Regional	Severe	**MODERATE**	Slight	**LOW**
Impaired water quality impacts to marine fauna	Short term	Regional	Severe	**LOW**	Slight	**LOW**
Litter during construction	Medium term	Localised	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Strandveld (Namaqualand Strandveld)	Permanent	Localised, within Study Area	Moderate	**MODERATE**	Moderate	**LOW TO MODERATE**
Loss of Sand Fynbos (Namaqualand Sand Fynbos)	Permanent	Localised, within Study Area	Fairly Minor	**LOW TO MODERATE**	Minor	**LOW**
Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)	Temporary to Permanent	Study Area	Low	**LOW**	Low	**LOW**
Loss of Riparian Vegetation (Namaqualand Riviere)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of Seashore Dunes	Permanent	Study Area	Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Coastal Duneveld	Permanent	Study Area	Low - Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Species of Conservation Concern	Permanent	Study Area	Moderate	**MODERATE**	Low - Moderate	**LOW**
Fragmentation of vegetation and edge effects	Permanent	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Amphibian Diversity	Medium term	Localised	Moderate	**LOW**	Slight	**LOW**
Loss of Reptile Diversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Bird Diversity	Medium term	Study Area	Moderate	**LOW**	Slight	**LOW**
Loss of Mammal Diversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Species of Conservation Concern	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Impacts on fauna due to habitat fragmentation and habitat loss	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Faunal impacts from dust	Short term	Study Area	Severe	**MODERATE**	Slight	**LOW**
Disruption to fauna from increased noise levels	Short term	Study Area	Severe	**LOW**	Moderate	**LOW**
Visual intrusion on views of sensitive visual receptors due to mine construction	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living:	Short Term	Study Area	Moderate	**MODERATE**	Slightly Beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Short Term	Study Area	Severe	**HIGH**	Slight	**LOW**
Increased social pathologies	Short Term	Study Area	Very Severe	**HIGH**	Severe	**LOW**
The use of security personnel for mine access control	Short Term	Study Area	Severe	**LOW**	N/A	**N/A**
Assisting with housing requirements in Garies	Long Term	Localised	Slightly Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Assisting with local economic development	Medium Term	Study Area	Moderately Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Upgrading of roads	Long Term	Study Area	Slight Beneficial	**LOW +**	Slightly Beneficial	**LOW +**
Economic viability of remaining unaffected land	N/A	N/A	N/A	**N/A**	Slight	**MODERATE +**
Employing local labour	Short Term	Study Area	Slightly Beneficial	**LOW +**	Very Beneficial	**HIGH +**
Developing and supporting local businesses	Short Term	Regional	Slightly Beneficial	**LOW**	Very Beneficial	**HIGH +**
Skills training and further training opportunities	N/A	N/A	N/A	**N/A**	Beneficial	**HIGH +**
Effects on farm-owners' place attachment	Long Term	Study Area	Severe	**HIGH**	N/A	**N/A**
Effects on the area's tourism industry	Medium Term	Localised	Slight Beneficial	**LOW +**	Slight Beneficial	**LOW +**
EHA #2: Acute respiratory infections and respiratory effects from housing	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #4: Sexually-Transmitted Infections, Including HIV/AIDS	Permanent	Regional	Very Severe	**VERY HIGH**	Moderate Beneficial	**MODERATE +**
EHA #5: Soil-, water- and waste-related diseases	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #6: Food- and nutrition-related issues	Medium Term	Study Area	Severe	**MODERATE**	Moderate Beneficial	**LOW +**
EHA#7: Accidents/Injuries	Long Term	Study Area	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #8: Exposure to potentially hazardous materials, noise and malodours	Permanent	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
EHA #9: Social determinants of health	Medium Term	Study Area	Severe	**MODERATE**	Moderate Beneficial	**MODERATE +**
EHA #9: Social determinants of health (social cohesion and well-being)	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
EHA #12: Non-Communicable Diseases	Long Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
ECONOMIC IMPACTS						
Impact on tourism	Short Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Impact on landowners	Short Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Impact of project related expenditure	Short Term	Regional	Moderately Beneficial	**MODERATE +ve**	Moderately Beneficial	**MODERATE +ve**
CULTURAL HERITAGE IMPACTS						
Proposed seawater intake, pump station and pipeline	Long Term	Study Area	Severe	**MODERATE**	Low	**LOW**
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Pollution of land and water *(General wastes)*	Long term	Study area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water *(Hazardous wastes)*	Permanent	District	Very Severe	**HIGH**	Moderate	**MODERATE**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Health impacts to employees and communities	Long term	District	Severe	**MODERATE**	Slight	**LOW**
Nuisance impacts (odour and flies)	Short Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Impacts related to air quality	Short Term	Study Area	Severe	**LOW**	N/A	**N/A**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Impacts related to noise	There are currently no impacts related to this issue.					
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Short Term	Study Area	Severe	HIGH	Severe	MODERATE
Increased dust generation	Short Term	Study Area	Severe	MODERATE	Slight	LOW
Disruption of traffic flows on the N7	Short Term	Regional	Slight	LOW	Slight	LOW
Disruption of traffic flows on provincial roads	Short Term	Regional	Moderate	MODERATE	Slight	LOW
Disruption of traffic flows on the N7 and provincial roads	Very Short Term	Regional	Moderate	MODERATE	Low	LOW

Residual impacts as a result of the operational phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Changes to topography	Long term	Study Area	Definite	MODERATE	Definite	LOW
The occupation of the land by a mining activity and associated infrastructure	Medium term	Study Area	Severe	HIGH	Moderate	MODERATE
The existence of hard surfaces	Permanent	Study Area	Moderate	HIGH	Slight	LOW
Mining activities may cause increased sediment load	Long term	Study area	Moderate	MODERATE	Slight	LOW
Mining activities will result in various vegetation types being cleared	Permanent	Study Area	Very severe	HIGH	Moderate	LOW
Loss of water (ground and surface water) as a result of mining activities	Permanent	Study area	Very Severe	HIGH	Moderate	MODERATE
Impacts on groundwater of the tailings storage facility and backfill	Permanent	Study area	Very Severe	HIGH	Moderate	MODERATE
Impacts on groundwater of groundwater abstraction	Long term	Local	Moderate	LOW	Slight	LOW
Impacts on groundwater of pollution by contaminants	Long Term	Study Area	Severe	HIGH	Moderate	LOW

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Impacts on surface water of the tailings storage facility and backfill	Permanent	Local	Slight	**LOW**	Slight	**LOW**
Impact on surface water of groundwater abstraction from the Groenrivier valley	N/A	N/A	N/A	**NO IMPACT**		
Impacts of river crossing infrastructure	Long Term	Local	Slight	**LOW**	Slight	**LOW**
Impingement of organisms	Long term	Localised	Severe	**MODERATE**	Slight	**LOW**
Loss of Strandveld (Namaqualand Strandveld)	Permanent	Study Area	Severe	**HIGH**	Moderate	**MODERATE**
Loss of Sand Fynbos (Namaqualand Sand Fynbos)	Permanent	Study Area	Severe	**HIGH**	Moderate - Severe	**HIGH-MODERATE**
			With Mitigation and Biodiversity Offset		Slight	**LOW**
Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)	Temporary to Permanent	Study Area	Moderate	**MODERATE**	Low	**LOW**
Loss of Riparian Vegetation (Namaqualand Riviere)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Seashore Dunes	Permanent	Study Area	Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Coastal Duneveld	Permanent	Study Area	Low - Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Species of Conservation Concern	Permanent	Study Area	Severe	**HIGH**	Moderate	**HIGH-MODERATE**
			With Mitigation and Biodiversity Offset		Moderate	**LOW-MODERATE**
Fragmentation of vegetation and edge effects	Permanent	Study Area	Severe	**HIGH**	**HIGH**	**MODERATE**
Increased dust levels on vegetation	Long Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Invasion of alien species	Permanent	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Loss of faunal biodiversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of Species of Conservation Concern	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Introduction of alien fauna	Medium term	Localised	Moderate	**LOW**	Slight	**LOW**
Impacts on fauna due to habitat fragmentation and habitat loss	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Increased Dust Levels	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Noise Pollution	Medium term	Study Area	Severe	**LOW**	Moderate	**LOW**
Pollution and Contamination	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Threats to Animal Movements	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Impact of introducing highly visible mine infrastructure	Permanent	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Impact of mine operation in light of the Department of Environmental Affairs' Strategy on Buffer Zones for National Parks	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living:	Long-term	Study Area	Moderate	**MODERATE**	Slightly Beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Long-term	Study Area	Slight	**MODERATE**	Slight	**LOW**
Increased social pathologies	Long Term	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
The use of security personnel for mine access control	Long Term	Study Area	Severe	**MODERATE**	N/A	**N/A**
Assisting with housing requirements in Garies	Long Term	Localised	Slightly Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Assisting with local economic development	Medium Term	Study Area	Moderately Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Upgrading of roads	Long Term	Study Area	Slighty Beneficial	**LOW +**	Slighty Beneficial	**LOW +**
Economic viability of remaining unaffected land	N/A	N/A	N/A	**N/A**	Slight	**MODERATE +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Employing local labour	Long Term	Regional	Slightly Beneficial	**LOW +**	Very Beneficial	**HIGH +**
Developing and supporting local businesses	Long Term	Regional	Slightly Beneficial	**LOW +**	Beneficial	**HIGH +**
Skills training and further training opportunities	N/A	N/A	N/A	**N/A**	Beneficial	**HIGH +**
Effects on farm-owners' place attachment	Long Term	Localised	Severe	**HIGH**	N/A	**N/A**
Effects on the area's tourism industry	Medium Term	Localised	Slight Beneficial	**LOW +**	Slight Beneficial	**LOW +**
ECONOMIC IMPACTS						
Impact on tourism	Long Term	Study Area	Moderate to Severe	**HIGH-MODERATE**	Moderate	**MODERATE**
Impact on landowners	Long Term	Study Area	Moderate to Severe	**HIGH-MODERATE**	Moderate	**MODERATE**
Impact of project related expenditure	Long Term	Regional	Moderately Beneficial	**MODERATE +ve**	Substantially Beneficial	**HIGH +ve**
Macro-economic impacts	Long Term	National	Substantially Beneficial	**HIGH +ve**	N/A	**N/A**
CULTURAL HERITAGE IMPACTS						
Impacts that may result from the operational phase	Long Term	Study Area	Severe	**MODERATE**	Low	**LOW**
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Health and safety of employees and local communities	Medium Term	Localized	Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water resources	Medium Term	Localized	Very Severe	**MODERATE**	Slight	**LOW**
Risk to Health and Safety of Employees	Medium Term	Localized	Very Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long term	Study area	Moderately Severe	**MODERATE**	Slight	**LOW**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Health impacts to employees and communities	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Impact on particulates	Long Term	Study Area	Very Severe	**MODERATE**	Severe	**MODERATE**
Impact on gaseous pollutants	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impacts related to air quality	Short Term	Study Area	Severe	**LOW**	Moderate	**LOW**
Impact of the vehicle noise the residents along the transport routes (DR 2938)	Long Term	Localised	High	**HIGH**	Moderate	**MODERATE**
Impact of the vehicle noise on the residents along the transport routes (N7)	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impact of the process plants on the noise sensitive receptors	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Long Term	Study Area	Very Severe	**VERY HIGH**	Severe	**MODERATE**
Increased dust generation	Long Term	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
Disruption of traffic flows on the N7	Long Term	Regional	Moderate	**MODERATE**	Slight	**LOW**
Disruption of traffic flows on provincial roads	Long Term	Regional	Moderate	**MODERATE**	Slight	**LOW**

Residual impacts as a result of the decommsioning phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Incorrect or insufficient rehabilitation of soil will result in a decrease of agricultural ability	Short term	Study Area	Moderate	**LOW**	Slight	**LOW**
Incorrect or insufficient rehabilitation of soil will result in a decrease of agricultural ability	Short term	Study Area	Moderate	**LOW**	Slight	**LOW**
Impacts on groundwater of the tailings storage facility and backfill	Permanent	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
Impacts on surface water of the tailings storage facility and backfill	Permanent	Local	Slight	**LOW**	Slight	**LOW**
Direct losses of intertidal and infratidal biota in development footprint	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Barotrauma of marine fauna as a result of blasting	Short term	Regional	Severe	**MODERATE**	Slight	**LOW**
Impaired water quality impacts to marine fauna	Short term	Localised	Moderate	**LOW**	Slight	**LOW**
Litter during decommisioning	Medium term	Regional	Moderate	**MODERATE**	Moderate	**LOW**
Impacts on the marine environment	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Increased Dust Levels	Short term	Study Area	Slight	**LOW**	Slight	**LOW**
Pollution and Contamination	Short term	Study Area	Slight	**LOW**	Slight	**LOW**
Noise Pollution	Medium term	Study Area	Severe	**MODERATE**	Moderate	**MODERATE**
Visual intrusion on views of sensitive visual receptors due to mine decommissioning	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
Impact of mine construction in light of the Department of Environmental Affairs' Strategy on Buffer Zones for National Parks			N/A	**N/A**	N/A	**N/A**
SOCIO-ECONOMIC IMPACTS						

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of social services	Permanent	Study Area	Severe	MODERATE	Severe	MODERATE
Retrenchment	Permanent	Study Area	Very Severe	VERY HIGH	Moderate	MODERATE
CULTURAL HERITAGE IMPACTS						
Due to the fact that significant sites of cultural heritage value that will be impacted on by the proposed development will be removed prior to construction and/mining, no impacts are anticipated for the decommissioning phase.						
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Pollution of land and water	Long term	Study area	Moderately Severe	MODERATE	Slight	LOW
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Pollution of soil and water	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Health impacts to employees and communities	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Nuisance impacts (odour and flies)	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Pollution of land and water	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Impact on particulates	Long Term	Study Area	Very Severe	MODERATE	Severe	MODERATE
Impact on gaseous pollutants	Long Term	Localised	Slight	LOW	Severe	MODERATE
Impacts related to air quality	Short Term	Study Area	Severe	LOW	Moderate	LOW
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Long Term	Study Area	Very Severe	VERY HIGH	Severe	MODERATE
Increased dust generation	Long Term	Study Area	Very Severe	HIGH	Moderate	LOW
Disruption of traffic flows on the N7	Long Term	Regional	Moderate	MODERATE	Slight	LOW
Disruption of traffic flows on provincial roads	Long Term	Regional	Moderate	MODERATE	Slight	LOW

Table 13.4: Residual impacts as a result of the Cumulative Impacts

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Impacts on surface and groundwater resources	There are currently no cumulative impacts anticipated on surface and groundwater resources					
Impacts on flora	Variable – mostly Long Term, and some permanent	Site, and Regional, especially when cumulative impacts are considered	Medium to Severe	**MODERATE - HIGH**	Medium	**MODERATE**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living	Long-term	Study area	Moderate	**MODERATE**	Slightly beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Long-term	Study area	Slight	**MODERATE**	Slight	**LOW**
Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)	Long-term	Study area	Very severe	**HIGH**	Moderate	**LOW**
Assisting with housing requirements in Garies	Long-term	Localised	Slightly beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Assisting with Local Economic Development	Medium-term	Study area	Moderately beneficial	**MODERATE +**	Very beneficial	**HIGH +**
Employing local labour	Long-term	Regional	Slightly beneficial	**LOW +**	Very beneficial	**HIGH +**
Developing and supporting local businesses	Long-term	Regional	Slightly beneficial	**LOW +**	Beneficial	**HIGH +**
Skills training and further training opportunities	Long-term	Regional	No affect		Beneficial	**HIGH +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
CULTURAL HERITAGE IMPACTS						
Loss of archaeological remains	No significant impacts are anticipated					
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Local knowledge of waste management practices	Permanent	District	Slightly Beneficial	LOW	Beneficial	**MODERATE +**
Change to waste profiles in the local communities	Permanent	District	Severe	MODERATE	Slight	LOW
Impacts related to radiation	Refer to Chapter 8, section 8.13					

EAP'S RECOMMENDATION

It is recommended that an ECO be appointed to ensure all recommendations in the EMP as well as mitigation measures are adhered to. The most important mitigation measures are included below:

- It is recommended that discussions are held with SANParks in regards to potential biodiversity offsets (whether to incorporate the area referred to as Roode Heuvel into the NNP or if another offset will be required). Recommendations in regard to this are made in the vegetation report as well as this Final EIR.
- A search and rescue for SCC must be undertaken by a qualified botanist, prior to any construction taking place. These plants should be transferred to an on-site nursery and/or transplanted into the proposed ecological corridors.
- The proposed ecological corridors that are located on land owned by the proponent must be clearly demarcated and no development may be allowed within these corridors. In addition to this livestock grazing must be prohibited in these areas to ensure that no further degradation will take place.
- The SLP must be implemented.
- Baseline monitoring for all parameters listed in the monitoring plan must be undertaken prior to operations taking place.
- An operational environmental management programme must be drafted prior to the operation phase of the mine.
- A community grievance mechanism must be developed and implemented.
- Water Use Licenses must be in place prior to the construction of the pipeline and the realignment of the road. All conditions within these licences must be strictly adhered to.
- A Waste License must be in place prior to the construction of the landfill site. All conditions within this licence must be strictly adhered to.
- Groundwater quality and quantity must be monitored throughout the life of the mine and post closure.
- Groundwater may only be utilised for processing purposes, in the event of electrical, mechanical or process failure of the seawater abstraction, delivery and treatment system.
- All relevant permits must be obtained from SAHRA prior to any heritage sites being disturbed.

Based on the above, it is believed that with appropriate mitigation, the social benefits of the proposed Kamiesberg Project will outweigh the negative impacts. **It is the opinion of the EAP that environmental authorisation for this project should be granted under certain conditions**, in order to address those impacts with a high significance rating, and included in Chapter 9 of this report.

It is also suggested that the recommendations made in *Volume 4: Environmental Management Programme: Kamiesberg Project* (CES, May 2012) also be followed.

WAY FORWARD

This Final EIAR, together with the Specialist Volume (Volume 2) and the EMPr (Volume 4), has been submitted to the DENC.

Upon thorough examination of the Final EIAR, the authority (DENC) will issue a decision, which either authorises the project or rejects the EIAR – in which case the DENC will request additional information or clarification of certain issues. Should an Environmental Authorisation be granted, it usually carries Conditions of Approval. The project proponent is obliged to adhere to these conditions.

Within a period determined by the competent authority, all registered I&APs will be notified in writing of (i) the outcome of the application, and (ii) the reason for the decision. The public or applicant (depending on the outcome of the authorisation) will then have time in which to appeal the decision should they wish to do so. The appeals procedure will also be communicated by the EAP. Any appeal must be submitted to the responsible Legal Officer at DEA.

TABLE OF CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Kamiesberg Project, the purpose of which is to exploit proven heavy mineral sand deposits, is situated 35 km to the southwest of the town of Garies (Figure 1.1) in the Northern Cape Province of South Africa.

Zirco Roode Heuwel (Pty) Ltd (Zirco) holds the prospecting rights to the Roode Heuvel (6 314 ha) and Leeuvlei (6 005 ha) deposits, and are also in the process of acquiring prospecting rights for a further deposit immediately east of and adjacent to Roode Heuvel, referred to as "Sabies" (8 600 ha). This report deals with all three areas which combined form Zirco's Kamiesberg Project. Information regarding the deposits has been based on a drilling programme on the Roode Heuvel and Leeuvlei portions, as Zirco has not drilled the Sabies deposit yet. To date Zirco has completed 12 843 m of air core drilling and fully delineated the deposits on Roode Heuvel and Leeuvlei. Drilling was extended to the basement rock to fully define the depth of the deposit. Global total heavy mineral grades (THM) are in the order of 3%, with both deposits together projected to contain some 1 400 million tons of mineralised sand. These sands consist of surface aeolian sand (referred to as Red Aeolian Sands - RAS), and higher slimes, mineralised sand (referred to as Orange Feldspathic Sands – OFS). These make up the bulk of the deposit. Basal grits and conglomerates are locally developed immediately above the basement.

In addition to the mining and associated infrastructure (mineral separation plant, primary concentrator plant, tailings dam, offices, workshops and stores, for example.), the project will also require the construction of various ancillary infrastructure such as, but not limited to, the following:

- Seawater intake, desalination plant, pumping station and pipeline
- Waste water treatment works
- Product transfer stations
- Airstrip
- Upgrade of the provincial road to and junction with the N7 road
- Fuel Depot
- Construction and operation accommodation

Figure 1.1: The location of the proposed development

1.2 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The International Association for Impact Assessment (1999) defines an Environmental Impact Assessment (EIA) as, "*the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made*."

The EIA process is guided by regulations made in terms of Chapter 5 of the National Environmental Management Act, No. 107 of 1998 (NEMA), published as Government Notice No R.543 in Government Gazette No 33306 of 2 August 2010. The regulations set out the procedures and criteria for the submission, processing and consideration of and decisions on applications for the environmental authorisation of activities.

Three lists of activities, published on 21st April 2006 and amended on 2nd August 2010, as Government Notice Numbers R.544, R.545, and R.546 define the activities that require, respectively, a Basic Assessment (applies to activities with limited environmental impacts), or a Scoping and Environmental Impact Assessment (applies to activities which are significant in extent and duration).

The activities triggered by the proposed development are listed in Table 1.1 below.

Table 1.1: Listed activities triggered by the proposed development

Number relevant notice	**Activity No(s)**	**Description of each listed activity based on the project description**	**Comments and observations**
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(2)	The construction of facilities or infrastructure for the storage of ore or coal that requires an atmospheric emissions license in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004).	This listed activity will apply should it be required to store and/or handle more than 100 000 tons of ore in an area other than the mine site.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(9)	The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more, excluding where: a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	The proposed construction of a pipeline from the coast to supply water for mining activities will be constructed outside an urban area and/or a road reserve, therefore the exclusions do not apply. Alternatives for the intake of this pipeline is yet to be assessed and may consist of an open water intake at Khnyp Bay or a gully intake (8 possible locations identified). Either way it is anticipated that the proposed pipeline will be in excess of 1 000 m in length.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(11)	The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) wESIRs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or **(xi) infrastructure or structures covering 50 square metres or more** where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	This listed activity will apply to the construction of the pipeline which will have to traverse a watercourse (i.e. the Groen River).
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(14)	The construction of structures in the coastal public property where the development footprint is bigger than 50 square metres, excluding (i) the construction of structures within existing ports or harbours that will not increase the development footprint or throughput capacity of the port or harbour; (ii) the construction of a port or harbour, in which case activity 24 of Notice 545 of 2010	Coastal public property refers to coastal waters, land submerged by coastal waters, any island in coastal waters, the seashore, any admiralty reserve owned by the state, any other state land declared as coastal public

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
		applies; (iii) the construction of temporary structures within the beach zone where such structures will be demolished or disassembled after a period not exceeding 6 weeks.	property and any natural resource occurring within any of these areas. It is therefore anticipated that the intake of the pipeline, a portion of the pipeline itself and possibly the pumping stations and port related infrastructure will be situated within what is defined as coastal public property. In addition to this, a portion of the subsea pipeline to the Single Point Mooring (SPM) buoy will also be anticipated to cross coastal public property.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(15)	The construction of facilities for the desalination of sea water with a design capacity to produce more than 100 cubic metres of treated water per day.	Approximately 690 000 m^3 of freshwater per annum will be required for potable water and to remove salt from the HMC. To provide this fresh water a reverse osmosis desalination plant is planned to be constructed at the mine site.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(16)	Construction or earth moving activities in the sea, an estuary, or within the littoral active zone or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever is the greater, in respect of – (i) fixed or floating jetties and slipways; (ii) tidal pools; (iii) embankments; (iv) rock revetments or stabilising structures including stabilising walls; (v) buildings of 50 square metres or more; or **(vi) infrastructure covering 50 square metres or more –** but excluding (a) if such construction or earth moving activities will occur behind a development setback line; or (b) where such construction or earth moving activities will occur within existing ports or harbours and the construction or earth moving activities will not increase the development footprint or throughput capacity of the port or harbour; (c) where such construction or earth moving activities is undertaken for purposes of maintenance of the facilities mentioned in (i)-(vi) above; or	It is anticipated that construction of the pipeline to transport seawater to the mine site (and possibly the pumping station) and the pipeline to the SPM will occur within 100 m of the highwater mark and the littoral active zone. The exclusions relating to this activity do not apply.

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
		(d) where such construction or earth moving activities is related to the construction of a port or harbour, in which case activity 24 of Notice 545 of 2010 applies.	
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(18)	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from: (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing , dredging, excavation, removal or moving; (a) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or (b) occurs behind the development setback line.	The construction of the pipeline to transport seawater to the mine site (and possibly the pumping station) and the pipeline to the SPM will require excavation and subsequent infilling within 100 m of the highwater mark and the littoral active zone.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(22)	The construction of a road, outside urban areas, (i) with a reserve wider than 13,5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.	It may be required to construct a haul road from the mine site to existing roads such as the N7 for the transport of product for export.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(23)	The transformation of undeveloped, vacant or derelict land to – (i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or (ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; -	This activity applies to the construction of the accommodation for workers and the water treatment facility. The footprints of these areas are currently unknown. Should the footprint of these areas be less than 1 ha, this activity would not apply.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(24)	The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule or thereafter such land was zoned open space, conservation or had an equivalent zoning.	At this stage the land use of the various areas proposed for construction is unknown. If any of these areas are currently zone as private or public open space or for conservation purposes this activity will apply. This may especially pertain to areas classified as coastal public property.

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(26)	Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	Section 53(1) refers to threatening processes in listed ecosystems and states that the Minister may, by notice in *the Gazette,* identify any process or activity in a listed ecosystem as a threatening process and have therefore been included.
Listing Notice 1 of GNR.544 EIA Regulations dated18 June 2010	(47)	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre - (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres – excluding widening or lengthening occurring inside urban areas.	Various existing roads within close proximity to the mine site may require upgrading.
Listing Notice 2 of GNR.545 EIA Regulations dated18 June 2010	(3)	The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	A fuel depot will be constructed at the mine site.
Listing Notice 2 of GNR.545 EIA Regulations dated18 June 2010	(14)	The construction of an island, anchored platform or any other permanent structure on or along the sea bed excluding construction of facilities, infrastructure or structures for aquaculture purposes.	This listed activity applies to the alternative of a single point mooring.
Listing Notice 2 of GNR.545 EIA Regulations dated18 June 2010	(15)	Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply.	The proposed mining area and associated infrastructure will be in excess of 20 ha.
Listing Notice 2 of GNR.545 EIA Regulations dated18 June 2010	(20)	Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	Zirco will be applying to DMR for mining rights.
Listing Notice 2 of GNR.545 EIA Regulations	(24)	Construction or earth moving activities in the sea, an estuary, or within the littoral active zone or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater, in respect of:	This listed activity applies to the alternative of a single point mooring.

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
dated18 June 2010		**(i) facilities associated with the arrival and departure of vessels and the handling of cargo;** (ii) piers; (iii) inter- and sub-tidal structures for entrapment of sand; (iv) breakwater structures; (v) coastal marinas; (vi) coastal harbours or ports; (vii) structures for reclaiming parts of the sea; (viii) tunnels; or (ix) underwater channels; but excluding — (a) activities listed in activity 16 in Notice 544 of 2010, (b) construction or earth moving activities if such construction or earth moving activities will occur behind a development setback line; (c) where such construction or earth moving activities will occur in existing ports or harbours where there will be no increase of the development footprint or throughput capacity of the port or harbour; or where such construction or earth moving activities takes place for maintenance purposes.	
Listing Notice 3 of GNR.546 EIA Regulations dated18 June 2010	(4)	The construction of a road wider than 4 metres with a reserve less than 13.5 metres. **(a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces:** (i) In an estuary; **(ii) Outside urban areas, in:** (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) **Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;** (ff) Core areas in biosphere reserves; (gg) **Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve;** (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. (iii) In urban areas:	It may be required to construct a haul road from the mine site to existing roads such as the N7 for the transport of product for export. Depending on the position it may transect Succulent Karoo Ecosystem Plan Priority Areas and is in close proximity to the Namaqua National Park (Figure 1.2)

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
		(aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) seawards of the development setback line or within urban protected areas.	
Listing Notice 3 of GNR.546 EIA Regulations dated18 June 2010	(8)	The construction of aircraft landing strips and runways 1.4 kilometres and shorter. (a) **In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces:** (i) In an estuary; **(ii) Outside urban areas, in:** (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an International Convention; (ff) **Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;** (gg) Core areas in biosphere reserves; (hh) **Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core of a biosphere reserve;** (ii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; (jj) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined. (iii) In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.	The proposed airstrip will be shorter than 1.4 km and in close proximity to mining activities.
Listing Notice 3 of GNR.546 EIA Regulations dated18	(12)	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (a) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the	See Figure 1.2 included below.

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
June 2010		publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (b) **Within critical biodiversity areas identified in bioregional plans;** (c) **Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas.**	
Listing Notice 3 of GNR.546 EIA Regulations dated18 June 2010	(13)	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010. **(a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority.** (b) National Protected Area Expansion Strategy Focus areas **(c) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and Western Cape:** (i) In an estuary; **(ii) Outside urban areas, the following:** (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Core areas in biosphere reserves; (ff) **Areas within10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve;** (gg) Areas seawards of the development setback line or within 1 kilometre from the	See Figure 1.2 included below.

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
		high-water mark of the sea if no such development setback line is determined. (iii) In urban areas, the following: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Areas seawards of the development setback line; (dd) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined.	
Listing Notice 3 of GNR.546 EIA Regulations dated18 June 2010	(14)	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes; (2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list; (3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. **(a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape:** **All areas outside urban areas.**	See Figure 1.2 included below.
Listing Notice 3 of GNR.546 EIA Regulations dated18 June 2010	(16)	The construction of: (i) jetties exceeding 10 square metres in size; (ii) slipways exceeding 10 square metres in size; (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. **(a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape:** (i) In an estuary;	This listed activity will apply to the construction of the pipeline which will have to traverse a watercourse (i.e. the Groen River).

Number relevant notice	Activity No(s)	Description of each listed activity based on the project description	Comments and observations
		(ii) Outside urban areas, in: (cc) A protected area identified in terms of NEMPAA, excluding conservancies; (aa) National Protected Area Expansion Strategy Focus areas; (bb) World Heritage Sites; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) **Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;** (ff) Core areas in biosphere reserves; (gg) **Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve;** (hh) **Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.** (iii) In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose; or (cc) Areas seawards of the development setback line.	

Based on the NEMA EIA listed activities identified by CES, namely the Listing Notice 2 listed activities in GNR.545, the proposed Zirco project's EIA application will be subject to the **scoping and environmental impact assessment reporting process** as stipulated in Part 3 of the EIA Regulations (GN R.543 of 18 June 2010, as amended).

The determination of who the relevant competent authority is stipulated in the Listing Notices as the provincial environmental authority unless the application is for an activity/ies contemplated in section 24C(2) of the Act. In this case the competent authority would be the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act. Based on the information provided (and subject to the **MSP facility being located at the mine site**), the **relevant competent authority** for the Zirco environmental authorisation application is the ***Northern Cape Department of Environment and Nature Conservation***. This has been confirmed by the National Department of Environmental Affairs (see Appendix C).

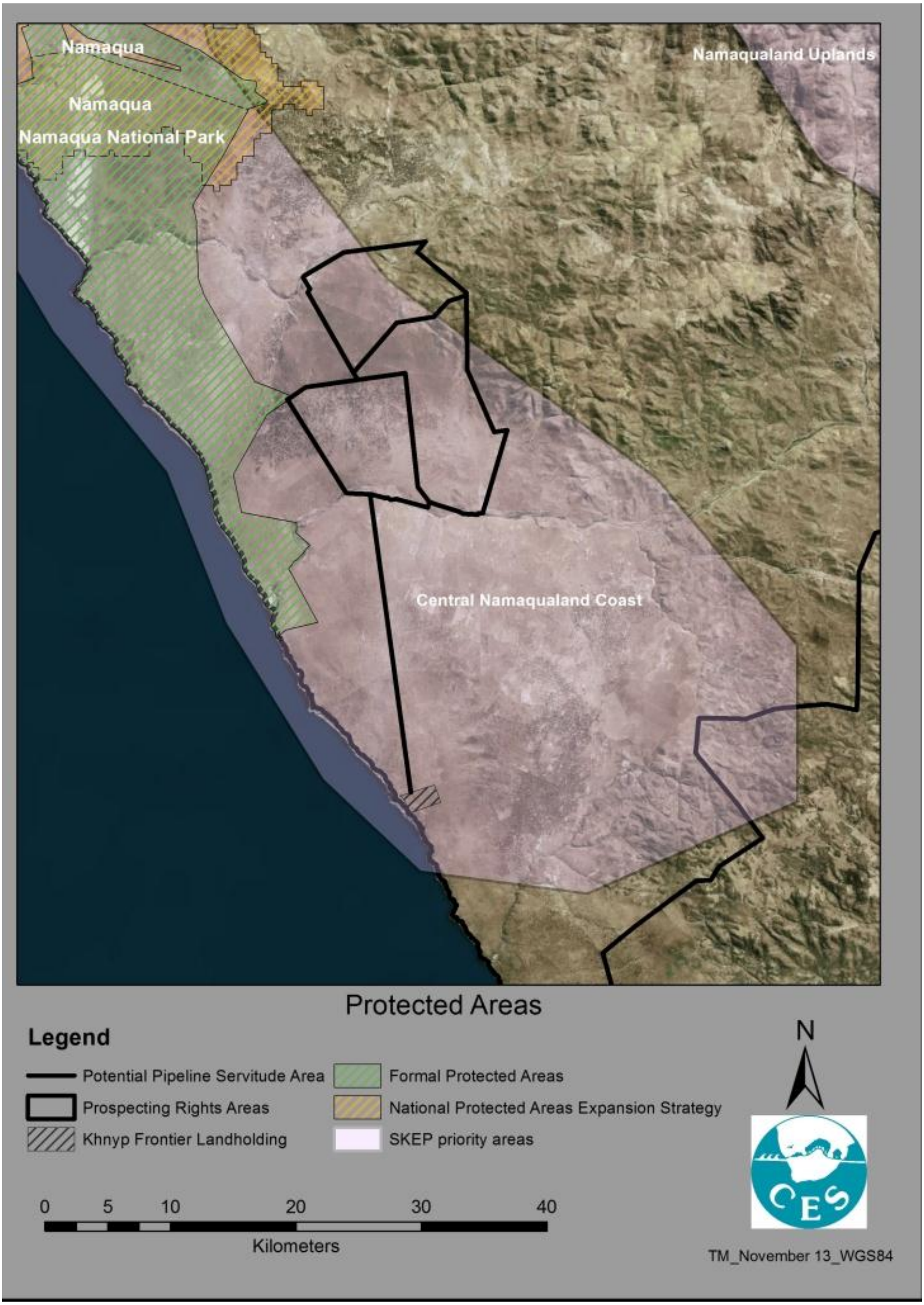


Figure 1.2: Priority areas and National Parks in proximity to the proposed project site resulting in listed activities being triggered from GNR 546 (Listing Notice 3).

Additional licensing requirements may include, but not be limited to the following:

- **Northern Cape Provincial Heritage Resources Agency:** The resources of heritage, archaeological and/or paleontological significance (these include national and provincial heritage sites, protected areas, heritage areas, and archaeological and paleontological sites, including wrecks and meteorites) located on site that will be impacted upon by the proposed development, will require a permit for removal. This will need to be obtained from SAHRA (South African Heritage Resources Agency). Should any buildings/structures, graves, etc. be found during construction, with heritage value, a permit will need to be obtained from Ngwao Boswa Kapa Bokoni (Provincial Heritage Resources Authority of the Northern Cape Province). A heritage impact assessment has been done for the proposed site. Middens or scatters of shellfish were found at the coast. These will require a permit to excavate and sample. Deflated sites (unless they will be avoided) in the mine application area will also need to be sampled/collected. The archaeologist will need to apply for a permit from SAHRA for mitigating archaeological sites. Mitigation and licensing is done prior to construction.
- **Department of Water Affairs:** The proposed pipeline and associated infrastructure, will cross the Groen River and thus a water use licence will be required from the Department of Water Affairs. The water use authorisation in terms of the National Water Act (Act 36 of 1998) sections 21 (c) and (i) will be applied for. Section (c) is relevant to impeding or diverting the flow of water in a watercourse, while section (i) is relevant to altering the beds, banks, course or characteristics of a watercourse, in this case, the Groen River. The water use licenses will be submitted in parallel with the submission of the Final EIR. Additional water use licences will be required should there be any additional crossings of water resources, including: rivers, wetlands, drainage areas and estuaries.
- **Department of Agriculture Fisheries and Forestry:** There is a range of legislation that list species of special concern. These include but are not limited to The National Forestry Act, NEM: Biodiversity Act, and provincial ordinances. A number of species of special concern have been identified on site. These will be identified by a suitably qualified botanist, whom will also apply to DAFF or the Northern Cape Department of Environment and Nature Conservation for the relevant permits for their removal prior to construction and operation of the mine.
- **Air Quality:** An Atmospheric Emissions Licence application was submitted to the Northern Cape Department of Environment and Nature Conservation on the 20th of August 2014. The application submission was acknowledged by the Northern Cape Department of Environment and Nature Conservation on the same day (Ref Number: NC/AEL/NDM/ZRH01/2014).
- **Department of Environmental Affairs:** The construction of the on-site landfill site may require a waste management licence if thresholds are above those listed in terms of the National Environmental Management: Waste Act 59 of 2008. The waste license (if required) will be applied for prior to the construction of the landfill site.
- **Department of Mineral Resources:** A Mining Right application has been submitted to the Department of Mineral Resources (DMR). Since acceptance of the application on 4 June 2014, a Scoping report has been compiled and submitted to DMR on 3 July 2014. The final EMPr is due to DMR on the 3rd of December 2014.
- **Land Use Planning Ordinance:** The proponent with the assistance of a town planner will have to apply for a LUPO application should a change in land use be required for the proposed project. In accordance with the Subdivision of Agricultural Land Act (Act 70 of 1970) this rezoning application must also be submitted to the Department of Agriculture. This application will be done once a mining right has been granted, and prior to construction.

1.2.1 The EIA Process to date

The overall EIA process is summarised in Figure 1.3 below.

A detailed description of the Scoping phase for the proposed development and the outcomes thereof are included in Volume 1: "Coastal & Environmental Services, January 2014: Final Environmental Scoping Report: Kamiesberg Project, Namaqualand, South Africa, CES, Grahamstown".

A Plan of Study (PoS) for the detailed EIAR phase was also submitted together with the Final Scoping Report (FSR), in fulfilment of section 28 (1) (n) of the EIA regulations (2010).

DENC advised the Environmental Assessment Practioner (EAP) in terms of Regulation 31(1) (a) to, — proceed with the tasks contemplated in the PoS for environmental impact assessment i.e. the detailed EIA Phase. DENC also requested that — comments from all relevant authorities be submitted to the Department with the Final Environmental Impact Assessment Report.

Following review of the FSR, DENC issued their approval of the FSR and PoS for EIA and instructed the EAP to proceed with the EIA Process as contemplated in the PoS on the 3rd of April 2014 (Appendix D).

The aim of the detailed EIA Phase is to undertake a comprehensive evaluation and study that addresses all the issues raised in the Scoping Phase, and produce a report that contains all the relevant information that is necessary for the competent authority to consider the application and to reach a decision contemplated in Regulation 36. More specifically, the EIA Phase has seven key objectives:

- Describe the biophysical and socio-economic environment that is likely to be affected by the proposed development.
- Undertake specialist studies to address the key biophysical and socio-economic issues.
- Assess the significance of impacts that may occur from the proposed development.
- Assess the alternatives proposed during the Scoping Phase.
- Provide details of mitigation measures and management recommendations to reduce the significance of impacts.
- Provide a framework for the development of Environmental Management Plans (EMPs).
- Continue with the public participation process.

This EIAR phase includes the following steps:

1. **Specialist Studies,** which include the specialist assessments identified in the Scoping Report and any additional studies required by the authorities. This required the appointment of specialists to gather baseline information in their fields of expertise, to assess the impacts and make recommendations to mitigate negative impacts and optimise benefits.
2. **Environmental Impact Assessment Report**. The main purpose of this report, the EIAR, is to gather and evaluate environmental information, so as to provide sufficient supporting arguments to evaluate overall impacts, consider mitigation measures and alternative options, and make a value judgement in choosing the best development alternative.
3. **Comments Report,** which compiles comments, issues and concerns raised by I&APs during the EIAR review period and the authorities and the relevant responses to these comments.

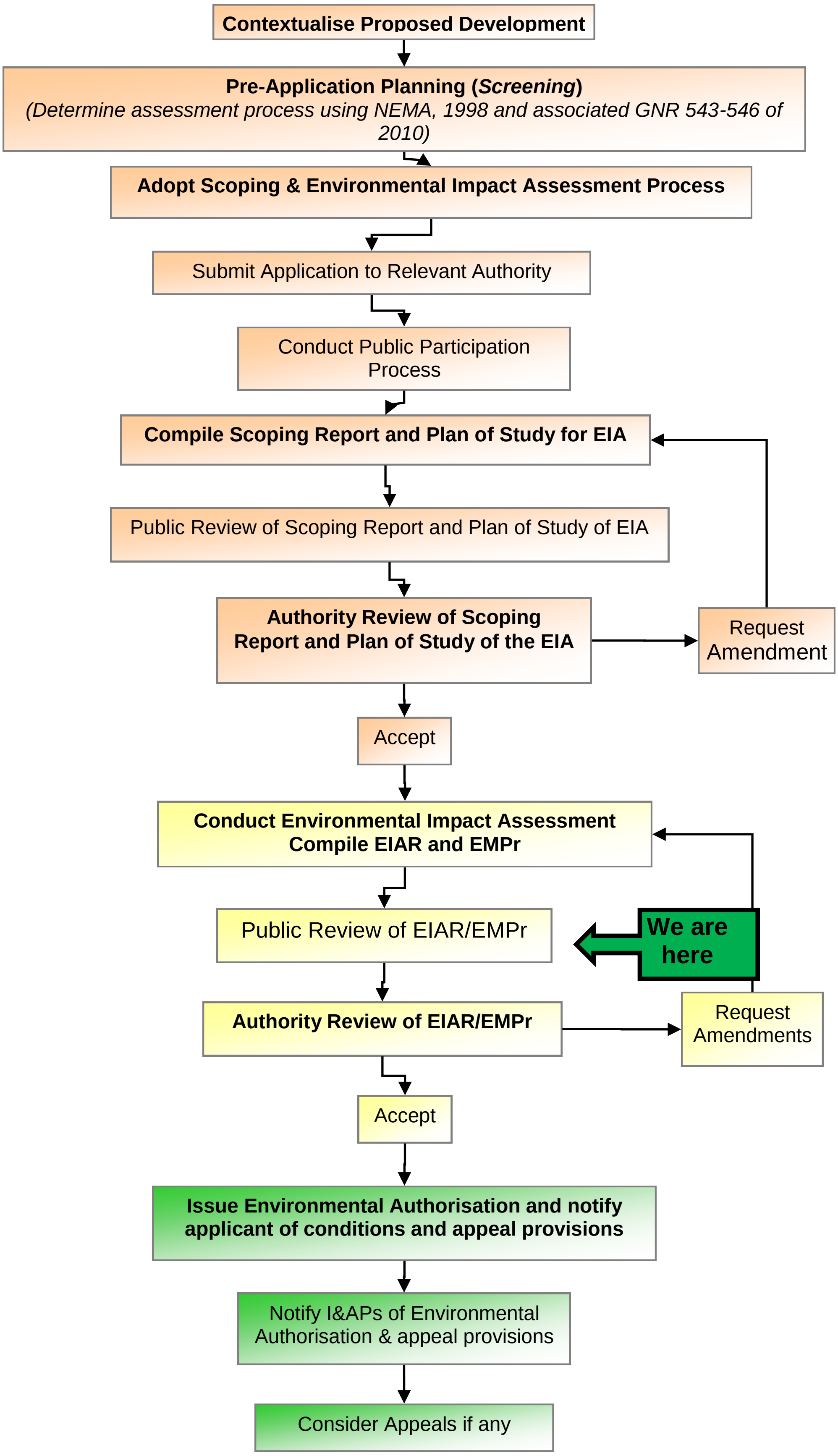


Figure 1.3: The EIA process under current legislation (NEMA Regulations 2010)

Environmental Management Programme, which informs the client and the technical team of the guidelines which will need to be followed during construction and operation to ensure that there are no lasting or cumulative negative impacts of these processes on the environment.

1.2.2 The Environmental Impact Assessment Report

In accordance with regulation 31 of GNR 543 of the EIA regulations which states that, "*an environmental impact assessment report must contain all information that is necessary for the competent authority to reach a decision contemplated in terms of regulation 35* – Decisions on applications", the overall purpose of the EIAR is to communicate the findings of the EIA to the authorities in order to inform the decision as to whether or not to authorise the proposed project. More specifically, the objectives of the EIAR are to:

- Confirm which issues have been investigated further and addressed in the EIAR;
- Identify and assess impacts of feasible alternatives within the development proposal;
- Provide a comprehensive assessment of predicted impacts that may result from the proposed project, in accordance with the specified impact assessment methodology;
- Where alternatives have been assessed, make recommendations for the best practice environmental option (BPEO);
- Recommend actions to mitigate negative impacts or enhance benefits;
- Provide recommendations for monitoring programmes.

This report is the third of a number of reports produced in the EIA process. This EIAR has been produced in accordance with the requirements as stipulated in Section 31 (2) of the EIA regulations (GNR 543), which clearly outlines the content of environmental impact assessment reports, and Chapter 6 (GNR 543) which covers the activities necessary for a successful Public Participation Process (PPP).

Nature of this Report

In accordance with the EIA Regulations (2010), an EIA report must contain all the information that is necessary for the competent authority to consider the application and to reach a decision (Table 1.2).

Table 1.2: EIA regulation requirements and structure of the report

EIA Regulation Requirements	Section/Chapter
Details of the Environmental Assessment Practitioner (EAP) and their expertise	Section 1.3
A detailed description of the proposed activity	Chapter 2
A description of the property on which the activity is to be undertaken and the location of the activity on the property	Chapter 2
A description of the environment that may be affected by the activity and the manner in which it may be affected	Chapter 4
Details of the public participation process conducted	Chapter 6 and Appendix F
A description of the need and desirability of the proposed activity	Chapter 5
Identification of potential alternatives to the proposed activity	Chapter 7
An indication of the methodology used in determining the significance of potential environmental impacts	Appendix A
A description and comparative assessment of alternatives	Chapter 7
A summary of the findings and recommendations of specialist reports.	Chapter 8

EIA Regulation Requirements	Section/Chapter
A description of all environmental issues, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures	Chapter 9
A description of any assumptions, uncertainties and gaps in knowledge	Section 1.4
An opinion as to whether the activity should or should not be authorised	Chapter 13
An environmental impact statement which contains a summary of the findings and a comparative assessment of the positive and negative implications.	Chapter 13
A Draft Environmental Management Programme (EMPr)	Volume 4
Copies of the Specialist Reports	Volume 2
Any additional information that may be required by the competent authority.	Appendix E

In line with Table 1.2, this report, which forms Volume 3 of the suite of EIA documents related to the proposed project, is structured as follows:-

Chapter 1 – Introduction: Provides background information on the proposed project, a brief description of the EIA process required by NEMA and its regulations, and describes the key steps in the EIA process that have been undertaken. The details and expertise of the Environmental Assessment Practitioner (EAP) who compiled this report are also provided in this Chapter.

Chapter 2 – Project Description: Provides a detailed description of the proposed development, the properties on which the development is to be undertaken and the location of the development on the properties.

Chapter 3 – Relevant Legislation: Provides details of all relevant legislation that was taken into account during the environmental impact assessment process.

Chapter 4 – Description of the Affected Environment: Provides a description of the environment that may be affected by the proposed activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected.

Chapter 5 – Public Participation Process: Provides details of the public participation process conducted in terms of regulation (31) sub-regulation (1) including:

- Steps undertaken in accordance with the Plan of Study (PoS);
- A list of all persons, organisations and organs of state that were identified and registered as I&APs in relation to the application.
- A summary of the comments received from, and a summary of the issues raised by registered I&APs, the date of receipt of these comments and the response of the EAP to those comments; and
- Copies of any representations, objections and comments received from registered I&APs.

Chapter 6 – Need and Desirability: Provides a description of the need and desirability of the proposed activity, including advantages and disadvantages of the proposed activity.

Chapter 7 – Alternatives: Provides a description of the alternatives to the proposed development or parts of the proposed development. It also includes a comparative assessment of viable alternatives.

Chapter 8 – Methodology for Assessing Impacts: Provides an indication of the methodology used in determining the significance of potential environmental impacts.

Chapter 9 – Key Findings of the Specialist Studies: This Chapter summarises the findings of the specialist studies which are included in full in ***Volume 2: Kamiesberg Project, Namaqualand, South Africa: Specialist Report (CES, August 2014).***

Chapter 10 – Assessment of Impacts: Provides -

- A description of all environmental issues relating to all phases of the proposed development that were identified during the EIA process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures.
- An assessment of each identified potentially significant impact, including:
    - i. Cumulative impacts;
    - ii. The nature of the impact;
    - iii. The extent and duration of the impact;
    - iv. The probability of the impact occurring;
    - v. The degree to which the impact can be reversed;
    - vi. The degree to which the impact may cause irreplaceable loss of resources; and
    - vii. The degree to which the impact can be mitigated.

Chapter 11 – Conclusions and Recommendations: Provides –

- An opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.
- An environmental impact statement which contains –
    - i. A summary of the key findings of the environmental impact assessment; and
    - ii. A comparative assessment of the positive and negative implications of the proposed activity and identified alternatives.

Chapter 12 – References: Cites any texts referred to during preparation of this report.

Appendices

Volume 1 - Final Scoping Report: The FSR has already been submitted to and approved by the DENC (Appendix D). This report is not included in the Final EIA submission as it has already been approved by the Department.

Volume 2 - Specialist Reports: Provides copies of the specialist reports complying with Regulation 32 of the EIA Regulations (GNR 543).

Volume 3 – Environmental Impact Assessment Report: This report represents the Final EIAR that has been submitted to DENC.

Volume 4 - Environmental Management Programme: Provides an Environmental Management Programme (EMP) that complies with Regulation 33 of the EIA Regulations (GNR 543).

1.3 DETAILS OF THE EAP

In terms of Section 31 (2), ***an environmental impact assessment report must include –***

(a) ***The details of -***
i. The EAP who compiled the report; and
ii. The expertise of the EAP to carry out an environmental impact assessment.

In fulfilment of the above-mentioned legislative requirement as well as Section 17 of the EIA Regulations (2010) which states that, *"an EAP must have expertise in conducting environmental impact assessments, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity"*, provided below are the details of the Environmental Assessment Practitioner (EAP) that prepared this Environmental Impact Assessment Report (EIAR) as well as the expertise of the individual members of the study team.

Coastal and Environmental Services (CES)
Physical Address: 67 African Street, Grahamstown 6139
Postal Address: P.O. Box 934, Grahamstown 6140
Telephone: +27 46 622 2364
Fax: +27 46 622 6564
Website: www.cesnet.co.za
Email: t.avis@cesnet.co.za

1.3.1 Expertise of the EAP

CES is one of the largest specialist environmental consulting firms in southern Africa. Established in 1990, and with offices in Grahamstown, East London, Johannesburg, Cape Town and Port Elizabeth in South Africa and Maputo in Mozambique, we primarily specialise in assessing the impacts of development on the natural, social and economic environments. CES's core expertise lies in the fields of strategic environmental assessment, environmental management plans, environmental management systems, ecological/environmental water requirements, environmental risk assessment, environmental auditing and monitoring, integrated coastal zone management, social impact assessment and state of environment reporting. In addition to adhering to all relevant national legislative requirements, which we are often required to review and summarise for specific projects, acquisition of equity funding from the majority of financial institutions demands that developments must meet certain minimum standards that are generally benchmarked against the Policy and Performance Standards of the International Finance Corporation and the World Bank Operational Directives and Policies. The quality of our work during our long and extensive association with heavy mineral mining in Africa (we have worked on large projects in South Africa, Mozambique, Malawi, Kenya, Madagascar and Egypt) has been acknowledged by international lenders such as the World Bank and the International Finance Corporation, and the large mining companies continue to approach us as their preferred environmental consultant for this type of project.

Provided below are short curriculum vitae (CVs) of each of the team members involved in the proposed Kamiesberg development.

Dr Ted Avis *(Project Leader and Report Reviewer)*
Ted is a leading expert in the field of Environmental Impact Assessments, having project-managed numerous large-scale EIAs to international standards (e.g. World Bank and International Finance Corporation). Ted has also project managed and provided professional input to the State of Environment reports and Strategic Environmental Assessments

produced by CES.

Dr Chantel Bezuidenhout *(Project Manager and Report Production)*
Chantel holds MSc and PhD degrees in Botany (estuarine ecology) and a BSc degree in Botany and Geography from NMMU. Chantel's main focus is estuarine ecology and she has done extensive work on 13 systems from the Orange River Mouth in the Northern Cape to the Mngazi Estuary in the Transkei. As a result she has been involved in a number of ecological reserve determination studies including the Kromme, Seekoei and Olifants systems. Chantel has been an Environmental Consultant for approximately 6.5 years and as such has been focused on environmental management and impact assessment. Chantel is well versed in environmental legislation and has been involved in number of environmental impact assessments and management plans in South Africa, Zambia, Mozambique and Madagascar. She is currently employed in the Port Elizabeth office of CES.

Ms Kim Brent *(Report Production)*
Kim holds a BSc degree with majors in Botany and Geography as well as a BSc (Hons) degree, both from NMMU. Her honours year focused on Environmental Impact Assessments, Environmental Management and Geographic Information Systems. Kim's research projects in her honours year focused on plant physiology and biological factors of the Velddrif Solar Saltworks. Kim's interests include Basic Assessments, Environmental Impact Assessments, Environmental Management Plans, Environmental Auditing, Geographic Information Systems and Botanical Assessments. Kim has 3 years' experience in the consultancy environment and is currently employed in the Port Elizabeth office of CES.

Internal Specialists

Mr Bill Rowlston *(Surface and Groundwater Assessment and Traffic and Transport Assessment)*
Bill holds a First Class Honours degree in civil engineering from the University of Salford, England (1971), after which he worked for 11 years for engineering consultants in England. He worked for 25 years for the South African Department of Water Affairs and Forestry, where he contributed to the development of the National Water Policy and the National Water Act, and compiled and edited the National Water Resource Strategy, First Edition (2004), much of which he wrote. Bill joined CES as a Director in 2007. He has worked as project manager on a number of large ESIAs and ESHIAs in South Africa and in other African countries, and has undertaken environmental and social due diligence studies, compliance reviews and audits to international standards for a range of proposed and operational projects. He has also prepared specialist reports on water resources, and has compiled traffic impact assessments for industrial, agri-industrial and mining projects, including a manganese smelter and an agri-industrial development in South Africa's Eastern Cape Province, an iron ore mine in Mozambique, forestry and agri-industrial projects in Mozambique, and a bulk water main in Kwa-Zulu Natal, South Africa.

Mr Roy de Kock *(Soils and Agricultural Assessment)*
Roy holds a BSc Honours in Geology and an MSc in Botany from the Nelson Mandela Metropolitan University in Port Elizabeth. His MSc thesis focused on Rehabilitation Ecology using an open-cast mine as a case study. He has been working for CES since 2010, and is based at the East London branch where he focuses on Ecological and Agricultural Assessments, Geological and Geotechnical analysis, Environmental Management Plans, mining applications and various environmental impact studies. Roy has worked on numerous projects in South Africa, Mozambique and Malawi.

Mr Thomas King *(Visual Impact Assessment)*
Thomas holds a BSc degree majoring in Zoology from the University of Pretoria and an Honours degree in Biodiversity and Conservation from Rhodes University. As part of his Honours degree, Thomas was trained in Geographical Information Systems (GIS) in addition to the required biological sciences courses. With CES, he has been primarily in charge of all GIS related work, including database and software management. He has been the lead author of two Visual Impact Assessments; for the Syrah Resources Graphite Mine in Mozambique and the Tete Iron Ore Mine in Mozambique. He has assisted in the compilation of numerous others. He is fully competent with the use of ArcGIS 10 including ArcMap, ArcCatalog, and ArcScene. He is also familiar with the use of supporting GIS software such as Oruxmaps, Quantum GIS, DNR Garmin, to name a few.

Mr Anton Hough *(Social Impact Assessment)*
Anton is a social scientist in the company engaging, amongst others, in Social Impact Assessments (SIAs), social baseline studies, Social Management Plans, Relocation Action Plans (RAPs) and Public Participation Processes (PPPs). His academic qualifications and accomplishments include a Masters Degree in Sociology obtained from the University of Stellenbosch in South Africa, in addition to one published ISI-listed academic publication and two forthcoming publications. Before CES he has gained experience as a social scientist mostly in the mining and community development sector, but also the socio-environmental arena; the latter for which he has published web-based articles on socio-environmental concern in Africa.

Dr Eric Igbinigie *(Waste Assessment)*
Eric is a registered Professional Natural Scientist (Pr.Sci.Nat.). Eric holds a PhD in Environmental Biotechnology and his professional interest is in Sustainable Integrated Environmental Management with a keen interest in Waste & wastewater specialist assessment, Environmental due diligence, Contamination assessment and remediation, and Environmental & Social compliance audits. Eric has successfully conducted several related local and international environmental projects across Africa in compliance with the requirements of Equator Principles Financial Institutions including the IFC, SWEDFUND, DEG and AfDB, where he served as both specialist consultant and project manager. Before joining CES Eric served as a Senior Research Scientist at the Institute for Environmental Biotechnology, Rhodes University conducting postgraduate lectures and led a research group tasked with the successful beneficiation of coal spoils, facilitating the re-vegetation of coal mine dump sites evident in Witbank, South Africa.

External Specialists

Mr Jonathan Kaplan (*Heritage Specialist*)
Jonathan (Director of the Agency for Cultural Resource Management - ACRM) qualified with an MA in Archaeology in 1989 from the University of Cape Town. He has taken part in more than 800 Archaeological Impact Assessments (AIAs), specialising in Stone Age, rock art and herder studies. Jonathan has undertaken baseline studies on large infrastructure projects, including the Lesotho Highlands Water Project, Maguga Dam (Swaziland), Namibia/Botswana Water Transfer Project, Sasol/ACO Gas Pipeline (South Africa & Mozambique), Corridor Sands (Mozambique) and numerous utility projects for Eskom, the Department of Transport and Public Works, local authorities, as well as coastal and inland surveys, research projects, catchment management studies, monitoring of construction activities, Heritage Management Plans and has undertaken excavations of rock shelters and coastal shell middens. since 2010, ACRM has also conducted baseline studies (Scoping and full EIA) on a number of alternative energy (wind and photo-voltaic) projects in the Western and Northern Cape Provinces. ACRM has been registered since 1992

Mr Nick Helme *(Botanical Assessment)*
Nick Helme Botanical Surveys was established in 2001, after 4 years of focussed botanical consulting experience as part of a larger company, and after extensive biological survey work in Bolivia, Cameroon and Madagascar. Nick Helme is a Sole Proprietor (no partners or associates) and is SACNASP registered as a Pri. Sci. Nat. (# 400045/08). Based in Scarborough, Cape Town. Nick specialises in botanical assessments (biodiversity assessments, baseline surveys, basic assessments, full impact assessments) in the Southwest and Northern Cape (mostly in the Greater Cape Floristic Region), and most work is related to development applications (urban, energy, agriculture, mining, infrastructural). Nick has compiled over 1300 site assessments and at least 250 full impact assessments. Nick undertook the vegetation mapping component for four regional Fine Scale Conservation Plans for CapeNature in 2006, and is a primary author of assessments in the SANBI Red List of South African Plants, and was co-author of the Fynbos Forum Ecosystem Guidelines and of the Fynbos chapter in the SA Vegetation Map publication. Nick has published 15 peer reviewed scientific papers, numerous popular articles, has collected 8500 plant specimens, and has discovered more than fifty previously undescribed plant species in the Cape region alone.

Mr Werner Conradie *(Faunal Assessment)*
Werner holds a Masters in Environmental Science (M.Env.Sc), specialising in Herpetology and Zoology in general with 8 years of experience in southern African herpetofauna. Main research interests focus on the taxonomy, conservation and ecology of amphibians and reptiles of southern Africa. Werner is co-author of 'Field Guide to the Frogs and Toads of the Vredefort Dome World Heritage Site' and numerous scientific papers. Research expeditions include countries like Namibia, Botswana, Zimbabwe, Mozambique, Angola and Malawi.

Ms Terri Bird *(Air Quality Assessment)*
Dr Terri Bird holds a PhD from the School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg. The focus of her doctoral research was on the impact of sulfur and nitrogen deposition on the soil and waters of the Mpumalanga Highveld. Since March 2012 she has been employed at Airshed Planning Professionals (Pty) Ltd. In this time, she has been involved in air quality impact assessments for various mining operations (including coal, mineral sand, diamond and platinum mines) as well as coal-fired power station ash disposal facilities. She has been a team member on the development of Air Quality Management Plans, both provincial and for specific industries. Recent projects include assessing the impact of Postponement and/or Exemption of Emission Standards for various Listed Activities.

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

Ms Vumile Dlamini *(Health Impact Assessment)*
Vumile is an Environmental Health Consultant employed within Digby Wells' Community Health Impact Assessment Division where she is involved in conducting Health Impact Assessments in various mining operations throughout Africa. Her responsibilities include the compilation of Health and Environmental Management Plans, in accordance with both local South African standards and International standards. Vumile holds a Bachelor of Social Sciences (Honours) degree in Environmental Analysis and Management from the University of Pretoria, and is currently completing her Masters Degree (at the University of the Witwatersrand) in Environmental Science focussing on Air Quality: The Respiratory Health Impacts of Open-cast Coal Mining. Before joining Digby Wells, Vumile has spent time as a Client Services Executive under Ernst and Young's Climate Change and Sustainability Services Department, offering Environmental Auditing and advisory services around sustainable development strategies and frameworks. Vumile has six years in the consultancy environment and is well versed in Environmental Impact Assessments, Environmental Auditing, GIS and Remote sensing, as well as Environmental Law practices.

1.4 ASSUMPTIONS AND LIMITATIONS

The following limitations and assumptions are implicit this report –

- ❖ The primary assumption underpinning this EIA and the individual specialist studies upon which this EIAR is based is that all information received from the proponent (Zirco Roode Heuwel (Pty) Ltd) and other stakeholders including registered I&APs was correct and valid at the time of the study.
- ❖ To ensure that the significance of impacts were not under-estimated, the specialists assessed impacts under the worst-case scenario situation.

2. PROJECT DESCRIPTION

2.1 LOCATION OF THE STUDY AREA

Zirco currently holds the prospecting right to the Roode Heuvel and Leeuvlei deposits, located approximately 500 km north of Cape Town and approximately 35 km to the southwest of the town of Garies in the Northern Cape Province of South Africa. They are also in the process of acquiring prospecting rights for a further deposit immediately east of and adjacent to Roode Heuvel, referred to as “Sabies”. This report deals with all three areas which combined form Zirco’s Kamiesberg Project. Included in the table below are the farm names and the co-ordinates of the properties involved in the proposed mining application.

Table 2.1: Farm names and co-ordinates of the mining deposists

Deposit	Farm Name	Co-ordinates
Roode Heuvel	Roode Heuvel 6/502	30°44'1.94"S 17°36'51.40"E
	Roode Heuvel 5/502	30°43'47.51"S 17°37'12.05"E
	Roode Heuvel 9/502	30°43'41.17"S 17°37'52.00"E
	Roode Heuvel 1/502	30°43'34.77"S 17°38'59.15"E
	Klipdam 633	30°43'57.81"S 17°40'8.77"E
Leeuvlei	Leeuvlei 642	30°36'51.55"S 17°39'30.46"E
	Leeuvlei 1/437	30°37'47.76"S 17°38'18.67"E
	De Klipheuvel 9/435	30°38'10.76"S 17°37'7.09"E
	De Klipheuvel 10/435	30°39'23.99"S 17°38'4.76"E
Sabies	De Klipheuvel 11/435	30°39'42.99"S 17°39'55.85"E
	Sabies 2/505	30°41'1.77"S 17°41'56.47"E
	Hawerland RE/503	30°42'26.05"S 17°40'49.63"E
	Hawerland 1/503	30°44'42.44"S 17°43'35.75"E
	Hawerland 2/503	30°44'43.09"S 17°42'17.14"E
	Hawerland 3/503	30°45'24.12"S 17°41'26.77"E

Figure 1.1 shows the location of the project in relation to the regional setting. The town of Garies is located approximately 35 km in a direct line from the site and approximately 50 km by road. The town of Bitterfontein is located 65 km south of Garies, and Springbok, where the regional administration for the Namaqua area is located, is 117 km north of Garies.

The proposed site layout is shown in Figure 2.1 below.

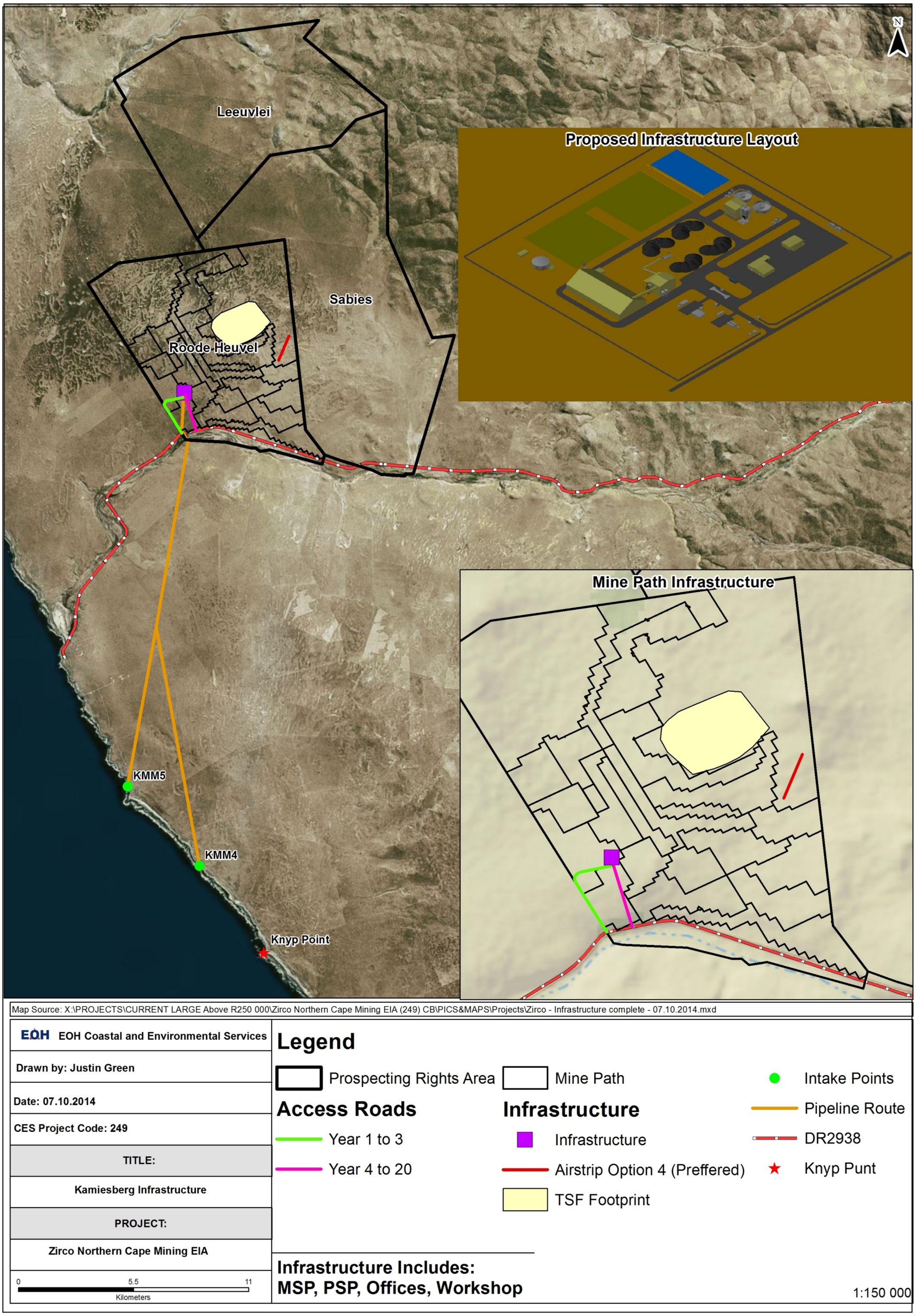


Figure 2.1: Project Layout

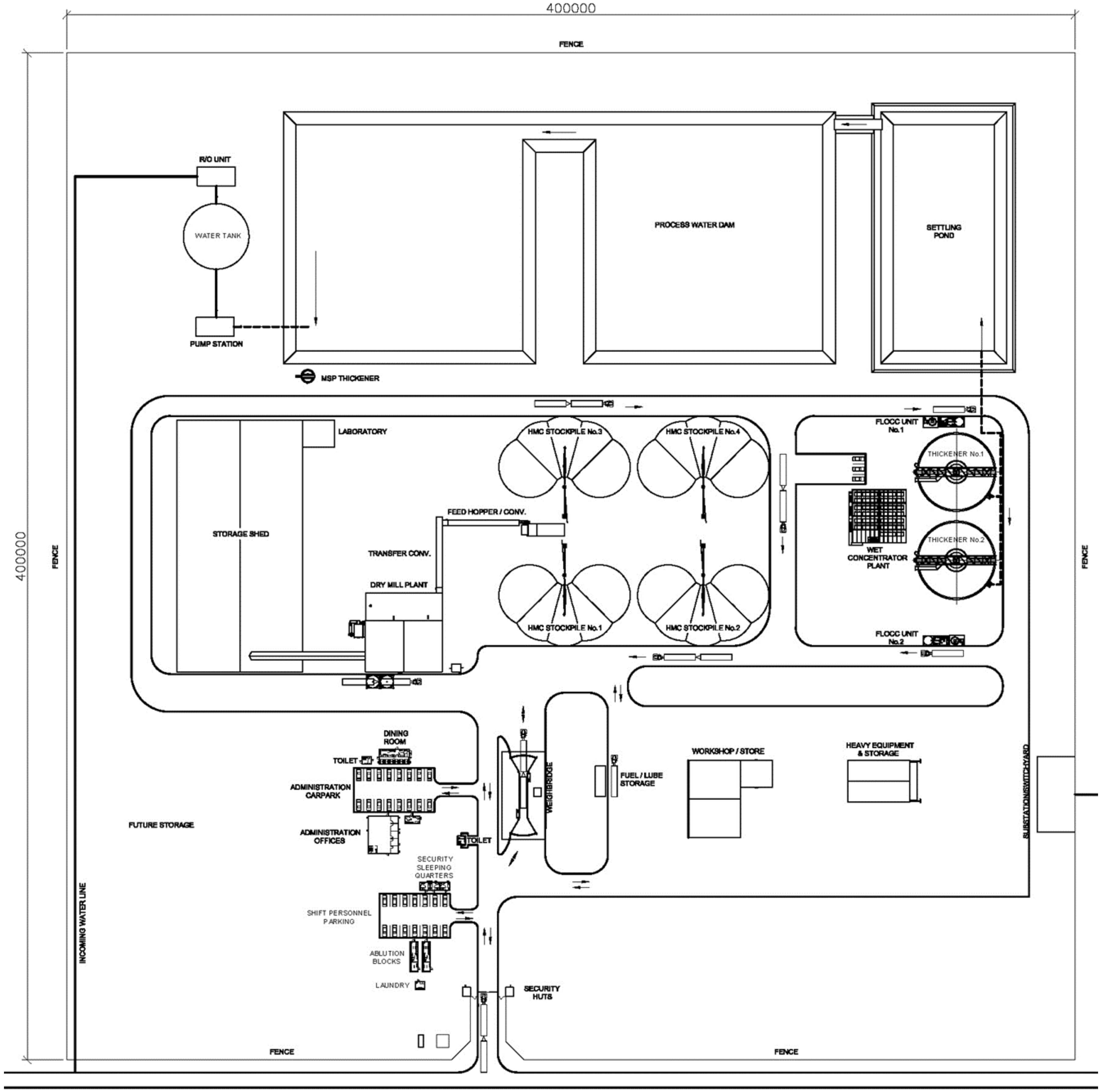


Figure 2.2: Layout of section labelled “infrastructure” in Figure 2.1

2.2 TECHNICAL DESCRIPTION OF THE PROPOSED MINING PROJECT

2.2.1 Proposed Mining Methodology

Dry mining using front end loaders is the most likely scenario. It is a low risk option and does not require as much water as a dredge mining operation. The latter could also be unsuitable given the high amounts of slimes in the deposit. Initial mining will target the higher grade areas at an initial rate of 1 000 to 1 500 tph. After year 6 the operation will move to the lower grade areas and the mining rate will increase to 1 800 to 2 300 tph to maintain an average output of about 520 000 tons per annum (tpa) of heavy mineral concentrate. Over a 20 year mine life a total of some 270 million tons would be mined.

Mining involves clearing vegetation and stockpiling topsoil ahead of the mine path, excavating the mineralised sand using front end loaders and transferring this material to a hopper from where it will be slurried and pumped to the primary concentration plant. The area would then be back-filled after mining, covered with top soil and rehabilitated.

This approach to mining and delivering the ore to the PCP is easy to manage, and is currently employed at several mineral sands operations around the world. Typical dry mining / slurrying operations are shown in Plate 2.1, and the process is illustrated schematically in Figure 2.3.

Plate 2.1: Typical loader and hopper dry mining operation

The excavated sand (via front end loader) is fed at a controlled rate through a small screen and into a hopper onto a conveyor. The conveyor feeds the material screen that removes oversize material, into the slurrying hopper. Water is added and the slurry is sucked by the transfer pump from the bottom of the slurrying hopper into the high-density polyethylene (HDPE) delivery line. The length of the pipeline between the excavation point and the PCP is a maximum of 2 000 metres. The slurrying / slurry pumping unit, which is mounted on a skid and is easily relocated to the next mining sector, is moved regularly to ensure the front-end loader tramming distance is kept to a minimum.

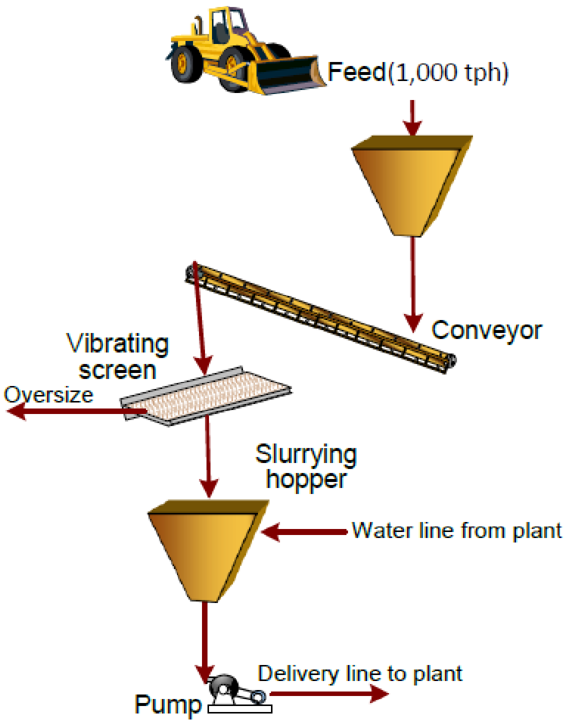


Figure 2.3: Mining operation and ore delivery flow diagram
(Source TZMI)

2.2.2 Mineral Processing

The mineralised sand will first be concentrated in the Primary Concentrator Plant (PCP) to produce a Heavy Mineral Concentrate (HMC).The HMC will then be processed in a Mineral Separation Plant (MSP) where the final products - ilmenite, monazite, zircon and rutile - will be produced.

Primary Concentrator Plant (PCP)

Ore from the mining face will be pumped to the PCP, where it will undergo desliming, to remove silt and clay before treatment on the spiral circuit to remove the quartz. The HMC will be polished by water attritioning to remove surface coatings, and then stockpiled at the concentrator.

Multiple stages of spirals will be used in the PCP(s) to upgrade the ore (± 5% THM) to a heavy mineral concentrate (95% THM). The flow sheet adopted is a standard configuration of spirals, with process water recirculated via a thickener from hydrocyclones to remove slimes from the ore. The water attritioning step has been added to the end of the wet plant to assist in further downstream processing through the removal of any surface coatings from the minerals.

It is important to note that this separation process does not involve any changes to the chemical composition of the ore. The HMC is separated from the ore by gravity using standard spirals, with the waste sand tailings back filled into the mined area. A simplified process flow sheet is presented in Figure 2.4.

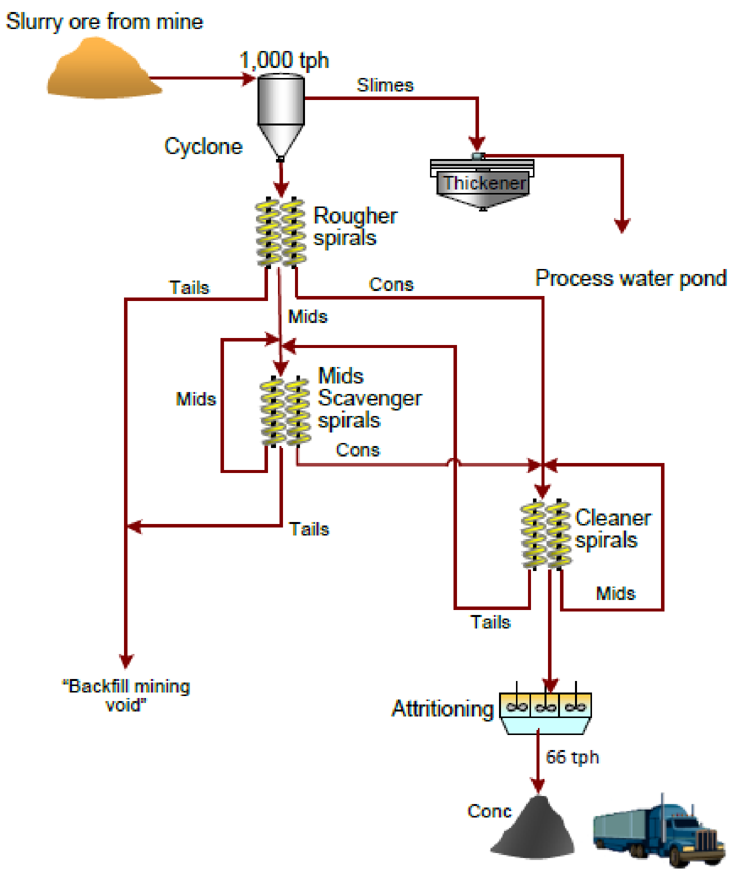


Figure 2.4: Simplified flow sheet for a single primary concentrator
(Source TZMI)

Mineral Separation Plant (MSP)

Once the HMC has been upgraded to 95% total heavy mineral it will be transported from the PCP to the MSP.

Incoming HMC from the PCP will be processed via a series of magnetic and electrostatic separators to produce three final products, ilmenite, a monazite rich concentrate and a combined rutile/zircon concentrate. A tactical stockpile of HMC will be maintained at the MSP site to enable a constant feed rate into the drying equipment (Figure 2.5).

The MSP has two separate sections; an ilmenite circuit and a non-magnetics circuit. The following principles have been adopted to achieve good product quality and very efficient recovery:

- The HMC must be fresh water-attritioned to remove surface coatings and salt;
- Dry magnetic separation followed by electrostatic cleaning gives superior yield and quality to the ilmenite products;
- Monazite removal is a significant process condition throughout the flow sheet;
- Conventional wet gravity cleaning is sufficient to remove light-heavy impurity minerals from the non-magnetics products; and
- Standard electrostatic and rare earth magnetic separators will be suitable for all of the dry parts of the flow sheet.

It is anticipated that the MSP will process 70 tph of feed to produce 500 000 tpa of ilmenite, 5 000 tpa of monazite and 62 500 tpa of a rutile/zircon concentrate.

Tailings Disposal

Mining, concentration and tailings disposal will occur as a continuous process. These fall into two categories, the coarser sand (predominantly quartz) and the finer slimes (predominantly clay). The only additives to the material prior to deposition as tailings will be water and a biodegradable flocculent (settling agent). Tailings will be placed in an off mine path tailings facility as well as backfill within the mined areas. A tailings facility is necessary as an initial void must be created prior to being able to deposit tailings back into the mined out areas and as a storage area when the areas being mined are not deep enough, or too steep, for effective slimes backfill.

The area of the tailings storage facility will have topsoil removed and stockpiled prior to walls being constructed with sand to form a dam for the tailings. Upon closure a top layer of sand and then topsoil will be placed over the facility prior to re-vegetation. The sand walls will be constructed at a very low angle to allow the facility to blend into the landscape once vegetated.

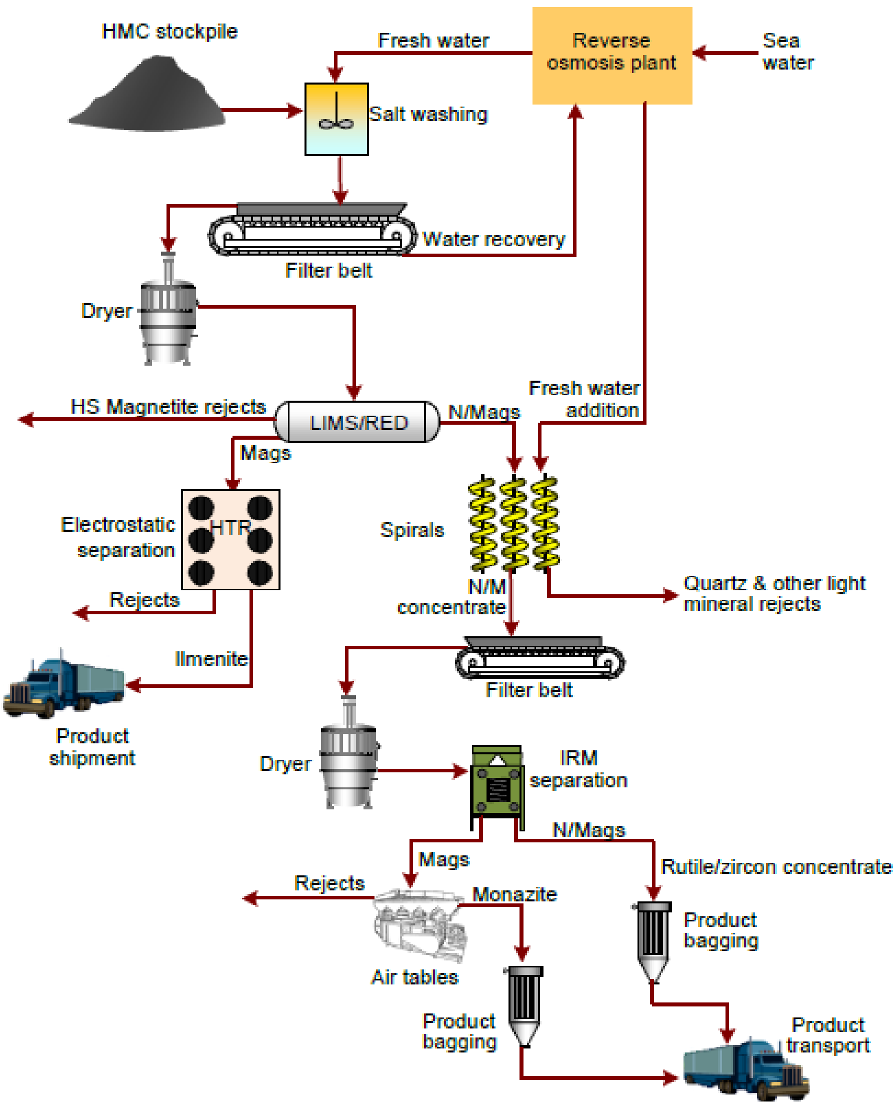


Figure 2.5: Simplified flow sheet for a mineral separation plant
(Source TZMI)

Sand will also be used to construct paddock walls within the mined out area to contain slimes pumped into them. These slimes filled paddocks will then be overtopped with sand and re-contoured to a similar profile to pre mining allowing it to blend in with the surroundings prior to topsoil covering and re-vegetation

The MSP will be located at the mine site.

2.3 TECHNICAL DESCRIPTION OF THE ASSOCIATED INFRASTRUCTURE

2.3.1 Processing Water

Even though a dry mining process is anticipated, the proposed operation will require large volumes of water, as a wet separation process is required to separate the HMC from the sand tails. Although water is recycled via the slimes thickener, a certain percentage of water remains tied up with the thickened slimes and sand tails in the backfill areas. TZMI assume that up to 12 G*l* (12 million m^3) of make-up water will be required per annum, translating to 33 000 m^3 per day. It is anticipated that seawater will be used for processing in the PCP as there is insufficient groundwater available for this purpose. It will thus be required to construct a pipeline from the coast to the mine site, as well as a pumping station. The diameter of the pipeline is anticipated to be approximately 1 m and the length approximately 20 km. The pipeline will be constructed above ground and thus no extensive trenching will be required, which will result in minimal disturbance of vegetation along this route. Seawater will be abstracted via a gully intake. This is feasible due to the rocky nature of the coastline in the area of the proposed development. Various options were considered for the position of the gully intake (refer to Chapter 7). The position of the pipeline, however is dependent on the position of the intake, thus only 2 options were considered (refer to Figure 2.6 below).

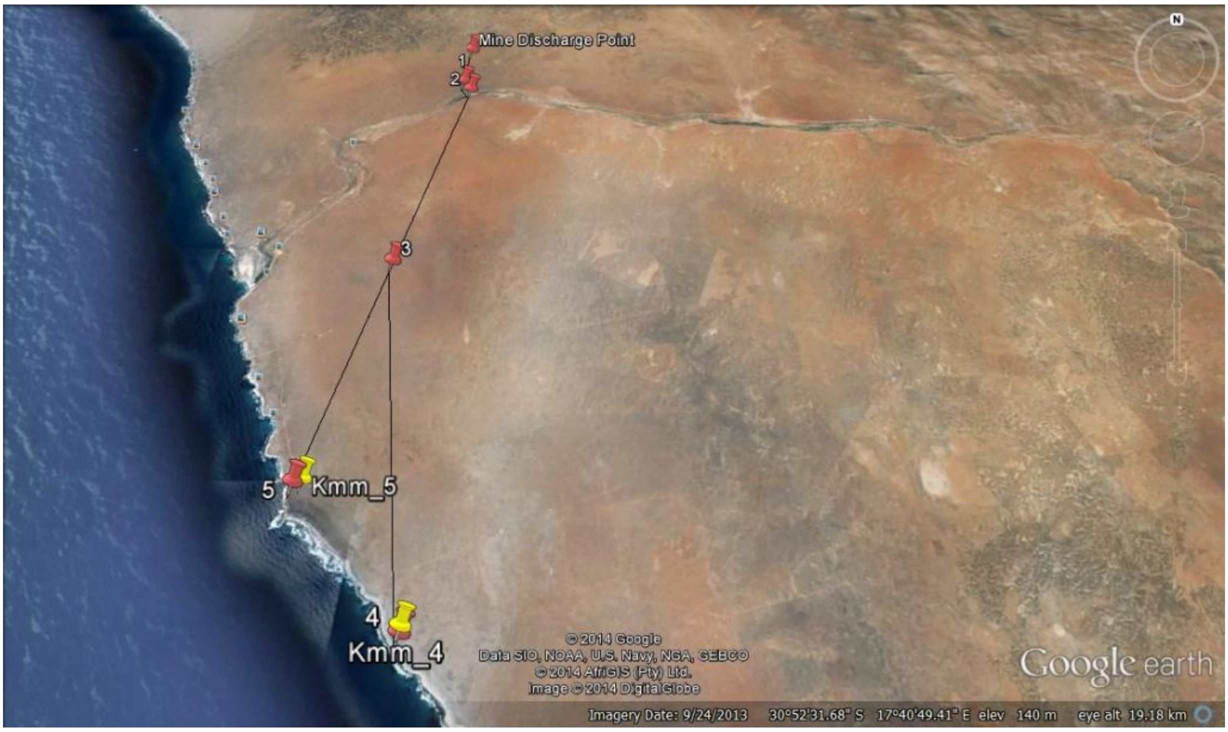


Figure 2.6: Pipeline routes from the preferred options for the gully intake (labelled as KMM4 and KMM5)

Table 2.2: Co-ordinates of the proposed options for the gully intake and pipeline

Point	South	East
Mine Discharge Point	30°44'25.00"	17°37'39.00"
Point 1 (North of River)	30°45'30.27"	17°37'35.93"
Point 2 (South of River)	30°45'45.98"	17°37'45.57"
Point 3 (Intersection)	30°50'33.70"	17°37'56.14"
KMM5	30°54'40.23"	17°37'12.26"
KMM4	30°56'43.26"	17°37'03.24"

Freshwater will be required for the washing of HMC prior to entering the MSP. The quantity of freshwater required has been estimated at 690 000 m^3 per annum (approximately 5.7% of the seawater requirements). This will be used for potable water and to remove salt from the HMC prior to it going into the MSP.

To provide this fresh water a reverse osmosis desalination plant is planned to be constructed at the mine site. The desalination plant will treat sea water brought to the mine site as process water. The freshwater produced from the desalination plant will be used to wash salt from the HMC prior to separation in the MSP. Water used to wash HMC will be recycled into the process water.

2.3.2 Electricity

TZMI have estimated a power requirement of 15 MW, to be sourced from the national power grid. This line would need to be constructed from the Frontier Rare Earths project at Zandkops Drift. They intend to construct a high voltage transmission line to service their project. The 35 km line from Frontier to Roode Heuwel would be subject to a separate EIA undertaken directly on behalf of Eskom.

2.3.3 Fuel

Approximately 10 million litres of fuel will be required for the MSP and related project use per annum. Both diesel and paraffin will be required, necessitating the need for constructing a fuel depot. This will be done by a fuel supply company who will sell fuel on site to the mine, this will be subject to a separate EIA undertaken by the service provider.

2.4 TECHNICAL DESCRIPTION OF PRODUCT TRANSPORT

Product will be transported by road (N7) all the way from the mine site to Saldanha Port, using a 37 tonne pay load horse plus 2 trailers. This will result in relatively large volumes of road traffic along the N7, estimated at 20 round trips per day. In addition to this the provincial road to and the junction with the N7 may require upgrading in certain sections. The existing road reserve along the provincial road is mostly 25 m wide and will require only minor adjustments. However, the road will need to be realigned where is crosses the Groen River and upgraded at the junction with the N7 to provide free movement of large vehicles.

2.5 TECHNICAL DESCRIPTION OF ANCILLARY INFRASTRUCTURE

2.5.1 Sewage Treatment Works

Domestic sewage is characterised by a high concentration of nutrients, organic matter and a variety of pathogens. As such, it must be properly treated prior to discharge to avoid negative impacts to human and environmental health.

The construction workforce of 243 individuals will be employed at peak construction of which 200 of them will be accommodated at the construction camp site. The remaining 43 individuals will reside off-site but will have access to the ablution facilities. The construction workforce of approximately 250 individuals (at peak period) will generate sewage and wash water that will need to be managed.

Table 2.3 shows the summary of the anticipated general sewage and domestic wash water effluent streams associated with the construction phase of the Kamiesberg Project.

Table 2.3: Anticipated wastewater streams associated with the construction phase of the Kamiesberg Project

Phase	Waste Type	Estimated Quantity	Management & Disposal
Construction	Sewage / domestic wash water	6.1m^3/day (conservative scenario) and 48.6m^3/day (worst case scenario)	Sewage and other effluent from ablution facilities will be disposed by use of septic tanks and mobile toilets. As the construction phase nears completion it may be an option to direct the sewage to a packaged sewage treatment plant and the treated effluent then sent to the process water dam from where it will be pumped to the process water tank to be used as recycled water for mineral processing. If the treated sanitary effluent water is discharged onto the environment, it must meet national discharge standards.

Based on the calculated estimate of generated sewage and domestic wash water during the construction and operational phases of the project, a packaged sewage treatment plant with the capacity of treating ~50m^3 of domestic effluent per day is required for installation.

2.5.2 Airstrip

It is proposed to construct an airstrip within the exploration area in close proximity to the mining activities. The airstrip will be approximately 1 300 m in length. Four alternative locations where considered for the airstrip (refer to Chapter 7 and Figure 2.7 below), with option 4 being preferred.

2.5.3 Landfill Site

A General Waste Communal Landfill site with the classification system G:C:B$^+$ will be developed for the site. This would be sufficient to meet the general waste disposal requirements during the life of mine. Practical options would be considered for the management and disposal of hazardous wastes. The total capacity for the proposed landfill is in excess of 1008.8 tonnes but not exceeding 25000 tonnes with a footprint of less than 200m^2. The engineering design for the proposed landfill site would be in accordance with the Minimum Requirements for Waste Disposal by Landfill (DWAF 2005).

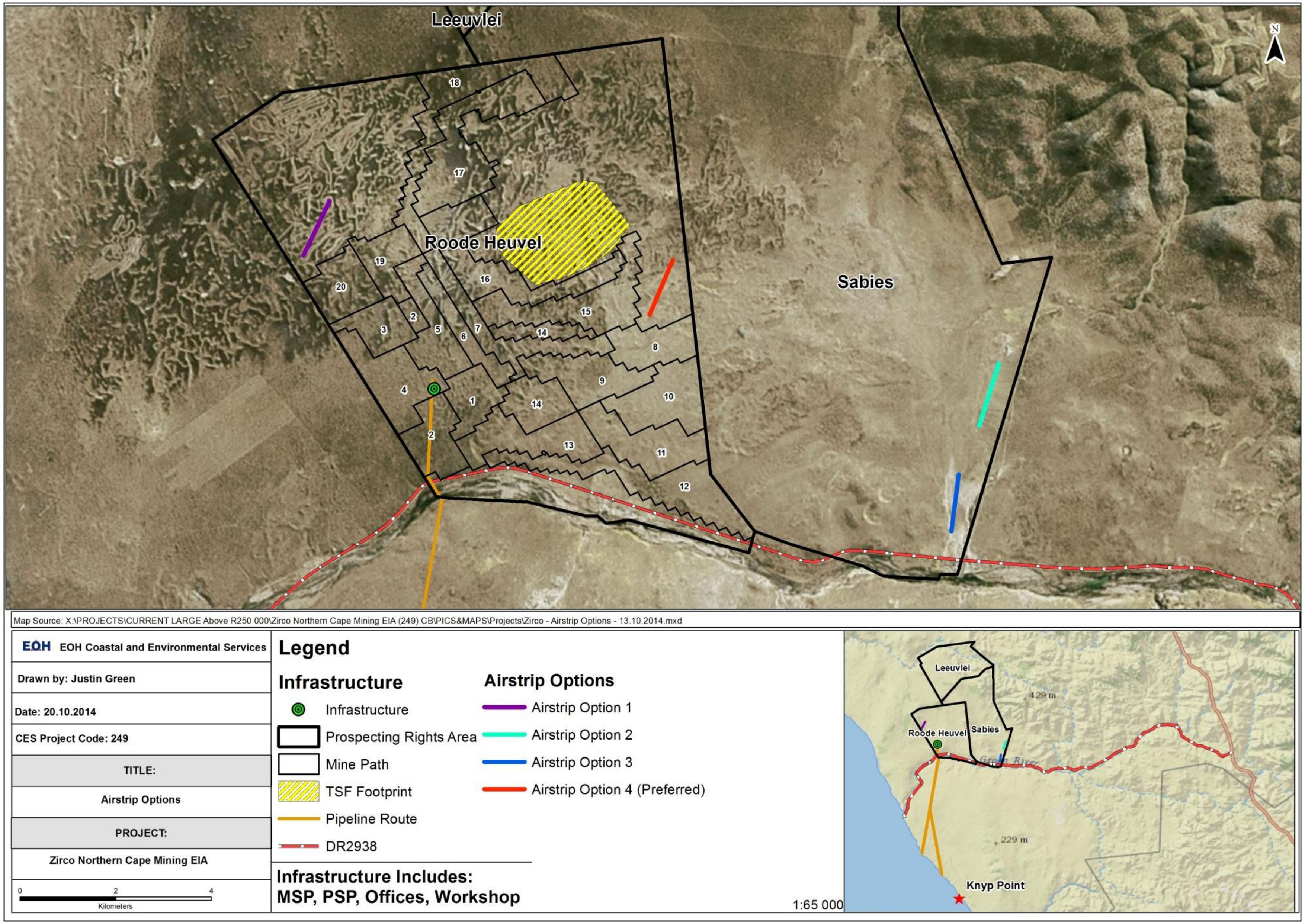


Figure 2.7: Alternative locations for the proposed airstrip

3. LEGISLATED REQUIREMENTS

The following International and South African legislation was taken into consideration during the environmental impact assessment process:

3.1 SOUTH AFRICAN LEGISLATION

3.1.1 The Constitution

The Constitution of the Republic of South Africa is the supreme law of the land. As a result, all laws, including those pertaining to the proposed development, must conform to the Constitution. The Bill of Rights - Chapter 2 of the Constitution, includes an environmental right (Section 24) according to which, everyone has the right:

a) To an environment that is not harmful to their health or well-being; and
b) To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that:

(i) Prevent pollution and ecological degradation;
(ii) Promote conservation; and
(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Relevance to the proposed mine and associated infrastructure:

- Obligation to ensure that the proposed development will not result in pollution and ecological degradation; and
- Obligation to ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.

3.1.2 The National Environmental Management Act (NEMA) (107 of 1998) as amended

The objective of NEMA is: "*To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith*."

A key aspect of NEMA is that it provides a set of environmental management principles that apply throughout the Republic to the actions of all organs of state that may significantly affect the environment. The proposed development has been assessed in terms of possible conflicts or compliance with these principles. Section 2 of NEMA contains principles (see Box 1) relevant to the proposed project, and likely to be utilised in the process of decision making by DENC.

BOX 1: NEMA ENVIRONMENTAL MANAGEMENT PRINCIPLES

(2)	Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.
(3)	Development must be socially, environmentally and economically sustainable.
(4)(a)	Sustainable development requires the consideration of all relevant factors including the following: i. That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;

	ii. That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; iii. That waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner.
(4)(e)	Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.
(4)(i)	The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.
(4)(j)	The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected.
(4)(p)	The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
(4)(r)	Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

As these principles are utilised as a guideline by the competent authority in ensuring the protection of the environment, the proposed development should, where possible, be in accordance with them. Where this is not possible, deviation from the principles would have to be very strongly motivated.

NEMA introduces the duty of care concept, which is based on the policy of strict liability. This duty of care extends to the prevention, control and rehabilitation of significant pollution and environmental degradation. It also dictates a duty of care to address emergency incidents of pollution. A failure to perform this duty of care may lead to criminal prosecution, and may lead to the prosecution of managers or directors of companies for the conduct of the legal persons.

In addition NEMA introduced a new framework for environmental impact assessments, the EIA Regulations (2010) discussed previously.

Relevance to the proposed mine and associated infrastructure:

- The developer must be mindful of the principles, broad liability and implications associated with NEMA and must eliminate or mitigate any potential impacts.
- The developer must be mindful of the principles, broad liability and implications of causing damage to the environment.

3.1.3 The National Environmental Management: Biodiversity Act (10 of 2004)

This Act provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 107 of 1998 (see Box 2 below). In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all developments within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

BOX 2: MANAGEMENT AND CONSERVATION OF SOUTH AFRICA'S BIODIVERSITY WITHIN THE FRAMEWORK OF NEMA

CHAPTER 4	
	Provides for the protection of species that are threatened or in need of national protection to ensure their survival in the wild; o To give effect to the Republic's obligations under international agreements regulating international trade in specimens of endangered species; and o Ensure that the commercial utilization of biodiversity is managed in an ecologically sustainable way.
CHAPTER 5 (Part 2)	
Section 73	A person who is the owner of land on which a listed invasive species occurs must: a) Notify any relevant competent authority, in writing, of the listed invasive species occurring on that land; b) Take steps to control and eradicate the listed invasive species and to prevent it from spreading; and c) Take all required steps to prevent or minimise harm to biodiversity.
Section 75	• Control and eradication of a listed invasive species must be carried out by means or methods that are appropriate for the species concerned and the environment in which it occurs. • Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment. • The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

The objectives of this Act are to provide, within the framework of the National Environmental Management Act, for:

- The management and conservation of biological diversity within the Republic;
- The use of indigenous biological resources in a sustainable manner.

The Act's permit system is further regulated in the Act's Threatened or Protected Species Regulations, which were promulgated in February 2007.

Relevance to the proposed mine and associated infrastructure:

- The proposed development must conserve endangered ecosystems and protect and promote biodiversity;
- Must assess the impacts of the proposed development on endangered ecosystems;
- No protected species may be removed or damaged without a permit;
- The proposed site must be cleared of alien vegetation using appropriate means

3.1.4 The National Forest Act (84 of 1998)

The objective of this Act is to monitor and manage the sustainable use of forests. In terms of Section 12 (1) (d) of this Act and GN No. 1012 (promulgated under the National Forests Act), no person may, except under licence:

- Cut, disturb, damage or destroy a protected tree; or
- Possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree.

Relevance to the proposed mine and associated infrastructure:

- If any protected trees in terms of this Act occur on site, the developer will require a licence from the DAFF to perform any of the above-listed activities.

3.1.5 The National Heritage Resources Act (25 of 1999)

The protection of archaeological and paleontological resources is the responsibility of a provincial heritage resources authority and all archaeological objects, paleontological material and meteorites are the property of the State. "*Any person who discovers archaeological or paleontological objects or material or a meteorite in the course of development must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority*".

Relevance to the proposed mine and associated infrastructure:

- An archaeological impact assessment must be undertaken during the detailed ESIR phase of the proposed project.
- No person may alter or demolish any structure or part of a structure, which is older than 60 years or disturb any archaeological or paleontological site or grave older than 60 years without a permit issued by the relevant provincial heritage resources authority.
- No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter or deface archaeological or historically significant sites.

3.1.6 The National Environmental Management: Air Quality Act (39 of 2004)

As with the Atmospheric Pollution Prevention Act 45 of 1965, the objective of the new Air Quality Act is to protect the environment by providing the necessary legislation for the prevention of air pollution. "*To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto.*"

Relevance to the proposed mine and associated infrastructure:

- The "best practicable means" for the abatement of dust during construction and operation if approved have to be taken.
- All appliances used for preventing or reducing to a minimum the escape into the atmosphere of noxious or offensive gases have to be properly operated and maintained and the best practice means for achieving this implemented.
- The construction of facilities for the storage of ore requires an Air Emissions Licence (This has been submitted).

3.1.7 Occupational Health and Safety Act (85 of 1993)

The objective of this Act is to provide for the health and safety of persons at work (See Box 3 below). In addition, the Act requires that, "*as far as reasonably practicable, employers must ensure that their activities do not expose non-employees to health hazards*" (Glazewski, 2005: 575). The importance of the Act lies in its numerous regulations, many of which will be relevant to the proposed development. These cover, among other issues, noise and lighting.

BOX 3: HEALTH AND SAFTY OF PERSONS AT WORK ACCORDING TO THE OCCUPATIONAL HEALTH AND SAFETY ACT

8: GENERAL DUTIES OF THE EMPLOYERS TO THEIR EMPLOYEES	
(1)	Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.
(2)	Without derogating from the generality of an employer's duties under subsection (1), the matters to which those duties refer include in particular- a) The provision and maintenance of systems of work, plant and machinery that, as far as is reasonably practicable, are safe and without risks to health; b) Taking such steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the safety or health of employees, before resorting to personal protective equipment; d) Establishing, as far as is reasonably practicable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in his business, and he shall, as far as is reasonably practicable, further establish what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons, and he shall provide the necessary means to apply such precautionary measures; e) Providing such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of his employees; f) As far as is reasonably practicable, not permitting any employee to do any work or to produce, process, use, handle, store or transport any article or substance or to operate any plant or machinery, unless the precautionary measures contemplated in paragraphs (b) and (d), or any other precautionary measures which may be prescribed, have been taken; g) Taking all necessary measures to ensure that the requirements of this Act are complied with by every person in his employment or on premises under his control where plant or machinery is used; h) Enforcing such measures as may be necessary in the interest of health and safety; i) Ensuring that work is performed and that plant or machinery is used under the general supervision of a person trained to understand the hazards associated with it and who have the authority to ensure that precautionary measures taken by the employer are implemented; and authority as contemplated in Section 37 (1) (b).
14: GENERAL DUTIES OF EMPLOYEES AT WORK **Every employee shall at work:-**	
(a)	Take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions;
(b)	As regards any duty or requirement imposed on his employer or any other person by this Act, cooperate with such employer or person to enable that duty or requirement to be performed or complied with;
(c)	Carry out any lawful order given to him, and obey the health and safety rules and procedures laid down by his employer or by anyone authorized thereto by his employer, in the interest of health or safety;
(d)	If any situation which is unsafe or unhealthy comes to his attention, as soon as practicable report such situation to his employer or to the health and safety representative for his workplace or section thereof, as the case may be, who shall report it to the employer; and
(e)	If he is involved in any incident which may affect his health or which has caused an injury to himself, report such incident to his employer or to anyone authorized thereto by the employer, or to his health and safety representative, as soon as practicable but not later than the end of the particular shift during which the incident occurred, unless the circumstances were such that the reporting of the incident was not possible, in which case he shall report the incident as soon as practicable thereafter.
15: DUTY NOT TO INTERFERE WITH, DAMAGE OR MISUSE THINGS **[S. 15 substituted by S. 3 of Act No. 181 of 1993.]**	
	No person shall intentionally or recklessly interfere with, damage or misuse anything which is provided in the interest of health or safety.

Relevance to the proposed mine and associated infrastructure:

- The developer must be mindful of the principles and broad liability and implications contained in the OHSA and mitigate any potential impacts.

3.1.8 National Water Act (36 of 1998)

The Act regulates the protection, use, development, conservation, management and control of water resources in South Africa. The principal concerns in terms of the Act are the potential for the proposed development to pollute surface and groundwater resources, and to ensure that water is used as efficiently as possible.

Chapter 4 Part 1 of the NWA sets out general principles for regulating water use. "*Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In general a water use must be licensed unless it is listed in Schedule 1, as an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence. The Minister may limit the amount of water which a responsible authority may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas*."

Since the proposed pipeline will cross the Groen River a Water Use License is required in accordance with Section 21 (c) and (i) of the National Water Act.

Relevance to the proposed mine and associated infrastructure:

19 (1) An owner of land, a person in control of land or a person who occupies or uses the land on which—

(a) any activity or process is or was performed or undertaken; or

(b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource,

must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.

3.1.9 Hazardous Substances Act (15 of 1973)

The Act aims to manage hazardous substances. It is the principal national legislation that controls the transportation, and manufacturing, storage, handling, treatment or processing facilities for any substance that is dangerous or hazardous (Groups I-IV). Specific regulations governing the conveyance of hazardous substances, including Group I substances, by road may also be relevant.

Relevance to the proposed mine and associated infrastructure:

- Manage the hazardous waste in such a manner that it does not endanger human health or the environment.
- Prevent the waste from being used for an unauthorised purpose.

3.1.10 National Environmental Management: Protected Areas Act (31 of 2004)

The purpose of this Act is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

The objectives of this Act are-

- To provide, within the framework of national legislation, including the National Environmental Management Act, for the declaration and management of protected areas;
- To provide for co-operative governance in the declaration and management of protected areas;
- To effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity;
- To provide for a representative network of protected areas on state land, private land and communal land;
- To promote sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas;
- To promote participation of local communities in the management of protected areas, where appropriate; and
- To provide for the continued existence of South African National Parks.

Implications for the proposed mine and associated infrastructure:

- The proposed mine site is in close proximity to the Namaqua National Park

3.1.11 Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks

The strategy on buffer zones for National Parks was originally established due to the increasing rate and extent of development in and around National Parks, resulting in the isolation of National Parks from wider natural areas. The function of the Buffer Zone is to reduce /mitigate the negative influences that activities in close proximities to National Parks may have on the Park. The function also includes integration of Parks into surrounding landscapes.

The main purpose of the Buffer Zone is thus to:

- “Protect the purpose and value of the National Park which is to be explicitly defined in the management plan submitted in terms of section 39(2) of the Act;
- Protect important areas of high value for biodiversity and/or to society where these extend beyond the boundary of the Protected Area;
- Assist adjacent and affected communities to secure appropriate and sustainable benefits from the National Park and buffer zone area itself by promoting a conservation economy, ecotourism and its supporting infrastructure and services, and sustainability through properly planned harvesting.”

According to this strategy, the establishement of a buffer zone around a National Park should be considered if the area is necessary for the proper conservation and effective protection of the National Park and would assist in achieving its objectives. This strategy also states that “the buffer zone is an area surrounding a National Park which has complementary legal and management restrictions placed on its use and development, aimed at providing an extra layer of protection to the integrity of the National Park.” This stretegy is specifically geared towards sections relating to protected areas as well as Goal 1.4 (Environmentally sound and sustainable development adjacent to protected areas).

A Buffer Zone has the following six (6) objectives:

1. Ensure the persistence of important species and ecological processes;

2. Promote broad based and sustainable economic activity;
3. Preserve, adapt, restore and stabilize cultural heritage and secure the sustainable use thereof;
4. Preserve and improve the quantity and quality of water from catchments in the park and the buffer zone;
5. Protect enhance and restore the unique and memorable character - the sense of place - that underpins the image of the National Park and their approaches, and
6. Protect and enhance the wilderness experience of park users.

The strategy stipulates that Buffer Zones must be established around National Parks in order to achieve the above goals. These buffer zones should be defined as priority natural areas, catchment protection areas and viewshed protection areas, and be identified by Government and integrated into management plans and Municipal Spatial Frameworks. These may then be established by publication in the Gazette or where appropriate, be declared as protected environments in terms of the Act.

It is important to note that to the best of our knowledge the buffer zone for the Namaqua National Park has not been promulgated in terms of the NEM:PAA by publication in the Government Gazette and a subsequent public participation process. In addition we have been informed by DENC (via the acceptance of the Scoping Report) that this project falls under their jurisdiction.

In terms of the implementing the buffer zone strategy, the Department of Environmental Affairs (DEA) is responsible for implementing the specific provisions of National Environmental Management legislation, as they relate to buffer zones, while SANParks is responsible for the management of National Parks. The National Park buffer zones, as defined in the park management plan, can be considered special areas in terms of section 24(2)(b) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The strategy also states that all development in a formally established buffer zone that requires an environmental authorisation in terms of the NEMA, will be subject to an environmental impact assessment process at national level. The Department's decision will be informed by the management authority's (SANParks) opinion on the potential impact on the National Park.

Implications for the proposed mine and associated infrastructure:

- The proposed mine site is within the Namaqua National Park Buffer Zone as established by the Namaqua National Park Management Plan

3.1.12 Convervation of Agricultural resources act (43 of 1983)

The purpose of this Act is to provide for control over the utilization of the natural agricultural resources in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants.

This is achieved by:

- Production potential of land is maintained,
- Preventing and combating erosion,
- Preventing and combating weakening or destruction of the water sources, and
- Protecting vegetation and combating of weeds and invader plants.

The Act provides a list of declared weeds and invader plants as well as indicators of bush encroachment.

In terms of weeds and invader plants:

- A land user shall control any category 1 plants that occur on any land or inland water surface.
- No person shall, except in or for purposes of a biological control reserve –
    - Establish, plant, maintain, multiply or propagate weeds and invader plants;
    - Import or sell propagating material of category weeds and invader plants; and
    - Acquire propagating material of weeds and invader plants

Implications for the proposed mine and associated infrastructure:

- If any declared weed and/or invader species listed in terms of this Act is present on site, it will have to be removed.

3.1.13 Mineral and Petroleum Resources Development Act (28 of 2002)

The MPRDA makes "*provision for equitable access to and sustainable development of the nation's mineral and petroleum resources*".

The Mineral and Petroleum Resources Development Amendment Act, 49 of 2008 (MPRDAA), which took effect on 7th June 2013, introduced significant amendments to the MPRDA, 28 of 2002 (Principal Act). In terms of the newly included section 38A, the Minister of Mineral Resources is the "*responsible party*" for implementing all "*environmental provisions*" as contained in NEMA. This is supported by section 24C(2A), introduced by the National Environmental Management Amendment Act, 62 of 2008 (NEMAA), which states that the Minister of Mineral Resources is the competent authority where the activity constitutes "*prospecting, mining, exploration, production or a related activity occurring within a prospecting, mining, exploration or production area*". However, section 14(2) of NEMAA states that "*any provision relating to prospecting, mining, exploration and related activities comes into operation on a date 18 months after the date of commencement of*" either NEMAA (62 of 2008) or MPRDAA (49 of 2008), whichever is the later date. The former commenced on 1st May 2009, and the latter on 7th June 2013, so the proposed changes to align the MPRDA with NEMA, and to make the Minister of Mineral Resources the responsible authority for mining-related environmental matters, will come into operation on 7th of December 2014.

The current application process for the submission of an application for environmental authorisation relating to a mining operation appears to remain as it was prior to the introduction of the MPRDAA. The Act, however still applies to the proposed project, since the proponent will have to apply for a mining licence from DMR in accordance with the MPRDA.

Implications for the proposed mine and associated infrastructure:

- The proposed project requires a mining license from DMR.

3.1.14 National Environmental Management: waste Act (59 of 2008)

This legislation aims to enforce an integrated approach to waste management, with emphasis on prevention and reduction of waste at source and, where this is not possible, to encourage reuse and recycling in preference to disposal. Section 16 (Chapter 4) of this Act deals with the general duty in respect to waste management and emphasises that, "*A holder of waste must, within the holder's power, take all reasonable measures to:- avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated; reduce, re-use, recycle and recover waste; where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner; manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts; prevent any employee or any person under his or her supervision from contravening this Act; and prevent the waste from being used for an unauthorised purpose*". Chapter 4, Part 3 of this Act deals with reduction re-use and recovery of waste, Part 4 deals with waste management activities, Part 5 covers storage collection and transportation of waste, Part 6 deals with treatment, processing and disposal of wastes, Part 7 covers industry waste management plans and Part 8 deals with contaminated land. Chapter 5 covers all issues regarding the licensing of waste management activities.

The proposed construction of a landfill site within the mine site may require a waste management licence if the thresholds identified within the NEM: WA listed activities are exceeded.

In terms of section 4 of NEM: WA, certain substances are specifically excluded from the application of NEM: WA, as they are regulated by another primary piece of legislation. The purpose of this exclusion is primarily to avoid any duplication in any regulatory processes. It is important to note these exclusions in relation to mining activities as section 4(1)(b) excludes "*residue deposits and residue stockpiles that are regulated under the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)"* from the application of NEM: WA. Therefore, all "residue deposits" and "residue stockpiles" will not be regulated by NEM: WA, but rather by the Minerals and Petroleum Resources Development Act 28 of 2002 ("MRPDA"). It is important to note that the MPRDA has recently been amended by the Minerals and Petroleum Resources Development Act 49 of 2008 ("MRPDAA").

The MPRDAA came into operation on 7 June 2013 (Proclamation 14 of 31 May 2013 published in *Government Gazette* 36512) amending the Mineral and Petroleum Resources Development Act 28 of 2002 (the Principal Act) including definitions. Section 1 of the MPRDAA defines "residue stockpile" as:

"any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated for potential re-use, or which is disposed of, by the holder of a mining right, mining permit, production right or an old order right"

There is, however, an intention to include "residue stockpiles" and "residue deposits" within the ambit of NEM: WA. It is unclear however when this proposed amendment will be effected, if at all.

Implications for the proposed mine and associated infrastructure:

- All reasonable measures must be taken to avoid the generation of waste and where such generation cannot be avoided, minimise the toxicity and amounts of waste that are generated; reduce, re-use, recycle and recover waste; where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
- Manage the waste in such a manner that it does not endanger human health or the environment or cause a nuisance through noise, odour or visual impacts.
- Prevent any employee or any person from contravening this Act; and prevent the waste from

being used for an unauthorised purpose.
- Waste management activities should be licensed.

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

According to Section 2 of the NEM: ICMA, the objects of this Act are:

- *To determine the coastal zone of the Republic;*
- *To provide, within the framework of the National Environmental Management Act, for the co-ordinated and integrated management of the coastal zone by all spheres of government in accordance with the principles of co-operative governance;*
- *To preserve, protect, extend and enhance the status of coastal public property as being held in trust by the State on behalf of all South Africans, including future generations;*
- *To secure equitable access to the opportunities and benefits of coastal public property; and*
- *To give effect to the Republic's obligations in terms of international law regarding coastal management and the marine environment.*

Section 13 of the NEM: ICMA states that any natural person in the Republic:

- *Has a right of reasonable access to coastal public property; and*
- *Is entitled to use and enjoy coastal public property.*

Coastal Public Property is defined by the Act as coastal waters, land submerged by coastal waters, any island in coastal waters, the seashore, any admiralty reserve owned by the state, any other state land declared as coastal public property and any natural resources. The ICM Act unequivocally vests ownership of coastal public property in the citizens of South Africa. Coastal public property cannot be transferred, sold, attached or acquired by prescription, nor can the rights over it be acquired by prescription. It is the duty of the State as trustee to ensure that coastal public property is used, managed, protected, conserved and enhanced in the interests of the whole community, as opposed to only a few individuals or groups.

Section 65(1) (subject to sections 67 and 95) states that no person may occupy any part of, or site on, or construct or erect any building, road, barrier or structure on or in, coastal public property except under and in accordance with a coastal lease awarded by the Minister in terms of this Chapter. This may be relevant to the proposed development as the intake works, pump station and portions of both proposed pipeline (for the transport of seawater to the mine site) may have to cross what is defined as coastal public property.

Section 69(1) of the Act states that no person may discharge effluent that originates from a source on land into coastal waters except in terms of a general authorisation or a coastal waters discharge permit issued under this section by the Minister after consultation with the Minister responsible for water affairs in instances of discharge of effluent into an estuary. This may have been applicable should the option of discharge of brine from the desalination plant at the mine site into coastal waters be considered as an option. However, it is the intention of Zirco to recycle the brine as process water and is thus not applicable.

The abstraction of seawater is not mentioned in the act and therefore it is assumed that this activity does not require any permits from Oceans and Coasts.

Implications for the proposed mine and associated infrastructure:

- A coastal lease may be required from the Minister for the construction of infrastructure within areas defined as Coastal Public Property.

3.1.16 National Nuclear Regulator Act (47 of 1999)

The National Nuclear Regulator Act (No. 47 of 1999) regulates nuclear activities to provide for safety standards and regulatory practices for the protection of persons, property and the environment against nuclear damage and to provide for matters connected therewith.

Section 1(i) defines an "action" as:

- The use, possession, production, storage, enrichment, processing, reprocessing, conveying or disposal of radioactive material
- Any action, the performance of which, may result in persons accumulating a radiation dose resulting from exposure to ionising radiation; or
- Any action involving radioactive material

Based on the above it may be necessary for Zirco to acquire a Certificate of Registration for the Kamiesberg Project, as the heavy minerals contain naturally occurring radionuclides and can thus be classified as naturally occurring radioactive materials (NORM). The heavy mineral sands will be concentrated through the production of the heavy mineral concentrate (HMC) and may therefore be considered to be above the naturally background radiation levels. Appropriate permitting will be identified and applied for by the radiation specialist.

<u>Implications for the proposed mine and associated infrastructure:</u>

- There may be permitting requirements for the production of ilmenite, ziron, rutile and monazite

3.1.17 Municipal By-Laws and Planning

There will be certain requirements related to health and safety during construction and approval of method statements. Certain activities related to the proposed development may, in addition to National legislation, be subject to control by municipal by-laws including the Namaqua District Municipality and Kamiesberg Local Municipality Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs).

3.1.18 Namaqua District Municipality IDP

According to the Namaqua District Municipality Integrated Developent Plan (IDP) (Draft IDP 2013-2014), one of the focus areas will be to optimize natural resource use within the area in a sectoral manner. One of the goals set to achieve this is a mineral beneficiation plant (i.e. process whereby extracted ore from mining is separated into mineral and waste rock or tails). Since the mineral separation plant separates the HMC into product this qualifies as beneficiation and is thus in line with the IDP.

In addition to the above, the IDP also stresses the need for social development within the area. Various goals such as the establishment of sport, arts, culture and heritage centres, providing support to vulnerable groups, providing infrastructure, etc. have been set by the District Municipality.

3.1.19 Namaqua District Municipality SDF (2012)

According to the Namaqua District Municipality (NDM) SDF mining is one of the major economic sectors in the NDM and is found in all municipalities except the Hantam and Karoo

Hoogland Municipalities (refer to Figure 3.1). Various larger concentration mineral deposits that can be found in the municipal area include diamonds, uranium, titanium, zinc and beryllium. The NDM has an undiversified economy with heavy reliance on the primary sectors of agriculture and mining for sectoral contribution to the GGP. Mining contributes about 52% to the GGP in 2007, equating to R1.2 billion. In addition to this mining and quarrying is the second largest employer within the NDM, employing 20% of the population (5 612 people) in 2001 and 18.47% in 2010. This decline can be attributed to the fact that a number of mines have reached the end of their economic life resulting in a number of mines having closed or in the process of closing.

The NDM SDF makes the following recommendations in regards to the mining sector:

- Community services, agriculture and mining should be supported as these are the biggest contributors to employment (the proposed project is a mining project, which will create employment for 318 people);
- The amount of beneficiation that occurs from mining and agriculture should be maximised by providing necessary facilities, training, education, environmental development and business support with a focus on economic empowerment (the mineral separation plant separates the HMC into product this qualifies as beneficiation, in addition to this Zirco is committed to provide an opportunity for people in the labour-sending areas to obtain the necessary post-graduate qualifications necessary either to be absorbed within the mining industry in general, or to pursue their fields of interests. Zirco is also committed via the SLP to contribute to local economic development. For information on the proposed project please refer to Chapter 5 Section 5.2.5);
- Care should be taken to ensure the larger community can benefit from new infrastructure that will be required for mining (refer to Chapter 5 Section 5.2).
- Encourage the use of local labour; e.g. all unskilled labour to be sourced from the local areas (The number of construction workers required is estimated at 243, and will be outsourced to construction companies. It should be noted that these employment figures are still preliminary projections. As far as reasonably possible, Zirco will employ the local population from the labour-sending communities. In order to do this, a skills audit will be conducted to establish whether the required skills are available and to advise any potential training programmes. The contractor labour force will gradually be replaced by the permanent labour force);
- Some of the resources extracted should be ploughed back into the local community, e.g. electricity made available for local use at a cheaper rate (Certain infrastructure may remain post closure. No dedicated haul road will be constructed for the proposed development. As stated in Chapter 12 and in the traffic and transport assessment, existing roads will be upgraded to meet the transport requirements for the proposed project. These upgrades will remain post closure and will not be decommissioned. In addition to this, it is assumed that the buildings of the administration block, workshop and maintenance area will remain to support post closure use. Once closure is complete, a decision to either demolish remaining facilities or hand them over to the KLM for conversion into social infrastructure (e.g. schools, clinic) will need to be made using a consultative process. Lastly, prior to closure the future use of the reverse osmosis plant and pipeline should be discussed with the relevant authorities and municipalities with a view to handing the system over to the KLM. This could be to the benefit of the local communities as potable water is a scare commodity within the region);
- Offsets should be introduced, e.g. where there is an impact on the local environment that an “offset” or a “pay back” be agreed upon to compensate for the envisaged damages. This could be a biodiversity offset, or agricultural offset, etc (The mining area will be rehabilitated progressively during the life of the mine, rehabilitation can

either be to natural conditions or for agricultural purposes which is the current land use).

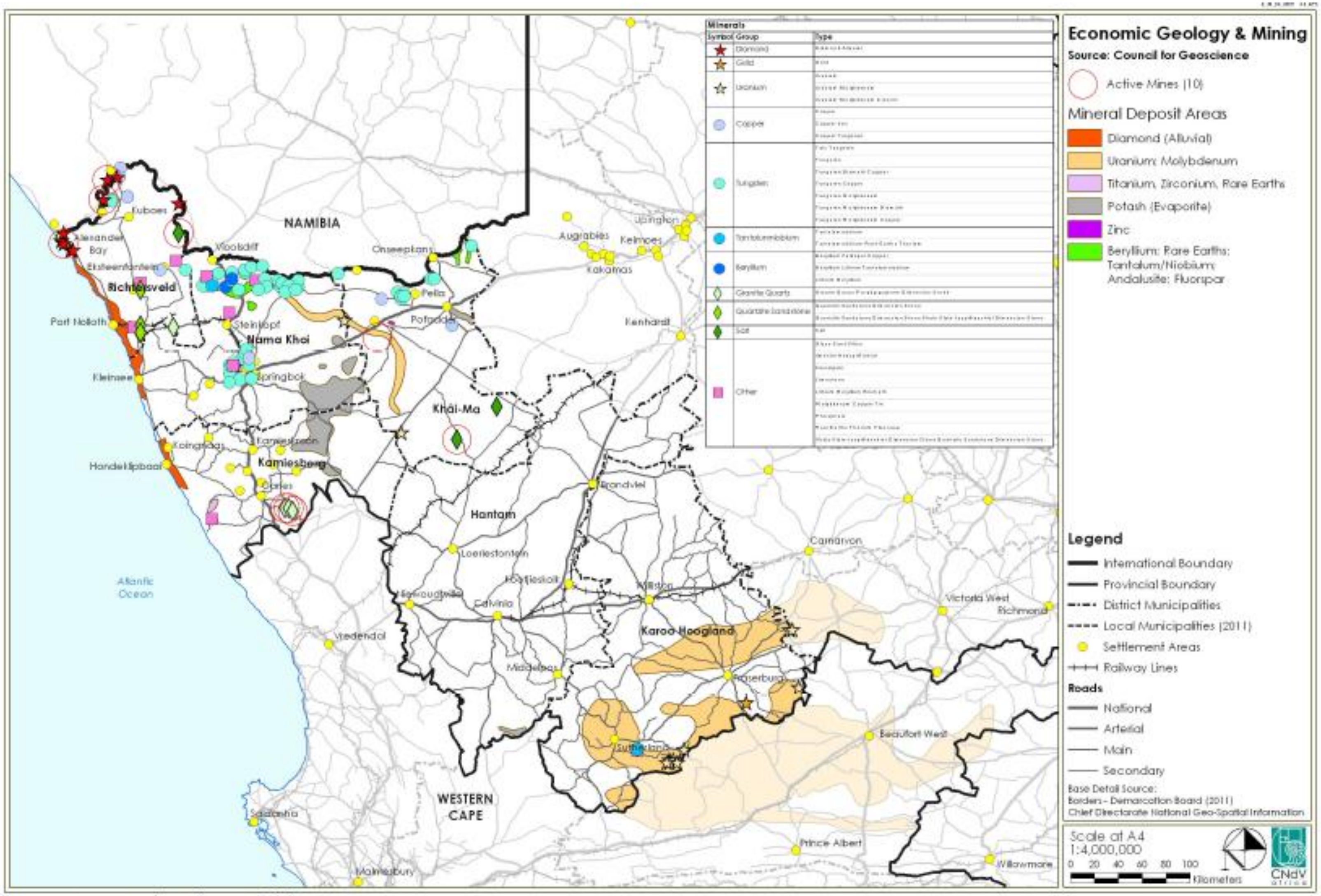


Figure 3.1: Existing prospecting and mining rights within the NDM

- Consider upgrading and development of infrastructure in the existing local towns to encourage economic opportunities and integration instead of creating new infrastructure at remote locations (Zirco is committed via the SLP to contribute to local economic development. For information on the proposed project please refer to Chapter 5 Section 5.2.5).
- Encourage the funding of social upliftment programmes which could benefit the local community (Zirco is committed via the SLP to contribute to local economic development. For information on the proposed project please refer to Chapter 5 Section 5.2.5).

Based on the above it is clear that the proposed project is in line with the NDM SDF.

3.1.20 Kamiesberg Local Municipality IDP (2013/2014)

According to the Kamiesberg Local Municipality (KLM) IDP, the KLM has a low skill level as only 4.23% (2011) of the total population received a form of higher education. In addition to this, the KLM has a major institutional and knowledge leakage of its youth towards bigger cities and metropolitan areas in search of better education and employment opportunities. This emphasises the need for skills development in the municipal area. Zirco is committed to provide an opportunity for people in the labour-sending areas to obtain the necessary post-graduate qualifications necessary either to be absorbed within the mining industry in general, or to pursue their fields of interests, which would attribute to skills development in the region.

In addition to the required skills development the KLM IDP also stresses the need to diversify the economy of the region as it is currently highly dependent on the construction sector and the tourism industry. Mining is identifies by the IDP as having economic growth and investment potential. Lastly, part of the LED strategy for the municipal area is to establish a job creating economic growth path. As stated earlier, the proposed project will provide employment for 318 people.

Based on the above it is clear that the proposed project is in line with the KLM IDP.

3.1.21 Northern Cape Province SDF

The following key environmental apects of the Northern Cape SDF (2012) has been considered in various specialist reports as well as the EIA Report:

a) Consider designation of agricultural reserves in areas of high-potential agricultural soils with adequate irrigation water.
b) Create appropriate ecological linkages between conservation areas.
c) Designate coastal zone as a core conservation area.
d) Institute standard development approach along the Orange River by all relevant municipalities. //Khara Hais SDF is to serve as a model in this regard.
e) Enhance sustainable use of formal conservation areas and their resources.
f) Enhance viability and sustainability of the Richtersveld Botanical and Landscape World Heritage Site which is the core of the Succulent Karoo Biodiversity Hotspot.
g) Explore desirability of implementing strategies such as Protected Nature Areas and Special Management Areas in collaboration with organised agriculture and the Department of the Environment.
h) Indicate mining areas with a dedicated Spatial Planning Category (SPC).
i) Land-use along the coastline must be addressed in a similar manner by all relevant municipalities and stakeholders.
j) Preparation and implementation of an efficient Water Demand Conservation Strategy must be mandatory on all municipalities.
k) Promote cross-border conservation initiatives – explore the merit and desirability of UNESCO biosphere reserves.
l) Promote history and archaeology as primary tourism resources.
m) Protect high-potential agricultural land through appropriate land-use designation.

n) Provide for biodiversity conservation in terms of SANBI's 'critical biodiversity area' (CBA) indicators.
o) Provide guidelines for the re-use and/or the more sustainable use of resources.
p) Provide innovative strategies to help conserve conservation-worthy habitats on private land.
q) Provide land-use plan as a basis for integration of mining activities with conservation.
r) Provide strategy to off-set loss of conservation-worthy habitat through mining through ex-situ conservation projects.
s) Standardise land-use planning and management by municipalities and other stakeholders.
t) //Khara Hais Tourism Plan is to serve as a model for municipal tourism & environmental planning.

3.1.22 Kamiesberg Local Municipality SDF

According to the KLM SDF the Namaqualand economy is clearly in crisis. The mining industry is on the decline and the fishing industry is vulnerable to changes in fish stocks and quotas. While agriculture in the region has apparently demonstrated some comparative advantages, it is vulnerable too, and constrained by the availability of water. Apart from tourism, which has been providing some boost to the area (particularly in scenic coastal areas and during the wild flower season) there are few signs of dynamic development. As a result, the following lead sectors in the regeneration of the Namaqualand economy have been identified:

- Macro projects linked to the mining-manufacturing complex;
- Small Scale Mining;
- Fisheries, Mariculture and Agriculture; and
- Tourism.

In addition to the above and according to the SDF, the KML is inundated with mineral deposits and although the mining sector is currently declining it would be worthwhile to facilitate exploration to determine the possible future economic contribution of this sector to the economy of Kamiesberg. Lastly, it is important to note that the current economic sector of employment within the KLM is mainly mining and community services followed by agriculture and wholesale trade.
Based on the above it is clear that the proposed project is in line with the KLM SDF.

3.2 INTERNATIONAL INSTRUMENTS

3.2.1 The Equator Principals

The Equator Principles (Box 4 below) are a financial industry benchmark for determining, assessing and managing social and environmental risks to projects. They are intended to ensure that projects financed by the Equator Principles Financial Institutions (EPFI) are developed in a manner that is socially responsible and reflects sound environmental management practices. In January 2013 a total of 79 financial institutions from 32 countries across the globe had adopted the Equator Principles.

Box 4: The Equator Principles (EP III - June 2013)

Statement of Principles
The EPFI will only provide Project Finance and Project-Related Corporate Loans to Projects that meet the requirements of Principles 1-10.

Principle 1: Review and Categorisation
When a Project is proposed for financing the EPFI will, as part of its internal environmental and social review and due diligence, categorise it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorisation process of the International Finance Corporation (IFC).
Using categorisation the EPFI's environmental and social due diligence is commensurate with the nature, scale and stage of the Project, and with the level of environmental and social risks and impacts.
The categories are:
Category A – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;

Category B – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and
Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.

Principle 2: Environmental and Social Assessment
For all Category A and Category B Projects the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II [1]). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.
The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. Furthermore, in limited high risk circumstances it may be appropriate for the client to complement its Assessment Documentation with specific human rights due diligence. For other Projects, a limited or focused environmental or social assessment (e.g. audit), or straightforward application of environmental siting, pollution standards, design criteria, or construction standards may be carried out.
For all Projects, in all locations, when combined Scope 1 and Scope 2 Emissions are expected to be more than 100 000 tonnes of CO_2 equivalent annually, an Alternatives Analysis will be conducted to evaluate less Greenhouse Gas (GHG) intensive alternatives. Refer to Annex A for alternatives analysis requirements

Principle 3: Applicable Environmental and Social Standards
The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.
EPFIs operate in diverse markets: some with robust environmental and social governance, legislation systems and institutional capacity designed to protect the people and the natural environment; and some with evolving technical and institutional capacity to manage environmental and social issues.
The EPFI will require that the Assessment process evaluates compliance with the applicable standards as follows:

1. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the IFC / World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) (Exhibit III [2]).
2. For Projects located in Designated Countries, the Assessment process evaluates compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6).

The Assessment process will establish to the EPFI's satisfaction the Project's overall compliance with, or justified deviation from, the applicable standards. The applicable standards (as described above) represent the minimum standards adopted by the EPFI. The EPFI may, at their sole discretion, apply additional requirements.

Principle 4: Environmental and Social Management System and Equator Principles Action Plan
For all Category A and Category B Projects the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS).
Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.

Principle 5: Stakeholder Engagement
For all Category A and Category B Projects the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; the decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation.
To facilitate Stakeholder Engagement the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant other stakeholders, in the local language and in a culturally appropriate manner.
The client will take account of and document the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts disclosure should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis.
EPFIs recognise that indigenous peoples may represent vulnerable segments of project-affected communities. Projects affecting indigenous peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in with adverse impacts on indigenous people will require their Free, Prior and Informed Consent (FPIC).

Principle 6: Grievance Mechanism

For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.

The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.

Principle 7: Independent Review

Project Finance

For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence and assess Equator Principles compliance.

The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible.

Project-Related Corporate Loans

An Independent Review by an Independent Environmental and Social Consultant is required for Projects with potential high risk impacts including, but not limited to, any of the following:

- Adverse impacts on indigenous peoples
- Critical habitat impacts
- Significant cultural heritage impacts
- Large-scale resettlement

In other Category A, and as appropriate Category B, Project-Related Corporate Loans, the EPFI may determine whether an Independent Review is appropriate or if internal review by the EPFI is sufficient. This may take into account the due diligence performed by a multilateral or bilateral financial institution or an OECD Export Credit Agency, if relevant.

Principle 8: Covenants

An important strength of the Equator Principles is the incorporation of covenants linked to compliance.

For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects.

Furthermore for all Category A and Category B Projects the client will covenant the financial documentation:

a) To comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and
b) To provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts that (i) document compliance with the ESMPs and Equator Principles AP (where applicable), and (ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and
c) To decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.

Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

Principle 9: Independent Monitoring and Reporting

Project Finance

To assess Project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information, which would be shared with the EPFI.

Project-Related Corporate Loans

For Projects where an Independent Review is required under Principle 7 the EPFI will require the appointment of an Independent Environmental and Social Consultant after Financial Close, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI.

Principle 10: Reporting and Transparency

Client Reporting Requirements

The following client reporting requirements are in addition to the disclosure requirements in Principle 5.

For all Category A and, as appropriate, Category B Projects:

- The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online.
- The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting.

EPFI Reporting Requirements

The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator

Principles implementation processes and experience, taking into account appropriate confidentiality considerations. The EPFI will report according to the minimum reporting requirements detailed in Annex B.

Notes:

[1] **Exhibit II:** Illustrative List of Potential Environmental and Social Issues to be addressed in the Environmental and Social Assessment Documentation.

[2] **Exhibit III:** IFC Performance Standards on Environmental and Social Sustainability and the IFC / World Bank Group Environmental, Health and Safety Guidelines

The IFC Performance Standards to which the Equator Principles refer, specifically in Exhibit III, are those that were published and took effect on the 1st of January 2012.

3.2.2 International Finance Corporation Performance Standards

The IFC is a member of the World Bank Group, and is the largest global development institution focused exclusively on the private sector in developing countries. Established in 1956 the IFC is owned by 184 member countries, and provides funding for emerging markets to create jobs, generate tax revenues, improve corporate governance and environmental performance, and contribute to the local communities.

The IFC published its Performance Standards (PS) on Environmental and Social Sustainability in April 2006, and published comprehensive Guidance Notes in July 2007. Since then the Performance Standards and Guidance Notes have been revised, and the updated versions were published and took effect from January 2012. The updated Performance Standards are listed in Box 5.

Box 5: IFC Performance Standards

Performance Standard 1:	Assessment and Management of Environmental and Social Risks and Impacts
Performance Standard 2:	Labour and Working Conditions
Performance Standard 3:	Resource Efficiency and Pollution Prevention
Performance Standard 4:	Community Health, Safety and Security
Performance Standard 5:	Land Acquisition and Involuntary Resettlement
Performance Standard 6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources
Performance Standard 7:	Indigenous Peoples
Performance Standard 8:	Cultural Heritage

Note: *PS 7 is not applicable to the project, since there is no indication that any group of potentially affected persons in the project's area of influence falls into the IFC definition of indigenous people (social groups with identities that are distinct from dominant groups in national societies)*

A summary of the key objectives of the Performance Standards is set out in the table below

Performance Standard	Key objectives
PS 1: Assessment and management of environmental and social risks and impacts	➢ To identify and evaluate environmental and social risks and impacts of the project. ➢ To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. ➢ To promote improved environmental and social performance of clients through the effective use of management systems. ➢ To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. ➢ To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.

Performance Standard	Key objectives
PS 2: Labour and Working Conditions	➢ To promote the fair treatment, non-discrimination, and equal opportunity of workers. ➢ To establish, maintain, and improve the worker-management relationship. ➢ To promote compliance with national employment and labour laws. ➢ To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. ➢ To promote safe and healthy working conditions, and the health of workers. ➢ To avoid the use of forced labour.
PS 3: Resource efficiency and pollution prevention	➢ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. ➢ To promote more sustainable use of resources, including energy and water. ➢ To reduce project-related GHG emissions.
PS 4: Community Health, Safety and Security	➢ To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. ➢ To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.
PS 5: Land Acquisition and Involuntary Resettlement	➢ To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. ➢ To avoid forced eviction. ➢ To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by: - Providing compensation for loss of assets at replacement cost and - Ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. ➢ To improve, or restore, the livelihoods and standards of living of displaced persons. ➢ To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	➢ To protect and conserve biodiversity. ➢ To maintain the benefits from ecosystem services. ➢ To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.
PS 7: Indigenous Peoples	➢ To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. ➢ To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. ➢ To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. ➢ To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. ➢ To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. ➢ To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.
PS 8: Cultural Heritage	➢ To protect cultural heritage from the adverse impacts of project activities and support its preservation. ➢ To promote the equitable sharing of benefits from the use of cultural heritage.

3.2.3 IFC General Environmental, Health and Safety Guidelines

The General EHS Guidelines provide an organized, hierarchical, best-practice approach to managing environmental, health and safety issues at facility or project level, which in broad terms comprises the following steps:

- Identifying EHS project hazards and associated risks as early as possible in the facility development or project cycle.

- Understanding the likelihood and magnitude of EHS risks, based on the nature of the project activities and the potential consequences to workers, communities, or the environment if hazards are not adequately managed.
- Prioritising risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.
- Favouring strategies that eliminate the cause of the hazard at its source to avoid the need for EHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and subsequently restoring workplace and community environments to a safe and healthy condition.
- Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

The Guidelines are organised in four main sections:

1. Environmental
2. Occupational Health and Safety
3. Community Health and Safety
4. Construction and Decommissioning.

3.2.4 IFC Sector Specific Guidelines

The EHS General Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide details of risks and impacts specific to particular industries, and guidance on the management.

The IFC EHS Guidelines for Mining (30 April 2007) are applicable to this project. The guidelines detail industry-specific impacts and ways in which to manage them. They cover environmental, occupational health and safety, community health and safety, and performance indicators and monitoring

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

According to regulation 31 (2) of the EIA regulations (2010), An Environmental Impact Assessment Report must include –
(d) A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.

4.1 INTRODUCTION

In line with the above-mentioned legislative requirement, this chapter provides a description of the natural and socio-economic environments that could potentially be impacted by the proposed development. The descriptions are based on the assessments presented by the various specialists who undertook baseline studies for this project.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Climate

Namaqualand is a semi-desert area with dry summers and rainfall occurring during the winter months, with most rainfall between May and August (Desmet, 2007). The area receives an average of 95 mm rainfall per annum, fluctuating between the highest rainfall in June (16.7 mm average) and the lowest in December (0.8 mm average). Other important sources of precipitation are in the form of coastal fog and heavy dew, the source of which is the nearby Atlantic Ocean. The temperature regime is moderate with a mean maximum summer temperature of less than 30°C, and average of 18.4°C in July.

The area experiences wind on a daily basis, peaking in the evening where average wind speeds are 25km/hr. During the day wind speeds are much lower (Figure 4.1 below) dropping to below 10km/hr.

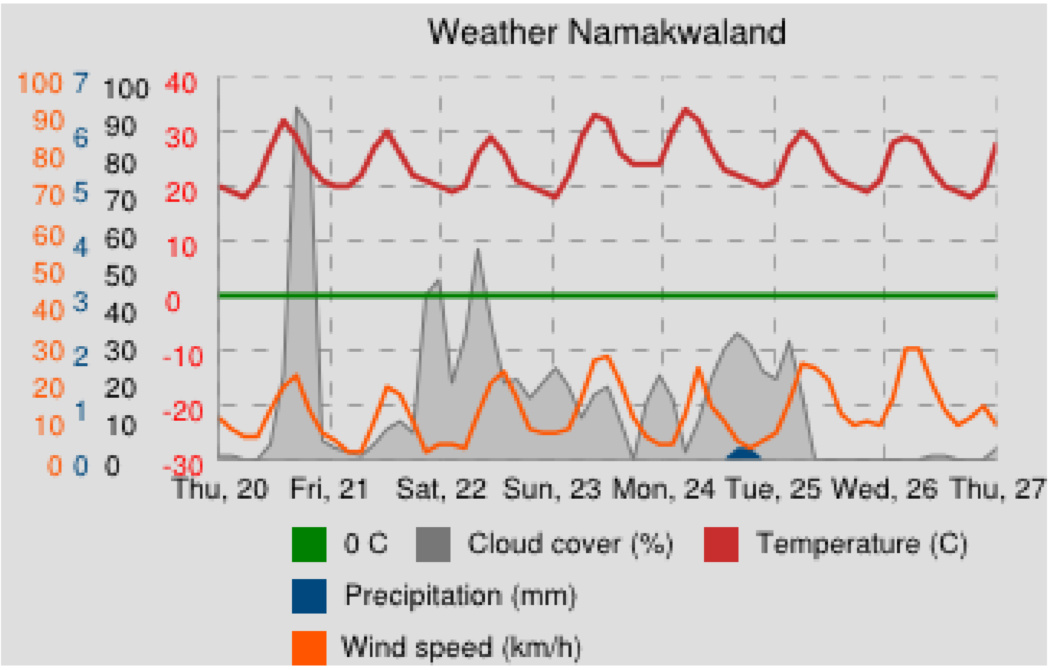


Figure 4.1: Summary of Namaqualand weather, showing average temperature, precipitation and wind speed.
(Source: http://www.getamap.net/maps/south_africa/south_africa_%28general%29/_namakwaland/) Namakwa District Municipality

4.2.2 Topography

The project area is characterised by flat to moderately flat relief with a general east-southeast slope toward the Atlantic Ocean (Figure 4.2). The highest and lowest points in the project area are at 275 masl and 25 masl respectively. The western region borders the start of low hills and the eastern region coastal plains. The northern region borders the Bitter River and the Groen River forms the southern border of the mining area.

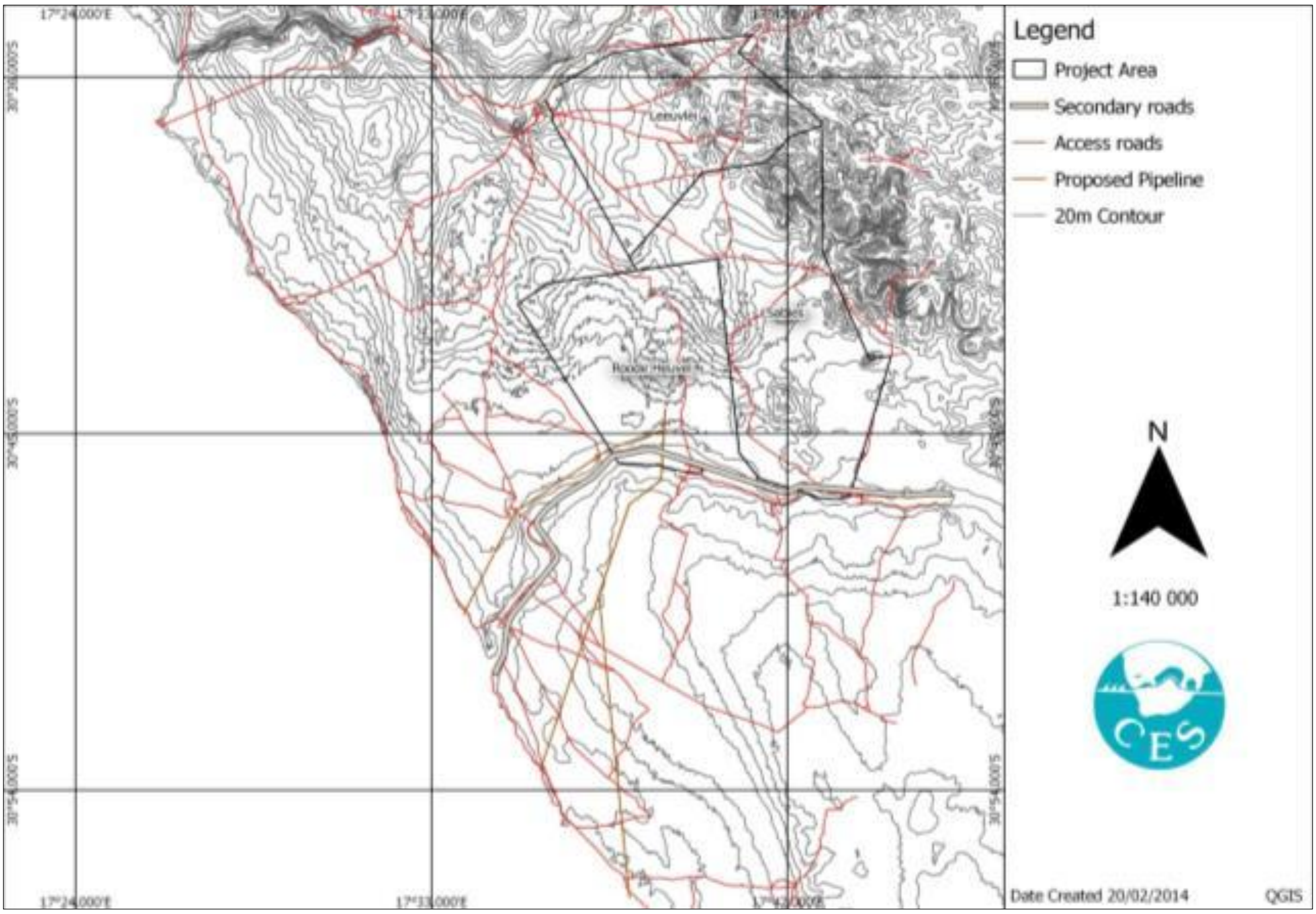


Figure 4.2: Topograpy of the Kamiesberg Project area showing 5m contour lines
(Source: Soil and Agriculture Assessment)

4.2.3 Geology and Soils

The underlying geology (Figure 4.3) consists of quaternary unconsolidated to cemented sand overlaying Kamieskroon leucocratic gneisses (Zirco, 2012).

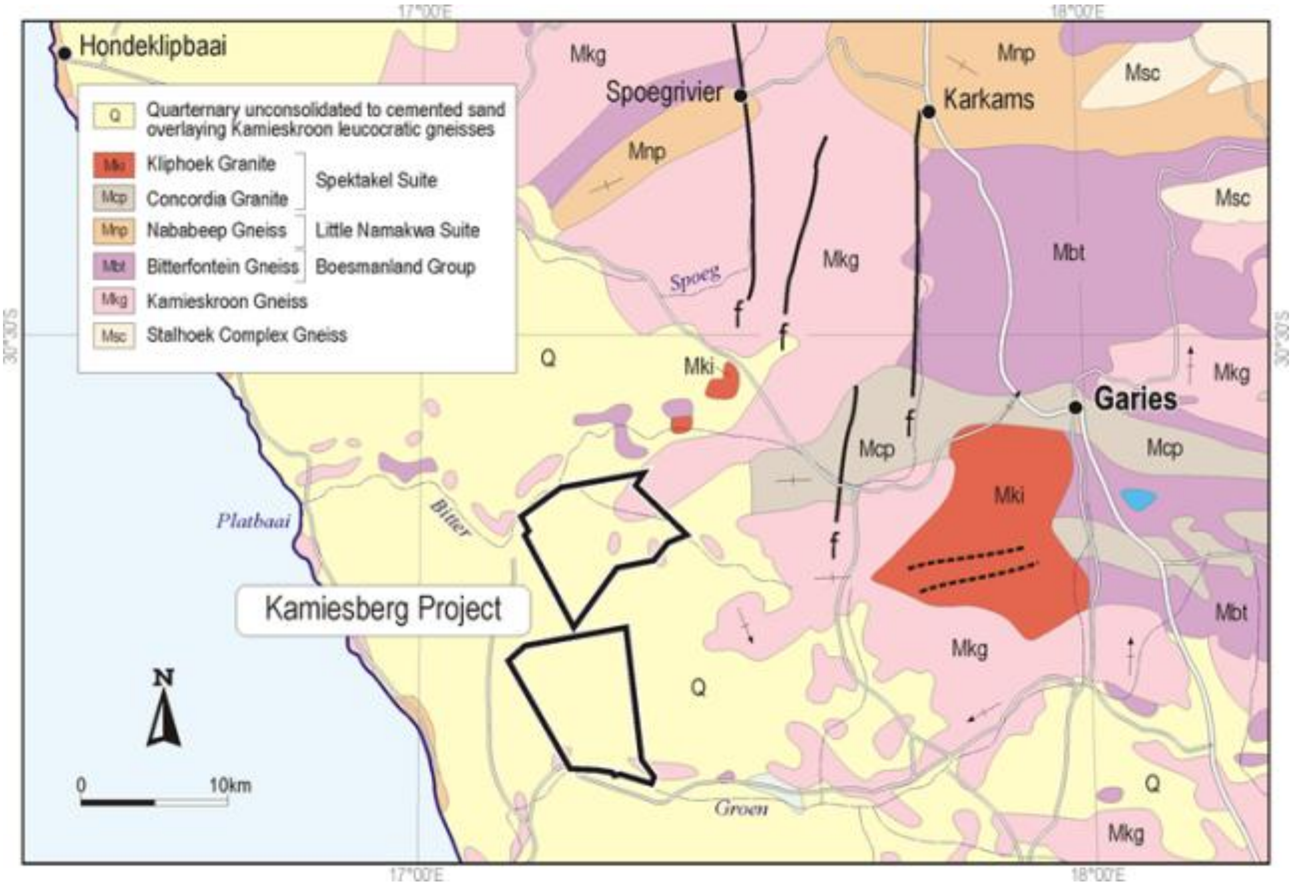


Figure 4.3: Geology of the Kamiesberg Project area
(Source: Zirco 2012)

The surface aeolian sand varies in thickness over the project area from a few centimetres up to 25 m. Dune systems are predominantly orientated NNE to SSW due to prevailing wind conditions (Zirco, 2012). The surface sands are part of a typical silicic soil structure, the distribution of which is associated exclusively with arid landscapes (Fey, 2010).

Mineralogical work to date shows these soils have a subsurface horizon cemented primarily by kaolin with minor iron (Fe) in indurated zones, and not silica dorbank, which is more typical of these areas.

Silicic soils are generally medium to coarse textured and well to moderately drained (although this depends on the coherence and depth of the underlying kaolin parent material). The pH of the soils varies between 5 and 10, but typical values are between 7.5 and 9.

The physical properties of the silicic soils in the area will depend on the depth at which the kaolin occurs in the profile, and the thickness of any overlying soil material. The often coarse texture of the overlying horizons means that plant available water content is low. The erosion susceptibility of silicic soils is low to moderate since they are most common on gentle slopes and generally have sufficient cover in the form of grass and short succulent shrubs.

As the Kamiesberg Project area is situated on sand-dominated land the associated soils are considered as having high wind erosion susceptibility (Figure 4.4), as well as low to moderate water erosion susceptibility within the project area (AGIS, 2007).

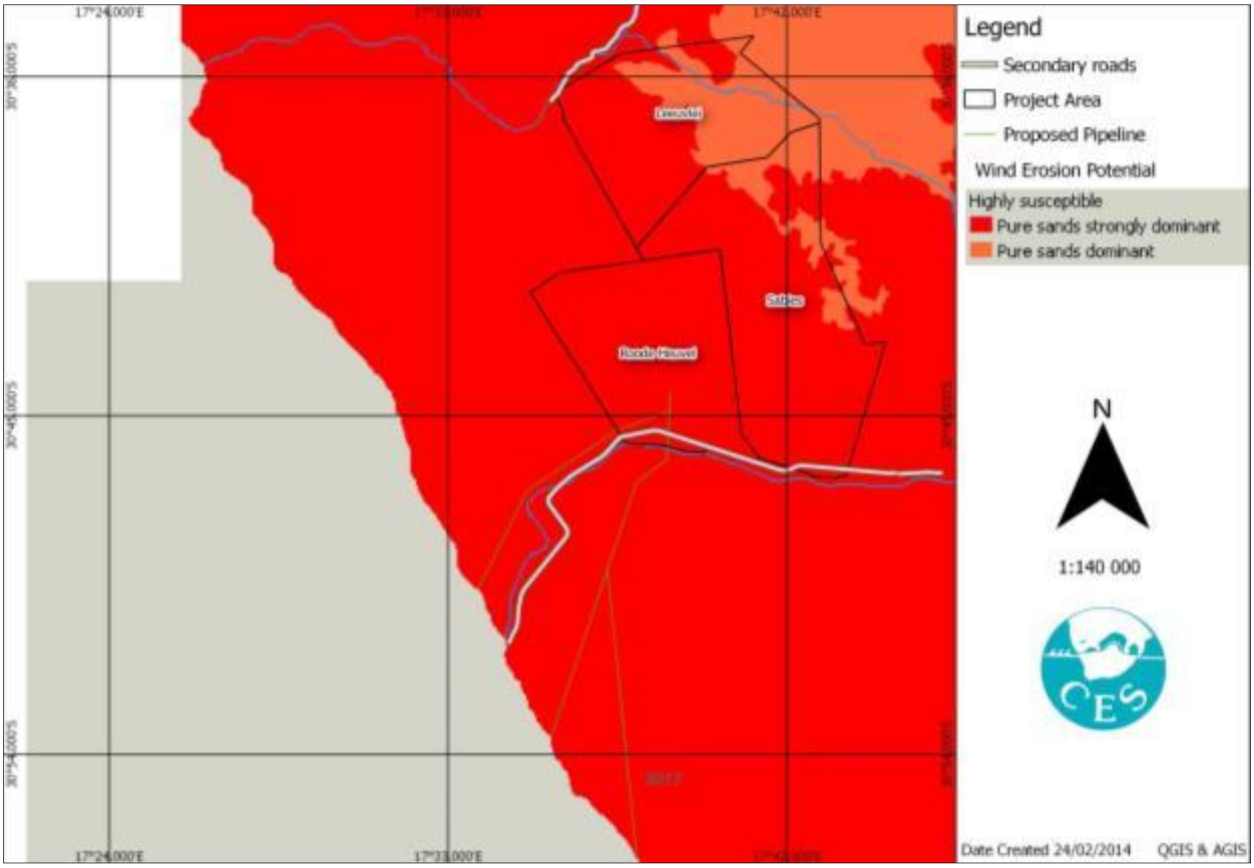


Figure 4.4: The map indicates a highly wind erosion susceptibility in the Kamiesberg Project area.

4.2.4 Air Quality

The main activities in the vicinity of the Kamiesberg Project site is sheep farming and with associated residences. This land-use contributes baseline emission sources via vehicle particulate entrainment on unpaved and paved roads and vehicle tailpipe emissions. Due to the low population density (0.9 people/km^2) of the area, these are not likely to be significant emission sources. Wind erosion of sparsely vegetated surfaces is likely to be an additional source of fugitive (emissions that are not discharged to the atmosphere in a confined flow stream) particulate emissions. The significant pollutant sources and how they are likely to contribute to the ambient air status quo are discussed below.

i. Vehicle particulate entrainment from unpaved and paved roads

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. The force of the wheels of a vehicle traveling on an unpaved road, results in the pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic (including average vehicle speed, mean vehicle weight, average number of wheels per vehicle) and the silt loading on the roads.

Emissions from paved roads are significantly less than those originating from unpaved roads; however, they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface.

Roads in the vicinity of the Kamiesberg Project include the unpaved district road from the coast to the paved national road (N7), as well as unpaved farm roads. Current use of these roads as detailed in the Traffic Impact Assessment (Bailey and Rowlston, 2014) is very low, and used primarily for access to farmsteads and recreational visitors to Groenriviermond.

ii. Vehicle Tailpipe Emissions

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted by internal combustion engines include carbon dioxide, carbon monoxide, carbon (C), sulfur dioxide, oxides of nitrogen (mainly nitric oxide), particulates and lead. Secondary pollutants include nitrogen dioxide, photochemical oxidants such as ozone, sulfur acid, sulfates, nitric acid, and nitrate aerosols (particulate matter). Vehicle (i.e. model-year, fuel delivery system), fuel (i.e. type, oxygen content), operating (i.e. vehicle speed, load), and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates (Onursal and Gautam, 1997). The release of vehicle emissions is likely to have localised impacts and be within ambient air quality standards and are considered to be a minor contributor to the emissions inventory.

iii. Windblown dust from open areas

Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time a surface is disturbed, its erosion potential is restored. Parameters which have the potential to impact on the rate of emission of fugitive dust include the extent of surface compaction, moisture content, ground cover, particle size distribution, wind speed and precipitation. Any factor that binds the erodible material, or otherwise reduces the availability of erodible material on the surface, decreases the erosion potential of the fugitive source. High moisture contents, whether due to precipitation or deliberate wetting, promote the aggregation and cementation of fines to the surfaces of larger particles, thus decreasing the potential for dust emissions. Surface compaction and ground cover similarly reduces the potential for dust generation. The shape of a storage pile or disposal dump influences the potential for dust emissions through the alteration of the airflow field. The particle size distribution of the material on the disposal site is important since it determines the rate of entrainment of material from the surface, the nature of dispersion of the dust plume, and the rate of deposition, which may be anticipated (Burger, 1994; Burger et al., 1995).

The vegetation types in the vicinity of the Kamiesberg Project (Namaqualand Strandveld, Namaqualand Sand Fynbos and Namaqualand Heuweltjieveld) would result in areas that naturally provide sparse cover. Erodible surfaces may also be a result of agriculture and/or grazing activities. The area also frequently experiences high wind speeds, which potentially could result in significant emissions. The dominance of coarse sand particles in the surface aeolian soils, however, will require wind speeds above the threshold value of 8.4 m/s to result in significant emissions.

4.2.5 Noise

The current ambient noise for the proposed study area is reflected in Table 4.1 below. As indicated in the table, the guideline limits for rural areas are mostly being met. It was noted during the field survey that there was very little traffic on the DR2938 during the measurement periods.

Table 4.1: Current ambient noise

Day Time Measurements

NO	AREA	NOISE LEVEL (LReqT dBA)	L_{90} (dBA)	Noise Source
Commencing at 16h00 on 17th September 2014				
Position 1	Farmhouse A 30º42'48.4" 17º58'12.4"	43.1	32.1	• Wind – Max 62.0; Min 27.5 • House to the south of A
Position 2	Farmhouse B 30º44'33.8" 17º56'8.4"	38.3	32.8	• Noise from telephone wires • Wind – Max 51.2; Min 29.1
Position 3	Farmhouse C 30º46'51.1" 17º48'31.9"	39.1	33.5	• Wind – Max 47.2; Min 32.4
Position 4	Farmhouse D 30º46'22.5" 17º42'57.4"	42.8	35.0	• Wind – Max 51.2, Min 32.5
Position 5	On Site Measurement 30º44'58.8" 17º38'53.8"	40.7	31.3	• Wind – Max 51.8, Min 28.9
Position 6	Farmhouse E 30º45'49.1" 17º39'54.3"	42.1	33.6	• Wind – Max 52.9, Min 33.1

Night Time Measurements

NO	AREA	NOISE LEVEL (LReqT dBA)	L_{90} (dBA)	Noise Source
Commencing at 05h15 on 17th September 2014				
Position 1	Farmhouse A 30º42'48.4" 17º58'12.4"	36.4	30.6	• Wind – Max 42.8, Min 29.2
Position 2	Farmhouse B 30º44'33.8" 17º56'8.4"	31.2	27.5	• Wind – Max 38.4, Min 25.8 • Birds
Position 3	Farmhouse C 30º46'51.1" 17º48'31.9"	35.1	30.0	• Wind – Max 41.1, Min 26.9 • Chickens
Position 4	Farmhouse D 30º46'22.5" 17º42'57.4"	36.0	31.3	• Wind – Max 42.3, Min 27.6 • Birds
Position 5	On Site Measurement 30º44'58.8" 17º38'53.8"	34.2	29.1	• Wind – Max 41.0, Min 27.8 • Birds
Position 6	Farmhouse E 30º45'49.1" 17º39'54.3"	29.8	27.1	• Wind – Max 40.9, Min 26.1 • Birds • Dogs

4.2.6 Surface and Groundwater Resources

i. Surface water

Two rivers, the Groenrivier and the Bitterrivier, border the project area to the south and north respectively (Figure 4.5). Neither river transects the mining areas, but a small tributary of the Bitter – the Outeepsrivier - flows through the north-eastern corner of the Leeuvlei Prospecting Right.

The lower reaches of both rivers flow through the Namaqua National Park, the boundaries of which are shown in green on Figure 4.5.

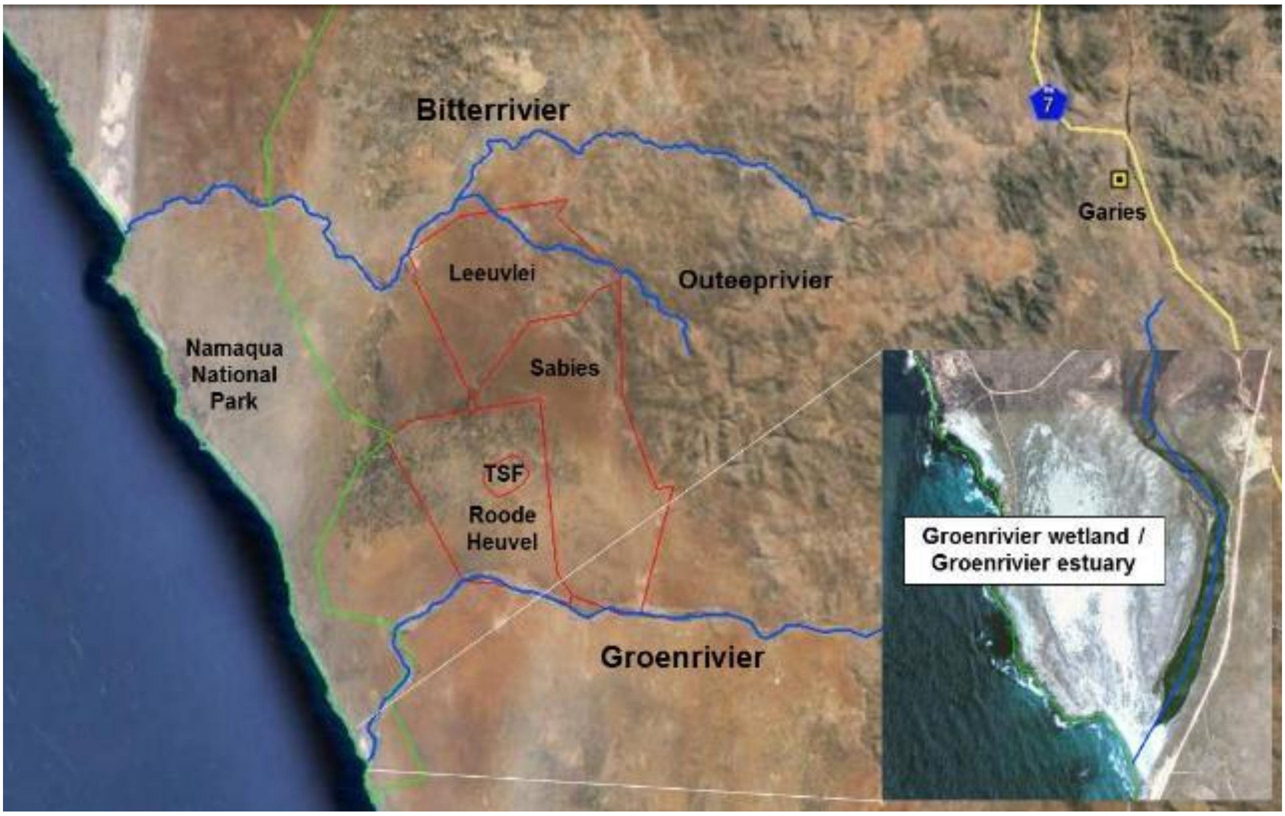


Figure 4.5: Rivers in the project area

The Groen and the Bitter, as is the case with other rivers in Namaqualand, comprise relatively small river channels (in places, more than one channel) meandering in wide, shallow, alluvium-filled valleys that have been incised over time into the granite bedrock (Heydorn & Grindley, 1981a).

The episodic nature of the flow in the rivers is confirmed by records from a hydrological gauging station (F5H001) on the Swartdoring River, a tributary of the Groenrivier, at Bruintjieshoogte[2]. The gauge is a rated concrete weir close to the N7 highway about 32 km south of the town of Garies. The station, which is the only gauge on the Groenrivier system, has a 92% complete verified daily flow record from April 1967 to March 2014. The area of the catchment upstream of the gauging station is 2 349 km^2, about 43% of the total catchment area – 4 500 km^2 - at the estuary. A brief analysis of the 531 months for which peak flow data is recorded indicates that there was no flow in the river for 445 months (84%). Peak flow rates exceeded 1m^3/sec in 28 months, 10m^3/sec in 13 months, and 20m^3/sec in 5 months. The two maximum recorded flow rates during the 57 years of the gauging station's operation were 46m^3/sec (June 1967) and 45m^3/sec (August 1974). During these events it is probable that the peak flow rates in the downstream reaches of the system, closer to the mining areas, were greater than those at the gauging station, because of the greater

2 http://www.dwaf.gov.za/Hydrology/ - Data, Dams and Flow Information

catchment area. It is, however, meteorologically improbable that the peak flow rates increased by the ratio of the catchment areas: that is, they were unlikely to have exceeded 100m^3/sec.

The ephemeral nature of the rivers in the project area means that surface water resources are not used to any significant extent in the area, either for domestic use or stockwatering. Neither river flows sufficiently reliably to be considered as a possible source of water for mining operations.

Although there is no visible flow in the rivers for most of the time they do experience flooding events from time to time. It is important to be aware of the probable extent of out-of-channel inundation arising from such events, in order to ensure that floods do not damage mining infrastructure near to the rivers, and equally to ensure that the rivers are not affected by mining infrastructure.

The estuaries of the Groenrivier and the Bitterrivier lie to the south west and the north west of the proposed mining area respectively. Both estuaries are within the boundaries of the Namaqua National Park. Recent scientific / technical data and information on the estuaries is very limited, and the most comprehensive compilation of information remains Part II of the CSIR's 1981 Estuaries of the Cape series of reports, *Synopses of Available Information on Individual Systems*, 1981, edited by Heydorn & Grindley.

Groenrivier estuary

In 1981 Heydorn & Grindley reported that "*The state of knowledge of the* [estuary of the] *Groen* [River] *is poor. The area, being remote, has received little attention in the past and the bulk of information in this report originates from the Estuarine and Coastal Research Unit (ECRU) survey.*" (Heydorn & Grindley 1981a).

The areal extent of the estuary was reported in Heydorn & Grindley (1981a) to be around 28 ha, and at the time of the survey, in October 1980, the approximate area of open water in the lagoon was 13 ha. Prior to the survey the previous significant surface flow was recorded at the Swartdoring gauging station in February 1976.

Among the conclusions of the report were:

- Although the Groen flows infrequently, probably once in about five years, surface water is always present in the estuary, even during dry periods.
- The occurrence of perennial water in the estuary makes it an important wetland habitat on the Namaqualand coast, particularly in respect of the diversity and abundance of aquatic bird life, since river mouths on the coastline between the Groen and Orange are often dry.
  Note: The importance of the estuary for bird life is also noted by the Working for Wetlands Kamiesberg Wetland Project (see next section), and is the primary reason for the proposed rehabilitation of certain aspects of the wetland.
- The water body in the estuary appears to be partially maintained during dry periods by springs situated on the flood plain in the upper reaches of the estuary (that is, about 2.5 km upstream from the river mouth).
- The volume of inflow from the springs upstream of the head of the estuary is insufficient to compensate for the evaporative losses from the water surface, resulting in a gradual reduction of the water level in the lagoon and a progressive increase in salinity. This is especially so in the downstream reaches of the lagoon, where extreme hypersalinity was reported to occur. Such extreme saline conditions appeared to be moderated in the upper reaches of the estuary by the diluting effect of the springwater, which emphasised the importance of the wetland source of the system.
- Elevated salinity in the lower reaches of the closed estuary after extended periods of zero surface flow places a severe constraint on the ecological viability of the estuary, as very little aquatic life is able to survive in such extreme saline conditions.

More recent studies by Schlumberger Water Services (SWS 2015) have provided a more detailed characterisation of the estuary and its relationship to other surface and groundwater resources in the area. The studies showed that the spring identified by CSIR (Heydorn & Grindley, 1981a), which is located at the lower limit of a natural wetland in the river channel, approximately 1 km upstream (shown as 2.5km upstream by the CSIR study) of the head of the estuarine lagoon (see Plate 4.2), can reasonably be supposed to be the only source of perennial discharge into the lagoon. In February 2014 the flow rate from the spring was estimated to be 1 litre per second.

The possibility that groundwater beneath the proposed mine site could contribute to the discharge from the spring was investigated by the use of hydrochemical ‘fingerprinting’, which is a comparison of high-resolution hydrochemical data for three boreholes in the mining area and equivalent data for the spring discharge. Data for all waters was compared statistically, and using conventional hydrochemical ‘typing’ plots. The results of the comparisons were:

- The TDS level of the estuarine spring water (approximately 8 000 mg/l) is markedly higher than all the groundwaters of the mining area (a range of between 3 300 and 7 300 mg/l)
- While all waters are NaCl dominated, a clear distinction exists with regard to the remaining major ion balance of the groundwater suite and spring water. This is particularly pronounced with respect to the contributions of Ca, Mg and SO_4 to the ion balance. In all instances, levels of Ca and Mg in the Kamiesberg groundwaters range up to approximately 150 and 200 mg/l respectively, while in the spring water the concentrations of these cations are 594 and 423 mg/l respectively. In the case of SO_4, enrichment by a factor of 2 to 3 is evident in the spring water relative to the groundwater suite.
- Relative enrichment of Sr is evident in the spring at a magnitude analogous to that described above for SO_4.
- Groundwater samples of the Kamiesberg district are routinely high in Flouride (F). Despite the conservative nature of F in solution, there is no evidence of fluoride enrichment in the spring water. This provides strong evidence of a lack of direct hydraulic inter-connection.

Key distinctions in the hydrochemical properties between the groundwater data and that of the spring strongly support the conclusion that a direct hydrogeological connection between them is highly unlikely.

In addition to this the possibility of subsurface flow into the estuary was investigated by SWS. A survey of the Groen River bed was conducted to identify any springs, seeps, sumps or any other features which may indicate that sub-surface flow occurs along the channel. Seven locations - referred to as ‘sumps’ – were identified over a distance of about 17km along the channel in which standing water was identifiable, or where some evidence of the recent presence of water was inferred. Electrical conductivity levels in these sumps were higher by up to a factor of two than those recorded in water sampled from boreholes in the immediate vicinity of the river, indicating significant evapo-concentration in the sumps. It was concluded from these observations that subsurface flow along the channel bed is negligible, and also that there is negligible discharge from base flow or interflow of groundwater to into the river bed. If this was the case, electrical conductivity would have been lower and more similar to groundwater levels.

Based on the above information, it is clear that there is no hydrological connectivity between the mine site and the estuary downstream. Thus it is highly unlikely that the estuary will be impacted upon by mining activities.

Bitterrivier estuary

The estuary of the Bitterrivier, when it exists due to surface water inflow or seawater penetration, is much smaller than that of the Groen, being about 5 ha, and extending only about 400 m upriver from the beach. There is no published flow-related information for the river, and the periods during which the estuary is wet are likely to be short and widely separated in time.

Heydorn & Grindley (1981b) concluded:
"*The* [estuary of the] Bitter [River] *is probably of limited value as an estuary in the true sense, due to the episodic nature of its flow. However, being as yet relatively undisturbed by man's activities (at the time of the CSIR survey the area was part of the De Beers Consolidated Mines prospecting area, and public access was restricted), this scenic section of the coast has high aesthetic value and is part of the last remaining stretch of the Namaqualand coastline as yet unaffected by mining operations."*

Wetlands

The Working for Wetlands Kamiesberg Wetland Project has prepared rehabilitation plans for nine individual wetland systems - Kleingaas, Groenrivier, Kleikop, Schaaprivier, Langvlei, Natpad, Windpoort, Xharas and Kraaifonteinin – in the Northern Cape Province in the general area of the Kamiesberg mining project (Working for Wetlands 2014).

All but one of the wetland systems identified for attention in the project - the Groenrivier wetland - are situated in four quaternary catchments - F30A, F30C, F50A and F50E - near the towns of Kamieskroon and Leliefontein, inland from the mine site. Of these four catchments the nearest catchment boundary - that of F50E - is 27 km inland from the mining area. None of the wetlands in these four quaternaries will be affected in any way by mining or related activities.

Groenrivier wetland

The Groenrivier wetland, however, is situated in quaternary catchment F50G, at the mouth of the Groenrivier some 10.5 km south-west of the south-western corner of the Roode Heuvel block (see Figure 4.5 above). The wetland is situated in the Namaqua National Park, and its extent approximates to that of the Groenrivier estuary, discussed previously.

The rationale for the rehabilitation work proposed for the wetland system is "*The* (proposed bird) *hide site is at a very scenic location visited by a diversity of wetland-dependent birds. It is located within the Namaqualand National Park and there is good public access. In addition, through the use of appropriate signage, there are good opportunities for raising public awareness of the importance of wetlands in the overall catchment."* (Working for Wetlands 2014). The rehabilitation work is rated 4th in order of priority out of a total of nine wetlands in the project as a whole.

The mouth of the Groenrivier is relatively easy to access for camping, bird watching, hiking and 4x4 tracks. As a result the wetland has been subjected to a number of impacts associated with the formation of a number of informal access routes for watching birds, as well as short hiking trails, all of which have increased the impact of erosion and sedimentation by providing preferential flow routes for surface water draining. The primary objective of the rehabilitation is to provide formalised enhanced public access for watching birds and appreciate the scenic beauty of the Groenrivier estuary without impacting negatively on the estuary. This can be achieved by means of a bird hide and boardwalk access to the hide, and the construction of an additional boardwalk at the seaward end of the wetland to enhance access whilst avoiding trampling of saltmarsh.

Although the wetland / estuary is some distance from the mine site, it will be important to ensure that the mining project does not result in direct or indirect impacts on the wetland, nor prejudice the success of the rehabilitation project.

ii. Groundwater

A hydrocensus covering the project area was conducted by SWS during September 2012. The hydrocensus was subsequently extended in 2013 to include the area between the project site and the Atlantic Ocean to the west. A total of 23 sites were investigated, 19 boreholes, two pits (sumps) excavated in the bed of the Groenrivier, and two sites in the ocean. Data from the hydrocensus is shown in Table 4.2, and the locations of the sites on Figure 4.6.

Table 4.4: Hydrocensus summary table

Location & Sample ID	Coordinates		Site type	Use	Collar height (m)	Water level (mbc)	Water level (mbgl)	Water level (mamsl)
	Latitude (south)	Longitude (east)						
Hydrocensus 2012								
ZIR01	-30.7452	17.64536	Borehole	Unused	0.35	Unable to measure		
ZIR02	-30.742	17.62974	Borehole	Livestock	0.16	80.63	80.47	107.7
ZIR03	-30.7053	17.62532	Borehole	Unused	0	58.06	58.06	123.12
ZIR04	-30.7357	17.66761	Borehole	Livestock	0.38	Unable to measure		
ZIR05	-30.6133	17.59311	Borehole	Livestock	0.61	3.37	2.76	88.23
ZIR06	-30.5993	17.6607	Borehole	Livestock	0.16	16.4	16.24	136.26
ZIR07	-30.6766	17.71211	Borehole	Livestock	0.37	34.39	34.39	174.43
ZIR08	-30.718	17.65561	Borehole	Livestock; Domestic	0.41	Unable to measure		
ZIR09	-30.78	17.69353	Borehole	Unused	0.43	7.87	7.44	45.92
ZIR010	-30.7582	17.63989	Borehole	Livestock	0.48	2.12	1.64	31.11
ZIR011	-30.7587	17.63707	Dug Sump	N / A	N / A	N / A	N / A	22.46
ZIR012	-30.8478	17.57605	Seawater	N / A	N / A	N / A	N / A	N / A
Extended Hydrocensus 2013								
GAT1	-30.7301	17.6849	Borehole	Livestock	0.35	Unable to measure		
GAT2	-30.7305	17.6855	Borehole	Unused	0.31	Unable to measure		
ZIR13	-30.7838	17.6028	Dug sump	N / A	N / A	N / A	N / A	16.7
ZIR14	-30.7814	17.6003	Borehole	Livestock	0.21	9.44	9.23	4.79
ZIR15	30.7463	17.5722	Borehole	Livestock	0.62	Unable to measure		
ZIR16	30.7528	17.5789	Borehole	Livestock	0.90	42.89	41.99	41.25
ZIR17	-30.8100	17.5986	Borehole	Livestock	0.79	2.11	1.32	10.68
ZIR18	-30.8054	17.6024	Borehole	Livestock	Unable to measure			
ZIR19	-30.8133	17.5901	Borehole	Livestock	0.78	2.71	1.93	7.34
ZIR020	-30.7670	17.6626	Borehole	Livestock	0.55	2.62	2.07	33.70
ZIR021	-30.8589	17.5751	Seawater	N / A	N / A	N / A	N / A	N / A

Source: Hydrocensus 2012 - SWS 2012, adapted from Table 3.1; Hydrocensus 2013 - SWS 2013, adapted from Table 4.1

According to local landowners, groundwater use is almost exclusively for livestock watering, with minor use for domestic purposes such as washing and cleaning. The high salinity of the groundwater makes it unsuitable for human consumption, and all drinking water is obtained from rainwater harvesting from the roofs of the farmsteads. All existing boreholes in the area were equipped with wind pumps, which pump water to storage dams. From the dams, water is generally distributed to livestock watering points by gravity flow.

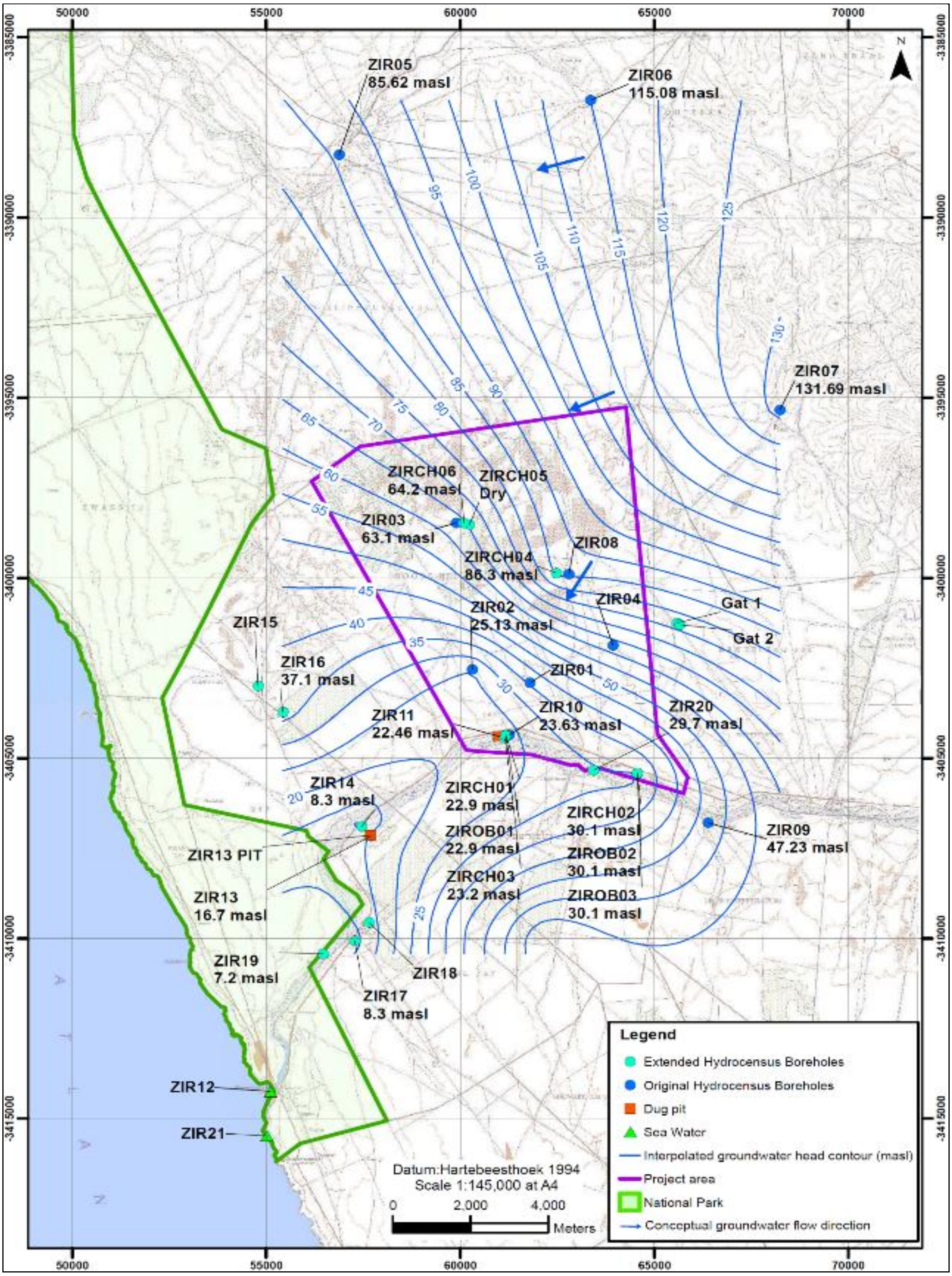


Figure 4.6: Extended hydrocensus points, borehole positions, groundwater contours
Source: SWS 2013, Figure 4.8

4.2.7 Estuarine Habitat

The estuarine study assessed the present ecological state of the Groen Estuary based on macrophytes, invertebrates and birds. In February 2015 the estuary could be divided into a lower hypersaline lagoonal area with abiotic characteristics very different to the narrow and shallow (<50 cm deep) channel in the middle and upper reaches. A salinity of 223 ppt was recorded in the lower reaches, which dropped to 70 ppt at approximately 0.7 km upstream from the mouth of the estuary. Reeds were abundant in the upper reaches - indicating brackish conditions - as they grow best at salinity less than 20 ppt. Freshwater springs at the head of the estuary are an important source of water to the estuary and at the time of the visit in February 2015, spring water recorded a salinity of around 10 ppt.

The dominant habitat at the Groen Estuary was supratidal salt marsh with the dominant species *Sarcocornia pillansii* that covered 8 ha. Intertidal salt marsh represented by *Sarcocornia natalensis* and *Salicornia meyeriana* occurred along the banks of the estuary mostly along the lower reaches of the northern bank. Terrestrial species including *Lampranthus* sp., *Lycium strandveldense* and *Mesembryanthemum guerichianum* were present in the ecotone between the suptratidal zone and terrestrial habitat. The reed and sedge habitat, represented by common reed (*Phragmites australis*), fringed the steeper channel in the upper reaches of the estuary. Filamentous macroalgae with the dominant species *Rhizoclonium riparium* (Cladophoraceae, Chlorophyta) are an important feature of the estuary. The filamentous cyanobacteria *Lyngbya* sp. was abundant in the estuary forming dense floating mats. Windblown algal mats were observed on the surrounding vegetation. This can increase salt load causing die-back but it is also a source of organic material to the surrounding supratidal salt marsh area. Salt pans were present in the middle and upper reaches of the estuary. These waterlogged areas were devoid of vegetation. Much of the vegetation surrounding the estuary was dead at the time of sampling in February 2015.

The only zooplankton found were insect larvae collected in the upper reaches at a salinity of 26 ppt. These larvae were associated with the floating algal mats. Extremely high salinity and anoxic sediment in the lower estuary excluded macroinvertebrates and mesozooplankton, while anoxic sediment in the channel area of the estuary (where salinity was lower) became the main limiting factor impacting the biota. Overall conditions were too stressful for invertebrates to thrive.

Most birds feeding in the estuary were either on the expansive sandflat in the lagoonal area of the lower reaches or present on or around the algal carpets floating on the water surface in the upper estuary. There were 15 different bird species and the total number of individuals was 109. Approximately one-third of the bird numbers were utilizing the estuary as a roosting area and not for feeding purposes. Long-billed benthic feeders and piscivores were not recorded on the estuary.

The absence of benthic macroinvertebrates, mesozooplankton, fish and low bird counts (mainly short-billed waders) support the conclusion that the Groen Estuary was a stressed ecosystem in February 2015. Main stressors were extreme hypersalinity, relatively low water volume, anoxic sediments and a mouth that had remained closed for a relatively long period of time (years).

4.2.8 Marine Environment

i. Oceanography

<u>Regional Oceanography</u>

The physical oceanography of an area, particularly water temperature, nutrient and oxygen levels, and wave exposure are the principal driving forces that shape marine communities. The broader oceanography of the Groenriviersmond region is influenced by the cold Benguela upwelling system of the west coast (Figure 4.7). The Benguela Current originates from the South Atlantic Circulation, which circles just north of the Arctic Circumpolar Current.

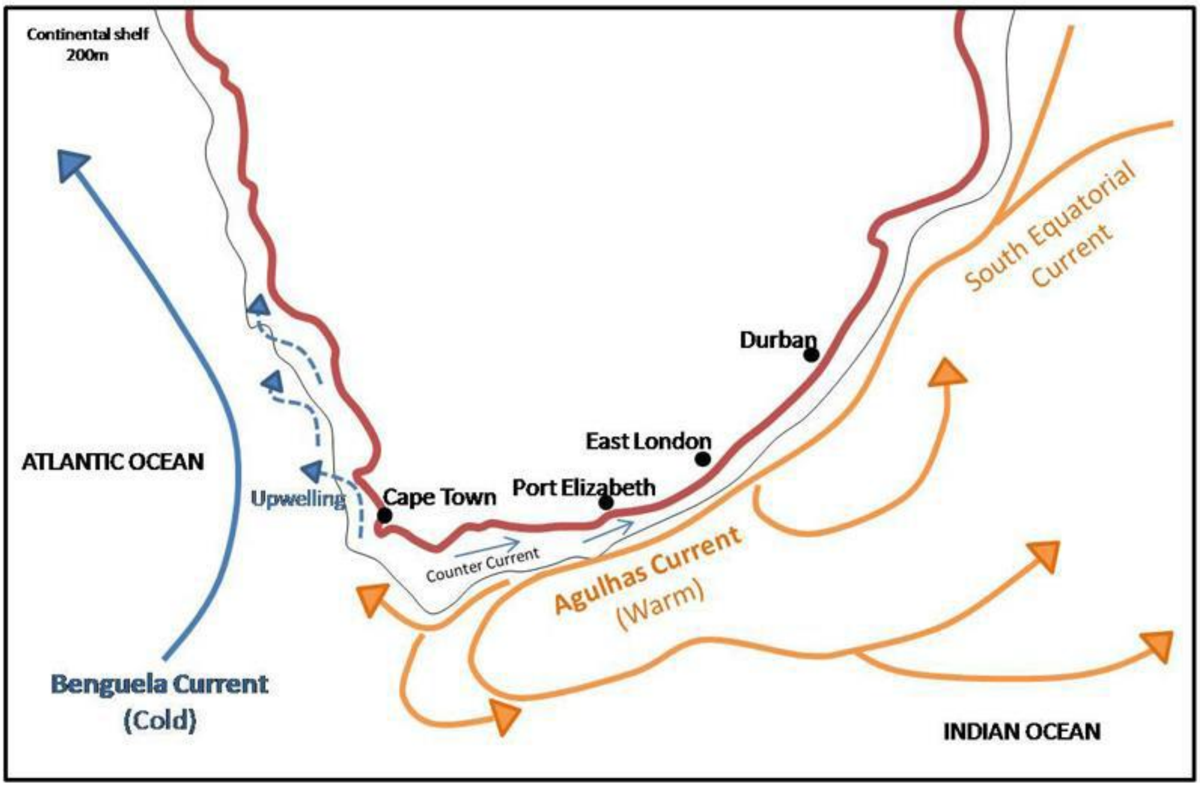


Figure 4.7: Southern Africa showing Agulhas and Benguela currents
(Source Anchor Environmental)

The naturally cool temperature of the Benguela current (average temperature 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 draws cold, nutrient rich water upwards to replace it (Figure 4.8). Phytoplankton bloom when the nutrients reach the surface waters where plenty of light is available for photosynthesis. The phytoplankton is then 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 also attracts large colonies of birds and seals (Branch 1981). The areas that experience the most intense upwelling activity in the southern Benguela are situated off Cape Columbine, approximately 80 km South of Lamberts Bay, and the Cape Peninsula. 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).

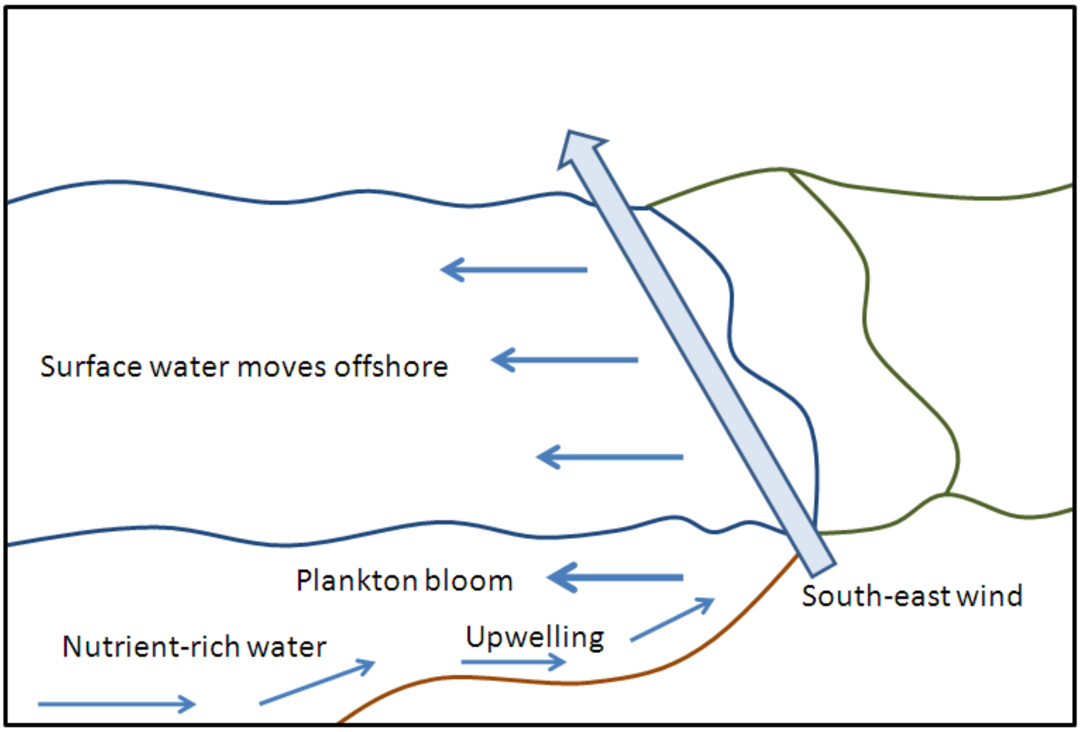


Figure 4.8: Wind-driven upwelling that occurs on the west and south west coasts of South Africa
(Source Anchor Environmental)

Local Oceanography

The study site is subject to semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. Each high tide occurs approximately 25 minutes later every day, which is due to the 28-day rotational cycle of the moon around the earth. 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 (e.g. relax, bathe, harvest marine resources). The tidal variation in the vicinity of Groenriviersmond usually ranges between 0.28 m (relative to the chart datum) at mean low water springs to 1.91m at mean high water springs with the highest and lowest astronomical tide being 2.25m and 0.056m 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 of South Africa typically experiences high wave energy and is dominated by south-westerly swells with a long fetch and a period of 10-15+ seconds (Branch and Griffiths 1988).

Regional Biogeography

Numerous attempts have been made to understand and map marine biogeographic patterns around the coast of South Africa (e.g. Stephenson and Stephenson 1972; Brown and Jarman 1978; Emanuel *et al.* 1992; Engledow *et al*. 1992; Stegenga and Bolton 1992; Bustamante and Branch 1996; Bolton and Anderson 1997; Turpie *et al*. 2000; Sink 2001; Bolton *et al*. 2004; Lombard *et al.* 2004). Most of these studies recognised three coastal regions – a cool temperate west coast, a warm temperate south coast and a subtropical east coast region, with the main points of argument relating to the position of the boundaries. Marine biogeographic patterns around the South African coast were recently reviewed and several new ecoregions were described (Sink *et al.* 2011). According to these divisions, Groenriviersmond and the study sites described in this report, fall in the Namaqua inshore ecozone, which is nested within the Southern Benguela Ecoregion.

ii. Ecology

<u>Sandy Beaches</u>

Intertidal sandy beaches are very dynamic environments. The faunal community composition is largely dependent on the interaction of wave energy, beach slope and sand particle size (beach morphodynamics). Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan *et al.* 1993). Dissipative beaches are wide and flat with fine sands and high wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities. Reflective beaches have low wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf-zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities. Intermediate beach conditions exist between these extremes and have a very variable species composition (McLachlan *et al.* 1993). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of e.g. kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch and Griffiths 1988; Field and Griffiths 1991).

The sandy beaches of the Southern Benguela Ecoregion are exposed to high energy waves with the exception of a few small sheltered bays (Bally 1987). The main inputs of food to the sandy beaches in this system are upwelling-related coastal phytoplankton and kelp detritus (Bally 1987). The biomass values reported for beaches along the southern Benguela coast are some of the highest in the world (Bally 1987).

Sandy beaches have no hard substratum onto which animals and plants can attach. Organisms living here rely on a nutrient source in the form of seaweed detritus which is constantly deposited on the beach together with organic rich froth, or spume (Branch 1981). Sandy beaches are highly dynamic; strong waves scour and erode beaches while gentle waves deposit sand. Sand is typically deposited with offshore winds, and eroded with onshore winds. Relatively few species occur on sandy beaches due to their unstable and harsh nature, but those that do occur are hardy, and well adapted to life in these environments (Branch 1981). Animals living here are, however, offered some degree of protection by being able to burrow into the layers of sand to escape desiccation, overheating and strong waves (Branch 1981). Five groups of organisms are typically found on sandy beaches: aquatic scavengers, aquatic particle feeders, air breathing scavengers, meiofauna (smaller than 1 mm in size), and higher predators (Branch 1981).

Aquatic scavengers feed on dead or dying animals that wash up on the beach and their activity is largely regulated by tides. This group includes species such as *Bullia* (the plough snail), that emerge from the sand as the tide rises and are deposited in the same area in which the waves drop debris and decaying matter. Later they follow the tide down the shore as it recedes to avoid being eaten by terrestrial predators. Aquatic particle feeders, such as the sand hopper, occur mostly on the low-shore and feed on small organic particles. The majority of these species migrate up and down the beach with each tidal cycle, such that they remain in the surf zone and can escape avian and terrestrial predators. Sand hoppers are important for the breakdown of washed up seaweed, and are also a major food source for sanderlings and other birds. Air breathing scavengers live high on the shore and feed on kelp and other seaweeds that have been washed up, as well as dead and decaying animal matter. These species complete their life cycles out of water, emerge from the sand during low tide when there is less risk of being washed away, and are almost strictly nocturnal to avoid desiccation and predation. Meiofauna (organisms < 1mm in size) are by far the most abundant of the animals found on sandy beaches, as their small size enables them to live between sand grains. The two most common groups are nematode worms and harpacticoid copepods. Meiofauna play an important role in breaking down organic matter which is then colonised by bacteria. Higher predators which feed on sandy beach organisms include birds, such as African black oystercatchers, White fronted plovers and sanderlings, and fish such as galjoen and white Steenbras (Branch 1981).

Beaches typically comprise three functional zones, namely the surf zone, the beach (intertidal and backshore zones) and the dunes. The diversity and abundance of species has been shown to increase with depth in the surf zone of beaches along the Benguela system. A rich outer turbulent zone (10-33m from the shore) supports delicate cnidarians (anemones), tube building polychaetes and amphipods, while the less diverse offshore turbulent zone (3m-5m from the shore) is typified by deep burrowing polychaetes and crustaceans. The poor species diversity and abundance, as well as the presence of the cumacean *Cumopsis robusta* (small crustacean), characterise the inner turbulent zone (0-1m from the shore) of the surf zone. Fish such as galjoen and white steenbras 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, and is even thought to rival that of estuaries in some areas (Clark *et al*. 1996, Lenanton *et al*. 1982, Bennett 1989). The intertidal zone of sandy beaches along the coast of the Benguela system can be divided into three zones; the zone of saturation (or the sublittoral fringe), the midshore and the upper drift line (or supralittoral zone). The sublittoral fringe is typified by mysids (*Gastrosaccus* spp.) and scavenging gastropods (*Bullia* spp.), while the midshore region is characterised by isopods (*Eurydice longicornis* and *Pontogeloides latipes*) and a polychaete (*Scolelepis squamata*). The upper drift line is typified by air-breathing amphipods (*Talorchestia*) and giant isopods (*Tylos* spp.), as well as a rich diversity of insects (mostly Coleoptera and Diptera) where large quantities of kelp have been deposited on the drift line.

Sandy beaches are important for the filtering and decomposition of organic matter in sea water. As water percolates down through the sand the organic particles are trapped and decomposed by bacteria, which in turn release nitrates and phosphates that are returned to the sea. Continual flow of water through the sand maintains oxygen levels and aids bacterial decomposition, and thus sandy beaches act as water purifiers (Branch 1981).

<u>Sandy Benthic Habitat</u>

The primary food source in near-shore sediments is plankton and detritus, brought in by currents from rocky shores and reefs, and other more productive coastal communities. Faeces, dead individuals and debris from plankton and nekton in the water column as well as detritus, generated by the bottom dwellers themselves as they die, is also present. Bacteria play a major role in decomposition and are an important source of protein on soft-bottom habitats.

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. Soft-bottom subtidal communities are dominated by benthic infauna, with some epifauna present, however sessile or attached forms are virtually absent as there is nothing to attach to (Castro and Huber 1997). The distribution of infauna and the depth atCe 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 which is used up during decomposition processes.

Much of the benthic infauna are deposit feeders which either ingest sediments and extract organic matter trapped between the grains or actively collect organic matter and detritus (Castro and Huber 1997). Many species of polychaetes and worms are deposit feeders. Peanut worms (Sipunculida) gather detritus using tentacles at the mouth of an elongate, tubular anterior process that can be squeezed out by muscular contraction and then retracted (Branch *et. al*. 1994).

Suspension feeders eat drifting detritus and plankton from the water column (Castro and Huber 1997). Some suspension feeders are filter feeders which actively pump and filter water to obtain suspended particles. These include clams as well as species of amphipods and polychaetes. Other suspension feeders lift arms, tubes, branches or polyps vertically into the water column to catch suspended particles.

Predators in soft bottom habitats may burrow through sediments to get to their prey or catch it on the surface (Castro and Huber 1997). Predators such as crabs, hermit crabs, lobsters and octopuses, which inhabit rocky areas, may move to sandy benthos to feed (Castro and Huber 1997). Most bottom-dwelling fish in soft bottom habitats are predators. Rays and skates scoop up clams, crabs and other infauna and epifauna, while flat fishes, such as flounders and soles, lie camouflaged or covered on the bottom and forage for a wide variety of prey.

Rocky Reefs and Kelp Forests

Temperate rocky reefs are found below the low water mark (i.e. are always completely submerged) and are known to support diverse assemblages of life. Disturbance from wave action and sedimentation result in a high turnover of competitors in these habitats. Many large predators such as fish and sharks are attracted to rocky reefs, and thus form an important component of these ecosystems (Barros *et al*. 2001). Rocky reef communities also influence the abundance and distribution of benthic macrofauna in adjacent soft bottom habitats, and it has been found that more benthic species occur close to rocky reefs (Barros *et al.* 2001). Thus many reef-associated fish and crustaceans not only forage directly on the reef but also on the adjacent sandy bottom areas.

The following generic description of subtidal, west coast rocky reef is largely based on information provided by Branch *et al*. (2010) and Meyer and Clark (1999). Rocky reefs provide substratum to which kelp (*Ecklonia*) can attach, and these large kelp forests provide food and shelter for many organisms. Light is the limiting factor for plant growth, and thus kelp beds only extend down to approximately 10 m depth. Many other algal species live underneath the floating canopy of kelp, especially inshore where the light is abundant and the water shallow. A sub-canopy of *Lamanaria* grows beneath the *Ecklonia* in deeper waters (Plate 4.2), and dense communities of mussels, sea urchins, and rock lobster live between the *Lamanaria*. Growing epiphytically on these kelps are the algae *Carradoria virgata*, *Suhria vittata* and *Carpoblepharis flaccida*. Representative under-storey algae include *Botyrocarpa prolifera*, *Neuroglossum binderianum*, *Botryoglossum platycarpum*, *Hymena venosa* and *Epymenia obtusa*, various coralline algae. The dominant grazer is the sea urchin *Parechinus angulosus*, with lesser grazing pressure from limpets, the isopod *Paridotea reticulata* and the amphipod *Ampithoe humeralis*. Herbivores occurring in the kelp forests include the kelp limpet *Patella compressa* which lives on the stipes of the kelp (Branch 1981). West coast rock lobster, *Jasus lalandii*, and *Octopus vulgaris* are two of the most important carnivores that occur within kelp forests in the Groenriviersmond area. Other kelp forest predators include the starfish *Henricia ornata*, various feather and brittle stars (Crinoidea & Ophiuroidea, Echinodermata), *Nucella* spp. and *Burnupena* spp. gastropods. Fish species likely to be found in the kelp beds off Lamberts Bay include hottentot *Pachymetopon blochii* (Plate 4.2), two-tone fingerfin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis,* milk fish *Parascorpis typus*, rock suckers *Chorisochismus dentex* and the catshark *Haploblepharus pictus* (Branch *et al*. 2010).

Kelp washed ashore forms an important food source for scavengers and provides shelter for numerous isopods (sea lice), which are in turn preyed upon by birds. Filter feeders such as mussels, red bait and sea cucumbers comprise 70-90% of the faunal community on rocky shores and their principal food source is kelp (Branch et al. 2010). Kelp thus forms an integral part of the rocky shore and sandy beach ecosystems. Kelp also produces large quantities of mucus, which encourages bacterial growth upon which protozoa feed.

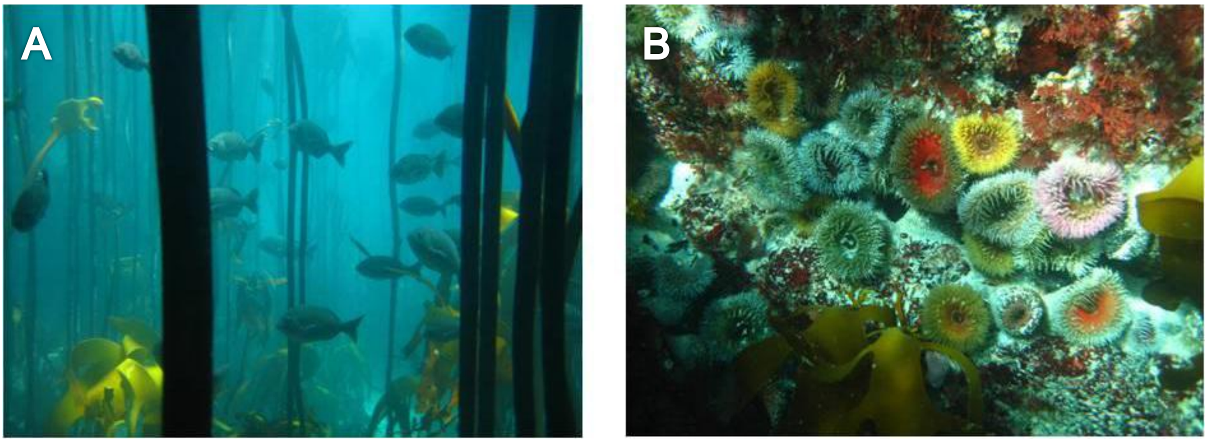


Plate 4.2: (A) E. maxima kelp forest with L. pallida sub-canopy and Hottentot (Pachymetopon blochii) (B) Sandy anemones (Bunodactis reynaudi), a typical west coast shallow reef species

<u>*Rocky Shore*</u>

Rocky shores can be divided into distinct bands according to the amount of time each is exposed to the air, which in turn influences the organisms that inhabit each section of the shore. Species that are more tolerant to desiccation (drying out) are found near the high-water mark, while those that cannot tolerate long periods of water recession are found near the low-water mark. There are five distinct zones that are typically found on rocky shores. 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. A further influencing factor on the distribution of organisms on the rocky shore is the degree of exposure to wave action, with significant differences noted between sheltered and exposed areas (Bustamante et al. 1997).

The Infratidal zone is inhabited by species which cannot withstand long periods of exposure and includes thick algal beds of kelp, *Gigartina, Champia lumbricalis* and articulated corallines interspersed with sea urchins (*Parechinus*) and the invasive black mussel, *Mytilis galloprovincialis*. The large limpets, *Scutellastra argenvillei* and *Cymbula granatina*, form dense stands which extend up into the cochlear zone effectively replacing *S. cochlear* which are somewhat rare in the region. *Octopus vulgaris*, and various species of fish, known as “klipvis” in South Africa, 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 *S. granularis*, winkles (*Oxystele tigrina* and *O. variegata*) and whelks (*Burnupena spp.*) are found. The black mussel, *M. galloprovincialis*, also extends into this zone and competes for space with *Gunnarea gaimardi*, the Cape reef worm. Little seaweed occurs within this zone, however some sea lettuce (*Ulva*) is present and there are scattered patches of the encrusting brown alga, *Ralfsia verrucosa*. The upper Balanoid zone is dominated by animals, in particular limpets and barnacles. The harshest of all is the Littorina zone, which is dominated by the snail *Afrolittorina knysnaensis* and the flat-bladed alga *Porphyra capensis* (Branch 1981).

The diversity of intertidal macroalgal species is relatively low in the region (Bustamante et al. 1997). Filter feeders such as mussels and the Cape reef worm comprise ~70% of the faunal community on rocky shores and their principal food source is kelp particulates together with various microorganisms, kelp spores, phytoplankton and other fragments of organic matter (du Toit & Attwood 2008). An ecological assessment of the rocky shore at each of the proposed gully intake sites was conducted in order to assess the importance of the area for rocky intertidal biodiversity conservation, this assessment is available in Chapter 9 of this report.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Flora

The project site is located within the Succulent Karoo biome which stretches from the Luderitz district of Namibia along the western extremes of the Northern Cape down towards Cape Town, and thence eastwards into the Little Karoo as far east as Steytlerville. It is the fourth largest biome in South Africa, and much of it consists of flat to undulating terrain, with hilly and more rugged terrain occurring in parts of Namaqualand, and notably so in the Kamiesberg and Richtersveld (Mucina and Rutherford, 2006).

The Succulent Karoo is part of what is now recognised as the Extra Cape Subregion (ECR) of the Greater Cape Floristic Region (GCFR; Snijman 2013). The GCFR is essentially defined by its predominantly winter rainfall, and a distinct flora. The GCFR is one of only six Floristic Regions in the world, and it is also by far the smallest floristic region. The Extra Cape Subregion occupies only 0.1% of the world's land surface, and supports about 3720 plant species, almost 20% of all the plant species in southern Africa, and some 8% of the plant species in sub-Saharan Africa. About 40% of all the plant species in the Extra Cape Subregion do not occur outside this region (Snijman 2013), and many have very small home ranges (these are known as narrow endemics). Although land use pressures are relatively low in the region (apart perhaps from overgrazing and mining), and there are consequently far fewer threatened plants in the region than in the Core Cape Region (commonly referred to as the Fynbos), many of the range restricted species are vulnerable to intense local development due to their very small ranges and specific habitat requirements.

The semi-arid Succulent Karoo is a winter-rainfall region, and is characterized by low to dwarf, open, succulent shrubland, typically including the families *Mesembryanthemaceae* and *Crassulaceae*. This shrubland is dominated by stem and leaf succulents, many of which are deciduous, and a few fine-leaved evergreen shrubs. Grasses are infrequent (partly due to heavy selective grazing) and are mainly annuals. The mass spring flowering displays of annuals (mainly Asteraceae) and geophytes, particularly in disturbed areas, are highly characteristic of the Succulent Karoo. Low trees are common only along river courses, where they may form woodland corridors (Barnes *et al.* 2001).

i. Regional Vegetation

Namaqualand, which forms the largest portion of the Succulent Karoo biome, is best known for its spring floral displays. This winter rainfall desert is home to a unique arid-land flora that is unparalleled globally in terms of its diverse mixture of both species and growth forms. The region is recognized as the only desert biodiversity hotspot on earth (Mittermeier et al. 2000) and hosts the world's greatest variety of succulent plants.

Mucina and Rutherford (2006), which is the most comprehensive data for vegetation types in South Africa, define the following vegetation types (Figure 4.9) from which source these descriptions are derived:

Namaqualand Strandveld (SKs7)

Namaqualand Strandveld (which is part of the Namaqualand Sandveld bioregion) occurs in the Northern and Western Cape Provinces and is characterised by a flat to slightly undulating landscape of coastal peneplain. It is found on Quaternary stabilised deep aeolian red or yellow sands and on stable dunes and deep sand overlying marine sediments and gneisses. These sands are alkaline or neutral, as opposed to the Sand Fynbos sands which are usually slightly acidic. Sometimes weakly defined scattered heuweltjies (circular, abandoned termite mounds) are found further away from the sea. Although predominantly coastal, this vegetation may penetrate as far as 40 km inland from the sea, especially where coastal dune plumes extend inland and where there is a high incidence of coastal fog. Strandveld vegetation structure is highly variable, ranging in height from an average 30 cm to an average 1.2 m, but it is typically low, species-rich shrubland dominated by a variety of erect and creeping succulent and often deciduous shrubs. This widespread vegetation type could perhaps be divided into at least 6 or 8 distinct forms based on morphology and species composition, but this has not yet been done on a formal basis.

Namaqualand Strandveld is classified as a **Least Threatened** vegetation type on a national basis (DEA 2011), with a conservation target of 26% of its total original extent, and about 10% of its total extent has been transformed (Rouget *et al.* 2004). Relatively little was formally conserved until recently, although the nearby Namaqua National Park does now include significant areas of this vegetation type (>60 000ha, or >15% of the total original extent, being over half of the conservation target of 26%). This vegetation type covers about 46% of the total prospecting area, and about 40% of the proposed mining area.

Namaqualand Heuweltjieveld (SKn4)

This vegetation type occurs in the Northern Cape along the western foothills of the Namaqualand Escarpment. It characterised by undulating plains that lead up the escarpment, and soils are typically relatively rich and derived from underlying granite or gneiss. The vegetation cover comprises a mosaic of low shrubland communities dominated by leaf-succulent shrubs that occur on slightly raised, rounded termite mounds or "heuweltjies"; ascribed to former activity of harvester termites (*Microhodotermes viator*). It is classified as **"Least Threatened"** on a national basis (DEA 2011), with a conservation target of 28% of its original extent. Approximately 11% has been statutorily conserved (mostly in the Namaqua National Park) and 3-4% has been transformed by cultivation (Rouget *et al* 2004). This vegetation type occupies about 18% of the prospecting area, but is not present in the proposed mining area.

Namaqualand Klipkoppe Shrubland (SKn1)

This vegetation type occurs in the Western and Northern Cape in the central and north-central regions of Namaqualand. It is typified by dramatic landscapes of large granite and gneiss domes and disintegrating boulder koppies that support open shrubland dominated by dwarf shrubs with ericoid or succulent leaves, many of which are deciduous. It is classified as **Least Threatened** on a national basis (DEA 2011), with a conservation target of 28%. Approximately 6% has been statutorily conserved and about 5% has been transformed (Rouget *et al* 2004). This vegetation type occupies only about 1% of the prospecting area, and is not present in the proposed mining area.

Namaqualand Sand Fynbos (FFd1)

Namaqualand Sand Fynbos occurs on the coastal plain (usually 5-20 km inland), on Quarternary and Tertiary sands of marine and aeolian origin, and is the only Sand Fynbos type found within the Succulent Karoo biome, all the others being part of the Fynbos biome further south. The topography, soil pH and moisture availability determine the dominance of Sand Fynbos or Strandveld communities. Strandveld communities prefer alkaline soils, while Sand Fynbos is found on leached (acidic) soils. In the case of Namaqualand Sand Fynbos, fire does not play a role in regeneration of the Fynbos elements, in contrast to other Sand Fynbos types. There is often a predictable presence of various shrubs of Fynbos affinity on the dune ridges, and Restionaceae are often dominant in dune slacks, and sometimes also on dune ridges.

The boundary (ecotone) between Sand Fynbos and Strandveld is usually dynamic and rather broad, and is driven primarily by soil pH. This boundary may be very diffuse, or it may be complex, and results in a difficult to map mosaic of vegetation types. The width of the ecotone from pure Strandveld to pure Fynbos may vary from quite abrupt to 2-5 km in certain areas (Mucina & Rutherford 2006). Scarps adjacent to riverine and wetland vegetation often support Strandveld, due to higher salinity in these areas.

Namaqualand Sand Fynbos occurs in the Western and Northern Cape along the coastal plain. The vegetation occurs on slightly undulating plains and is dominated by Cape reeds (Restionaceae) that occur between scattered shrubs. It is classified as **Least Threatened** on a national basis (DEA 2011), with a national conservation target of 29% (Rouget *et al* 2004). The Namaqua National Park has recently incorporated an unknown proportion of this vegetation type (perhaps some 11 000 ha), but the total area statutorily conserved is probably still under 12% of its original extent. It is estimated that about 7% has been transformed by cultivation and by ongoing mineral sand mining near Brand se Baai, which has resulted in the loss of over 3000 ha of this unit. This vegetation type occupies about 29% of the prospecting area, and about 60% of the Roode Heuvel property.

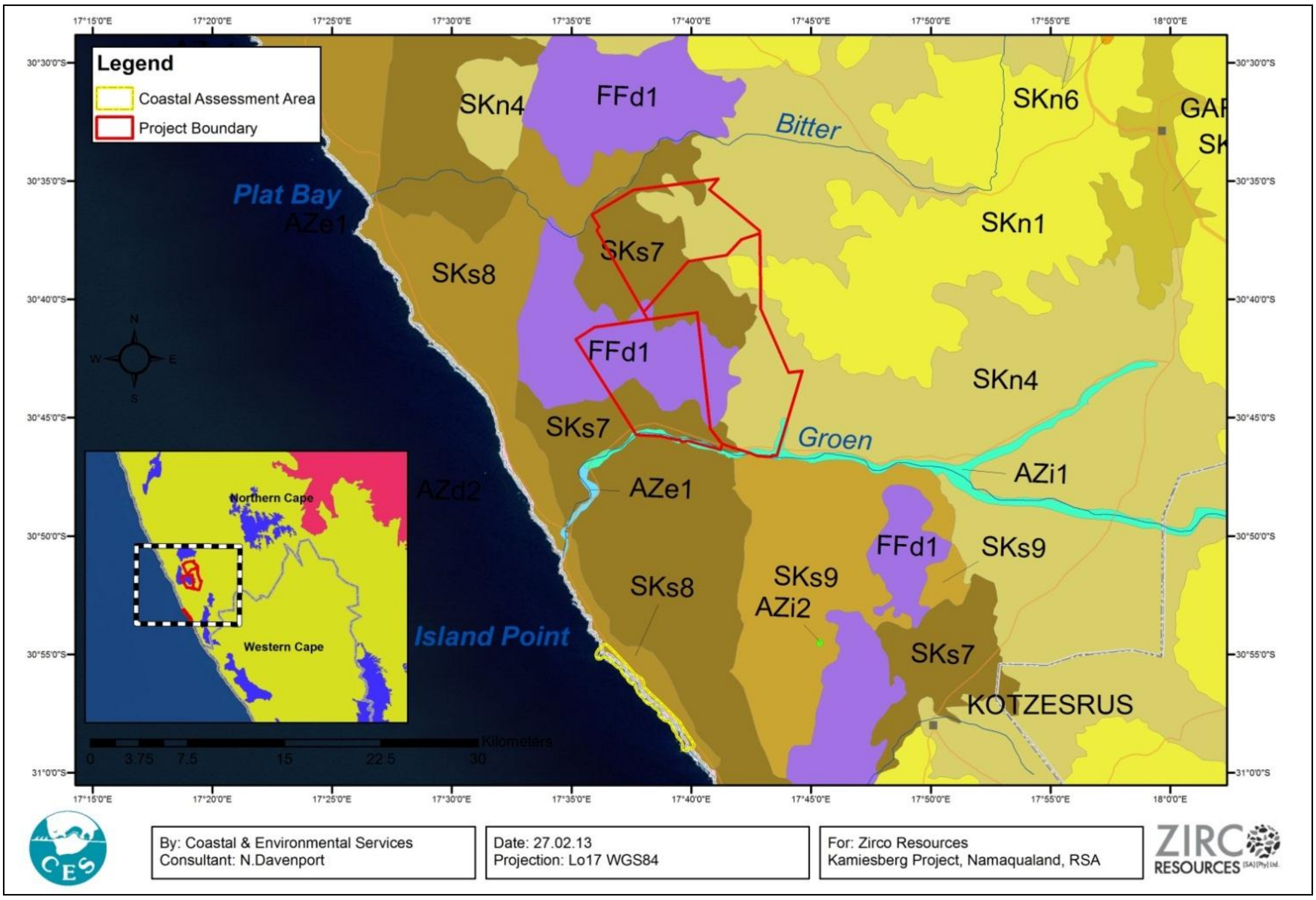


Figure 4.9: Regional vegetation of the study area as per Mucina and Rutherford (2006)
SKs7 - Namaqualand Strandveld; SKn4 – Namaqualand Heuweltjieveld; SKn1 – Namaqualand Klipkpppe Shrubland; FFd1 - Namaqualand Sand Fynbos; AZi1 - Namaqualand Riviere; SKs8 - Namaqualand Coastal Duneveld; AZd2 - Namaqualand Seashore Vegetation.

<u>Namaqualand Riviere (AZi1)</u>

Namaqualand Riviere occurs in the Western and Northern Cape along dry riverbeds throughout Namaqualand. It is characterised by a complex of alluvial shrubland interspersed with patches of tussock graminoids (grasses). Soils are a mix of heavy silts and coarse granitic sands, and are often strongly saline, as reflected by the presence of salt tolerant species such as *Sarcocornia* and *Salicornia*. In places low thickets of *Acacia karroo* and *Tamarix usneoides* are found, and *Phragmites* reeds are common in areas with more regular surface water. The vegetation type is classified as **Least Threatened** (DEA 2011), with a conservation target of 24% (Rouget et al. 2004). Only a small percentage has been statutorily conserved while almost 20% has been transformed through cultivation (Mucina & Rutherford 2006). This vegetation type occupies only about 3% of the prospecting area, and is not present in the proposed mining area.

Namaqualand Coastal Duneveld (SKs8)

This vegetation type occurs in the Western and Northern Cape along the coastal plains. The vegetation is typically dwarf shrubland dominated by erect succulent shrubs and non-succulent shrubs. Spiny grasses are common on the windblown semi-stable dunes. The Namaqualand Coastal Duneveld is classified as **Least Threatened** with a conservation target of 26%. As of 2004 none was statutorily conserved, but the Namaqua National Park has recently incorporated a significant but unknown area of this vegetation type (estimated at about 20% of its total original extent). Some 8% of its original extent has been transformed through diamond mining, mainly in the Hondeklipbaai area (Mucina & Rutherford 2006). This vegetation type occurs in the study area along the coast between Island Point and Knyp Point, but not in the prospecting or mining area.

Namaqualand Seashore Vegetation (AZd2)

Namaqualand Seashore Vegetation is distributed along the Northern Cape coastline, in a very narrow strip above the high water mark, from Holgat River to Olifants River. It is typically found on alkaline coastal dunes, and is typically a sparse vegetation community of partly succulent hummock-forming and spreading dwarf shrubs, grasses and herbs. Namaqualand Seashore Vegetation is classified as **Least Threatened** with a conservation target of 26%. As of 2004 none was statutorily conserved, but the Namaqua National Park has recently incorporated a significant but unknown area of this vegetation type. About 5% has been transformed through diamond mining (Mucina & Rutherford 2006). This widespread vegetation type occurs between the high water mark and the Namaqualand Coastal Duneveld, along the coast between Island Point and Khnyp Point.

ii. Vegetation and floristics of the project area

Prospecting areas

Five (5) key vegetation types occur on the Zirco prospecting areas (Figure 4.2), namely:

1. Strandveld (Namaqualand Strandveld)
2. Sand Fynbos (Namaqualand Sand Fynbos)
3. Heuweltjieveld (Namaqualand Heuweltjieveld)
4. Riparian vegetation (Namaqualand Riviere)
5. Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)

Strandveld (9544 ha) is the dominant vegetation unit in the study area and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas (Plate 4.3A). It is also found scattered throughout Sabies, and extends into Leeuvlei (Figure 4.10). Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld (181 ha) occurs along the southern section of Roode Heuvel (Plate 4.3B). The cause of degradation is overgrazing, resulting from water points and livestock pens (kraals) which occur along the road, and incidentally along the Groen River.

A. Strandveld

B. Previously cultivated and degraded Strandveld which is now dominated by grass species

C. Sand Fynbos, dune slack in foreground, dune ridge behind. The restio *Thamnochortus bachmanii* is dominant in the foreground.

D. Fallow fields in Sand Fynbos

E. Heuweltjieveld, with a high density of dwarf succulents in the foreground

F. Degraded Heuweltjieveld dominated by 'kraalbos' (*Galenia africana*)

G. Riparian bush along the Groen River, with *Acacia karroo*

H. The Groen River riparian vegetation includes salt tolerant succulent shrubs

I. Klipkop shrubland

J. Rocky outcrop with Klipkop Shrubland

Plate 4.3: Examples of the various vegetation types which occur in the prospecting area

Typical species in Strandveld include *Zygophyllum morgsana* (skilpadbos; slaaibos)*, Othonna cylindrica* (ossierapuisbos)*, Othonna coronopifolia, Tetragonia fruticosa* (klimopkinkelbossie), *Cladoraphis cyperoides*, *Berkheya fruticosa, Tripteris oppositifolia, Osteospermum incanum, Leucoptera nodosa*, *Lycium strandveldense* (muisbos), *Salvia africana-lutea* (bruinstrandsalie), *Limonium peregrinum* (strandroos), *Limonium* sp. nov. (*L. dagmarea* MS), *Calobota angustifolia* (fluitjiesbos), *Ruschia floribunda, R. subpaniculata, R. fugitans, Lampranthus watermeyeri, L. stipulaceus, Heliophila lactea, Euphorbia mauritanica* (melkbos), *Pelargonium gibbosum* (dikbeen malva), *Hermannia trifurca* (poprosie), *H. scordifolia*, *Thesium spinosum, Exomis microphylla, Microloma sagittatum, Pteronia divaricata, Manulea altissima, Stoeberia utilis* (asbos), *Manochlamys albicans* (spanspekbos; seepbos; soutbos), *Cissampelos capensis, Conicosia pugioniformis* ssp*. alborosea* (vetkousie), *Vanzijlia annulata, Phyllopodium pumilum, Gorteria personata, Tylecodon wallichii* (krimpsiektebos), *Eriocephalus racemosa* (kapokbossie; wilderoosmaryn), *Asparagus africana*, *Adenogramma mollugo, Pharnaceum lanatum*, and *Helichrysum tricostatum.* Scattered larger woody shrubs are a feature in some areas, especially in transitions to Sand Fynbos, and may include *Searsia longispina* (taaibos) and *Gymnosporia buxifolia* (pendoring). Grasses may be prominent after rains, mainly *Ehrharta calycina* (rooisaadgras), *Schismus barbatus* and *Stipagrostis zeyheri*. Bulbs include *Babiana brachystachys*, *B. grandiflora*, *Lachenalia unifolia*, *Oxalis flava*, *O. luteola*, *Trachyandra divaricata* (duinekool)*, Trachyandra falcata* and *T. muricata* (veldkool), *Drimia capensis* (maerman), and *Boophone haemanthoides* (gifbol).

Relatively few **Species of Conservation Concern (SCC)** are known to occur in true Strandveld, but nevertheless six SCC were recorded in this unit (24% of those in the total study area).

1. *Leucoptera nodosa* (Plate 4.4) is Red Listed as Vulnerable (Helme & Raimondo 2006). This is a succulent shrub in the daisy family, previously known from only five definite localities in the Strandveld between Hondeklipbaai and Lamberts Bay. The species was recorded at three new localities within the study area (see Figure 4.10), and at various other new localities within the Namaqua National Park during the August 2014 survey. The species seems to usually occur as scattered individual plants, although one of the localities (Leeuvlei area) supported what is to date the largest known population of the species (about 150 plants).
2. *Arctotis sp nov.1* is an undescribed perennial daisy known only from this unit, and although widespread (Brand se Baai to Hondeklipbaai) it may be threatened by mining (pers. obs.). As it is yet to be described the species has not been assessed for the Red List.
3. *Calobota lotononoides* (Near Threatened; Helme et al. 2008) is common in this habitat, often on the ecotone with Sand Fynbos.
4. *Helichrysum tricostatum* (Near Threatened) is also fairly common in this habitat, but is a very widespread species (Saldanha to Orange River).
5. *Hermannia* sp nov. is common in this unit, but has not yet been assessed. The species is common in the region from Brand se Baai to Hondeklipbaai.
6. *Wahlenbergia asparagoides* (Vulnerable) is most common in Sand Fynbos, but may also occur in this unit.

Plate 4.4: Leucoptera nodosa is a perennial daisy Red Listed as Vulnerable, photographed here west of Leeuvlei. This is the largest known population of this rare species.

Sand Fynbos (6072 ha) is the second largest vegetation unit in the area. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei (Figure 4.10). Sand Fynbos occurs on slightly undulating plains and is often dominated by restios (typically *Thamnochortus bachmanii* and *Restio macer*) in the dune slacks (troughs), and asteraceous fynbos or restios (*Willdenowia incurvata*) on the dune ridges (Plate 4.3C). The vegetation on the dune ridges often includes Strandveld elements.

Species typical of this unit include *Nenax arenicola, Arctotis canaliculata, Willdenowia incurvata* (sonkwasriet), *Thamnochortus bachmanii, Restio macer, Kedrostis psammophila, Ficinia argyropa, Ficinia indica, Grielum humifusum* (pietsnot), *Chrysocoma longifolia., Eriospermum arenosum*, *Salvia lanceolata, Wahlenbergia asparagoides, Lebeckia ambigua, Aspalathus cuspidata, A. quinquefolia, A. spinescens ssp. lepida, Chlorophytum viscosum, Coelanthum* *grandiflorum, Albuca* sp., *Nemesia affinis, Justicia cuneata, Elegia sp nov., Diosma ramosissima, Osteospermum incanum, Trichogyne pilulifera, Elytropappus rhinocerotis* (renosterbos), *Stoebe nervigera, Aspalathus cuspidata, Leucospermum rodolentum* (luisbos), *Leucadendron brunioides ssp. brunioides, Metalasia densa, M. adunca, Macrostylis* sp*., Wiborgia obcordata, Ornithoglossum viride* (slangblom), *Moraea ciliata, Calobota lotononoides*, *Muraltia obovata*, *Gethyllis* sp. (kukumakranka), *Asparagus juniperoides, Pteronia onobromoides* and *Limeum africanum*.

This habitat unit is known to support at least **15 SCC**, and is the richest vegetation type in the study area in terms of number of threatened plant species. This is a highly significant number of SCC for a single vegetation unit, being 60% of all SCC recorded in the total study area. See Appendix 2 of the vegetation assessment for a full list of the SCC in this unit, and a list of the significance of the populations of all SCC. Only the most significant are outlined below.

The unit includes a number of undescribed or only recently described species, which is indicative of how poorly known the unit is, or at least was until recently.

- *Elegia* sp nov is a striking, undescribed restio that is only known from the northern Sandveld. Originally (in 2009) recorded close to Kotzesrus, it was found to be fairly common on site (the second known locality) only on the northern edge of Roode Heuvel (Figure 4.11). The August 2014 fieldwork showed that it also occurs in about a 20 ha patch of the adjacent Namaqua National Park, and again in a small area north of the Bitter River, where new cultivation had already resulted in loss of about half this population.
- *Lachenalia* sp nov (Plate 4.5) is a bulb that was first discovered in September 2012 close to Koekenaap, and was then found to be fairly common in the study area, where the Type collection was made, and the species will be described in 2014 (as *L. arenicola* MS). The August 2014 fieldwork revealed this species to be present but never common as far north as Riethuis (giving it a total known range of about 170 km), and is fairly well represented within the Namaqua National Park.
- *Lampranthus procumbens* (Plate 4.6) is a creeping vygie that was described in 2009, and is known from Kommagas south to Kotzesrus, and the species is common on site only in the northern areas of Roode Heuvel. It was found to be common in the adjacent parts of the Namaqua National Park, but was rare elsewhere in the Park.
- *Agathosma elata* is a buchu that was previously only known from near Vanrhynsdorp and Klawer, some 150 km to the southeast, and its discovery here was thus a major surprise. The species is Red Listed as Endangered, and the population in the study area is small. In August 2014 the species was found at various other localities as far north as Riethuis (40km NW of the site), including 3 within the Namaqua National Park, but it is never common, and the total population is small (estimated at <500 plants).
- *Caesia sabulosa* is a common geophyte in Sandveld, but was also only recently described, and is here at or close to its northernmost distribution.

Fallow cereal (oats, rye and wheat) fields (308 ha) occur scattered throughout large sections of the Sand Fynbos communities, especially in the north western sections of Roode Heuvel (Figure 4.10; Plate 4.3D). The Pilot mine (5 ha) is located on Roode Heuvel on the ecotone between Sand Fynbos and Strandveld. These disturbed areas support a limited number of widespread, pioneer species, and generally do not support any SCC. However, a population of *Wahlenbergia asparagoides* (Vulnerable) was observed in the rehabilitated portion of the pilot mine, suggesting that this shrubby species is tolerant of disturbance, and is perhaps a pioneer species. Similar observations from Namakwa Sands support this idea, but it does seem to be the only SCC readily able to colonise the mined areas. Alien invasive species are rare, even in these disturbed areas.

Rehabilitation potential of these disturbed areas is fairly good, as they are generally narrow strips surrounded by extensive areas of natural vegetation which could act as a seed source. Rehabilitation success would be significantly better in the absence of livestock grazing, as heavy grazing of recovering veld promotes the abundance and dominance of unpalatable species such as *Galenia africana* (kraalbos).

Plate 4.5: **This bulbous plant is an undescribed species of *Lachenalia* found in the Sand Fynbos on site (see Figure 4.3), and will be formally described in 2014 as *L. arenicola*.**

Plate 4.6: ***Lampranthus procumbens* is a rare and recently described creeping vygie known only from the northern Sandveld, between Komaggas and Kotzesrus, and is uncommon in the study area. These flowers have yet to open.**

Heuweltjieveld (3798 ha) may be found all along the eastern extent of Leeuvlei, and a large part of north eastern Sabies (Figure 4.10). It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld (252 ha) occurs in the south eastern sections of Sabies adjacent to alluvial corridors, and is dominated by the unpalatable shrub *Galenia africana* (kraalbos). This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals.

Common species in this unit include *Drosanthemum hispidum, Othonna sedifolia, Osteospermum pinnatum, Oncosiphon suffruticosum* (stinkkruid), *Zalusianskya villosa, Ursinia cakilefolia, Leysera tenella, Felicia tenella, Zygophyllum retrofractum*, *Aridaria noctiflora, Lycium cinereum, Manochlamys albicans, Ruschia leucosperma,Stoeberia frutescens, Didelta carnosa, Salsola aphylla* (gannabos), *Tetragonia fruticosa, T. spicata, Berkheya fruticosa, Limeum africanum, Lampranthus otzenianum, Psilocaulon foliosum, P. junceum* (asbos), *Ehrharta calycina, Rhynchopsidium pumilum, Oxalis annae* and *Pharnaceum croceum*.

This unit is relatively poorly researched, but at least six **SCC were recorded here, two of which are undescribed species discovered for the first time.** The conservation value of the poorly known quartz patches within this unit (the habitat of 4 of the 6 SCC) is thus Very High (Figure 4.11).

Both the new species were discovered on an isolated quartz patch in the Leeuvlei area, near the Outeep River (Figure 4.11), and both are vygies. The two new species are a species of *Jacobsenia* (Plate 4.7) and a species of *Cheiridopsis* (Plate 4.8). Both species are being sequenced and described by Dr C. Klak of the Bolus Herbarium. Both seem to be restricted to this isolated quartz patch, which is less than 5 ha in extent, and other suitable looking quartz patches in the region (not all within the study area) were surveyed for these species, with no success. This pattern of extreme endemism is not uncommon amongst quartz patch specialists in the region.

Othonna lepidocaulis (Plate 4.9) is a rare, perennial, tuberous daisy known previously only from the Knersvlakte, some 150 km to the south, and its occurrence here, on the same quartz patch (Figure 4.11), is both very interesting and highly significant. *Aloe krapohliana* is a dwarf aloe that was also observed primarily in the vicinity of this quartz patch, and the species is Red Listed as Data Deficient and, according to the available data, should be listed as Threatened (von Staden 2008).

Plate 4.7: A new species of what is likely to be a *Jacobsenia* vygie, discovered near the Outeep River on Leeuvlei. The species will be described by Dr C Klak.

Plate 4.8: A new species of *Cheiridopsis* discovered near the Outeep River, in a different part of the same quartz patch

Plate 4.9: *Othonna lepidocaulis* – a rare species previously only known from 150km to the south, and also found on the quartz patch on Leeuvlei

Riparian (564 ha) areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also includes tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins (Figure 4.10). The vegetation varies from *Acacia* thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species.

Acacia karoo is characteristic of this unit, and may form dense thickets in places. The only other notable tree is *Tamarix usneoides*. Shrubs include *Galenia africana* (kraalbos), *Zygophyllum retrofractum, Hoplophyllum spinosum*, *Lycium* spp., *Cephallophyllum* sp., *Malephora lutea, Suaeda fruticosa, Atriplexa cinerea, Salsola tuberculata and Ballota africana*, and the perennial grass *Stipagrostis namaquensis* may be prominent. The succulent *Mesembryanthemum guerichianum* may be prominent in silty areas. Where surface or near surface water accumulates there are also some large patches of reedbed (*Phragmites australis)*, which provide critical roosting sites for many bird species. The reedbeds may be interspersed with *Odyssea paucinervis, Scirpoides dioecus, Juncus* sp. and *Sporobolus virginicus* (brakgras).

Saline areas may be dominated by *Salicornia* sp. (an undescribed species, according to L. Mucina, in Snijman 2013) and *Sarcocornia pillansii* (brakkoraal), with *Salsola* sp. (gannabos), *Odyssea paucinervis* and *Spergularia bocconii*.

No SCC were recorded in this unit, and no such species are likely to occur here in significant numbers.

Klipkop Shrubland (251 ha) vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies (Figure 4.10). These serve as important sites for local reptile populations.

Typical plant species include *Montinia caryophyllacea* (klappers), *Berkheya fruticosa, Didelta spinosa* (perdebos), *Euphorbia mauritanica* (melkbos), *Leipoldtia schultzei, Manochlamys albicans, Pelargonium crithmifolium, Phyllobolus roseus, Othonna cylindrica, O. furcata, O. macrophylla, Ehrharta calycina, E. barbinodis, Chaetobromus dregei, Stoebera utilis* (asbos*), Senecio junceus, Tylecodon paniculatus* (botterboom), *T. reticulatus, Hermannia disermifolia, Eriocephalus microphyllus* (kapokbos), *Whiteheadia bifolia*, *Calobota sericea, Solanum burchelli, Selago glutinosa, Crassula muscosa, Crassula tomentosa, Conophytum bilobum and C.* spp*., Ornithogalum multifolium, O. rupestre* and *Sarcostemma viminale.*

No SCC are likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively, and it is known to support many SCC in nearby areas.

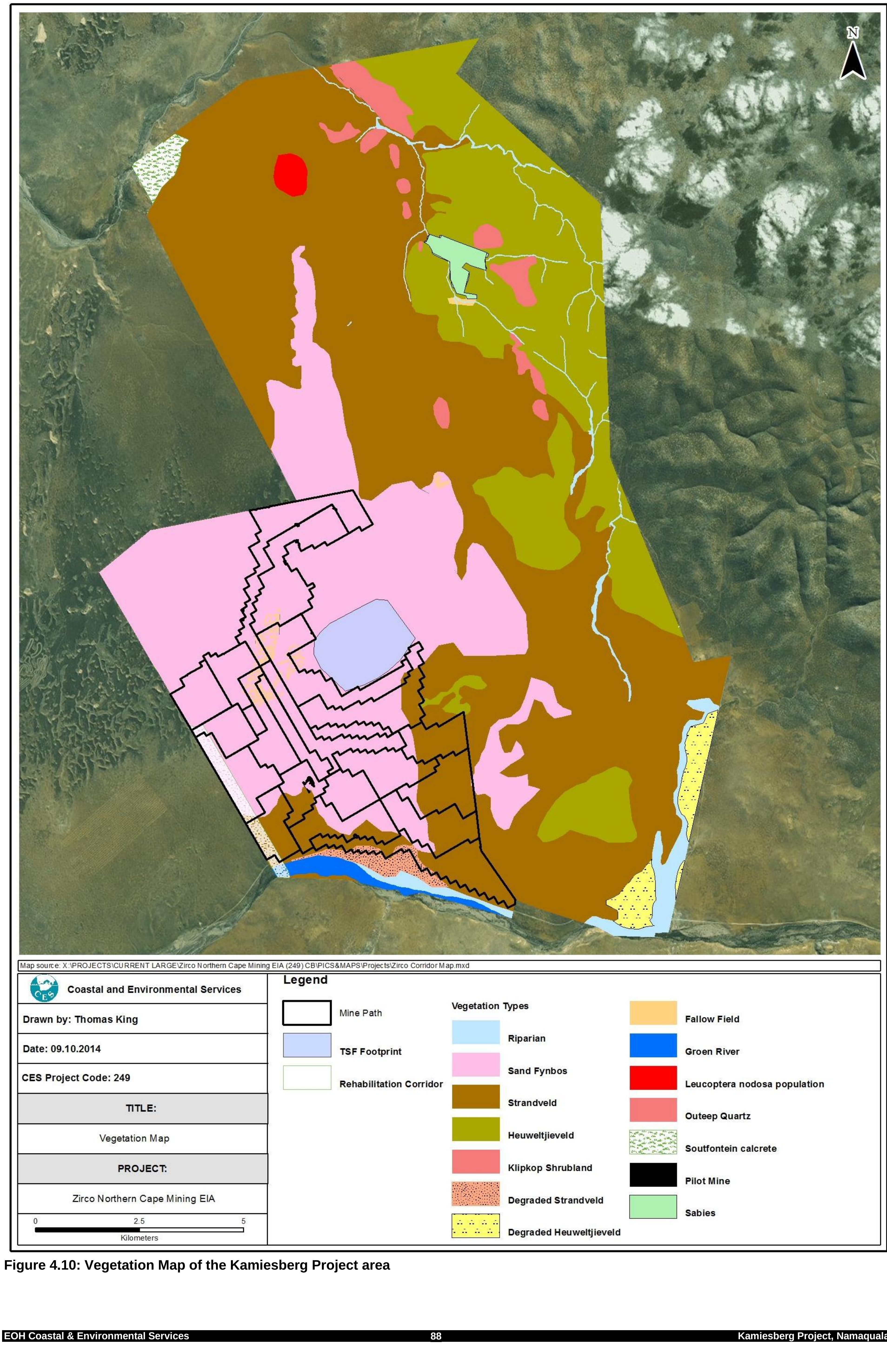


Figure 4.10: Vegetation Map of the Kamiesberg Project area

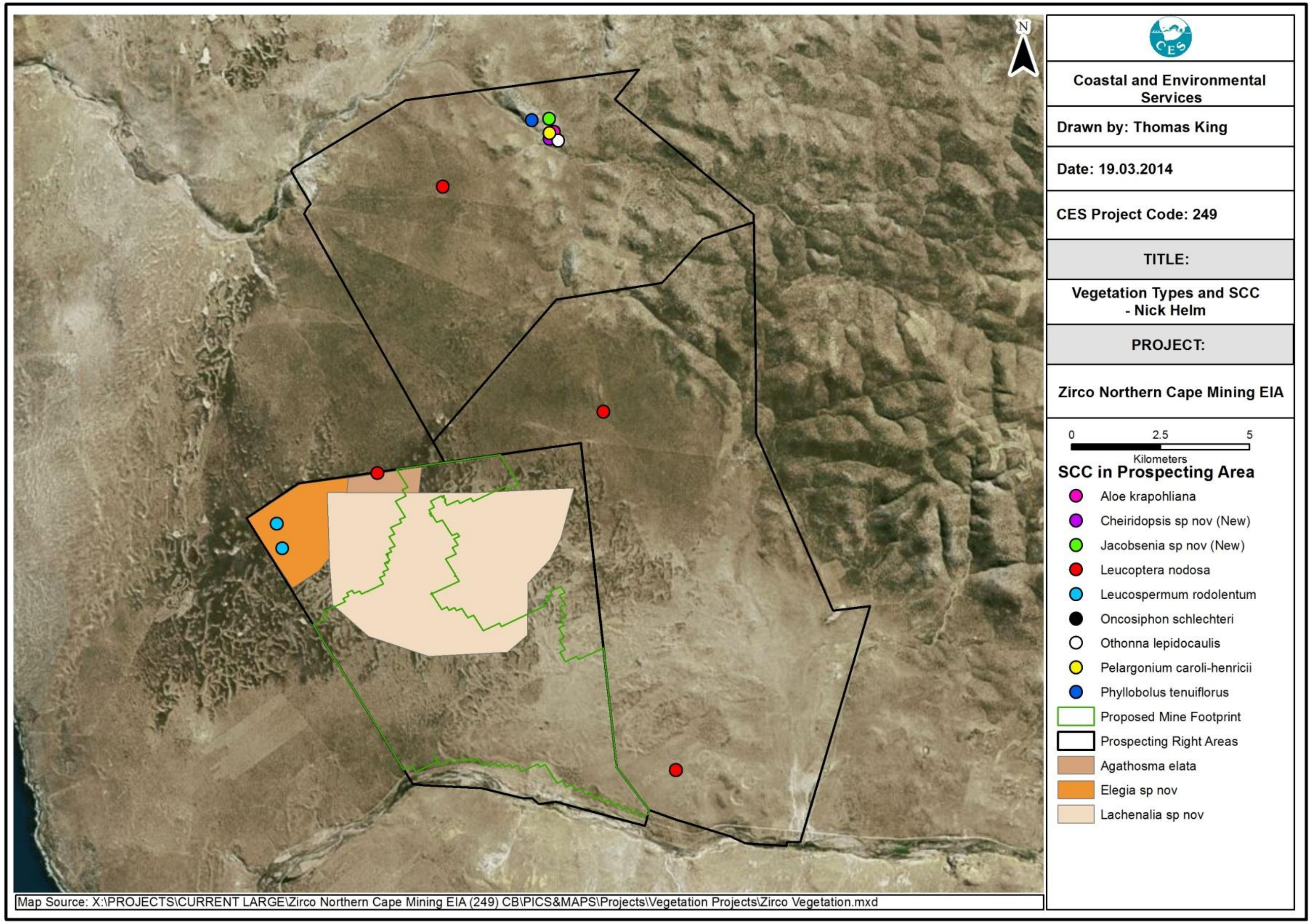


Figure 4.11: Map of 11 of the 23 plant Species of Conservation Concern (SCC) in the project area (black outline). The other 12 SCC are too common and widespread within the RoodeHeuvel property to map at this scale. The green outline is the proposed mine footprint

iii. Coastal Area

Two key vegetation types occur within the coastal assessment area (Figures 4.12-4.15):

1. Seashore Dunes
2. Coastal Duneveld

Seashore Dunes occur as a belt along the coastline, above the high tide water mark, and on the seaward side of the Coastal Duneveld. Essentially it consists of Namaqualand Seashore Vegetation, but also includes transition zones of seashore vegetation occurring on white dune sands, which have taller shrubs, but are not considered part of the Coastal Duneveld (Plate 4.10).

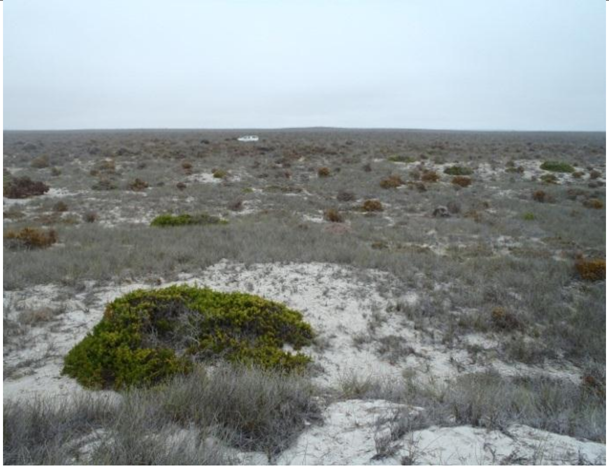
Typical species include *Cladoraphis cyperoides, Eriocephalus racemosus, Lycium strandveldense, Babiana hirsuta, Didelta carnosa, Senecio arenarius, Amphibolia hutchinsonii, Zygophyllum morgsana, Thinopyrum distichum, Arctotheca populifolia, Thesium elatior, Othonna cylindrica, Lessertia* cf. *globosa, Hypertelis angrae-pequenae, Helichrysum tricostatum, Othonna coronopifolia, Arctotis decurrens, Conicosia pugioniformis* ssp. *alborosea, Trachyandra divaricata* and *Tripteris oppositifolia.*

This environment is not known to host many **SCC**, although at Brand se Baai there are at least three SCC in this unit, two of which are local endemics not yet known from the current study area (Desmet & Helme 2003). *Oncosiphon schlechteri* is Red Listed as Endangered, and was recorded only in the vicinity of proposed Gulley Intake 3 (Figure 4.12). What may be *Limonium decumbens* (Data Deficient) was also recorded here. *Helichrysum dunense* (Vulnerable; Helme & Raimondo 2006) is restricted to coastal dunes north of Elands Bay, and was recorded in the study area only in the vicinity of Gulley Intakes 4 and 1 (Figure 4.12). *Manulea cinerea* is restricted to this dune habitat on the Namaqualand coast, and may also occur within the study area (although not recorded), and is Red Listed as Vulnerable (Helme & Raimondo 2005).

Coastal Duneveld is situated on the inland side of the Seashore Dunes, and gradually merges with Strandveld further inland (Plate 4.10 A and D). Common species *Jordaaniella spongiosa, Odyssea paucinervis, Asparagus capensis, Phyllobolus trichotomus, Zygophyllum cordifolium, Z. cuneifolium, Z. morgsana, Mesembryanthemum guerichianum, Dicrocaulon crassum, Ruschia* spp., *Cephallophyllum luteum, Hypertelis salsoloides, Galenia sarcophylla, Didelta carnosa, Drosanthemum* spp*., Leipoldtia schultzei, Osteospermum incanum, Othonna cylindrica, O. sedifolia, Lycium strandveldense* and *Gazania* sp. *aff. krebsiana*.

No SCC were recorded in this unit.

The littoral zone (the area from the high water mark to shoreline areas that are permanently submerged) along the west coast consist of alternating zones of rocky and sandy shores (i.e. sandy beaches), which is true for the coastal assessment area (Figures 4.12-4.15).



A. Seashore Dune vegetation merging inland into Coastal Duneveld, within which the vehicle is parked

B. Seashore Dune vegetation above the high water mark, below which is a sandy beach

C. Seashore Dune vegetation above the high water mark, below which is a rocky shoreline

D. Coastal Duneveld, which in this case comes very close to the littoral zone

Plate 4.10: Examples of the various vegetation types which occur in the coastal assessment area

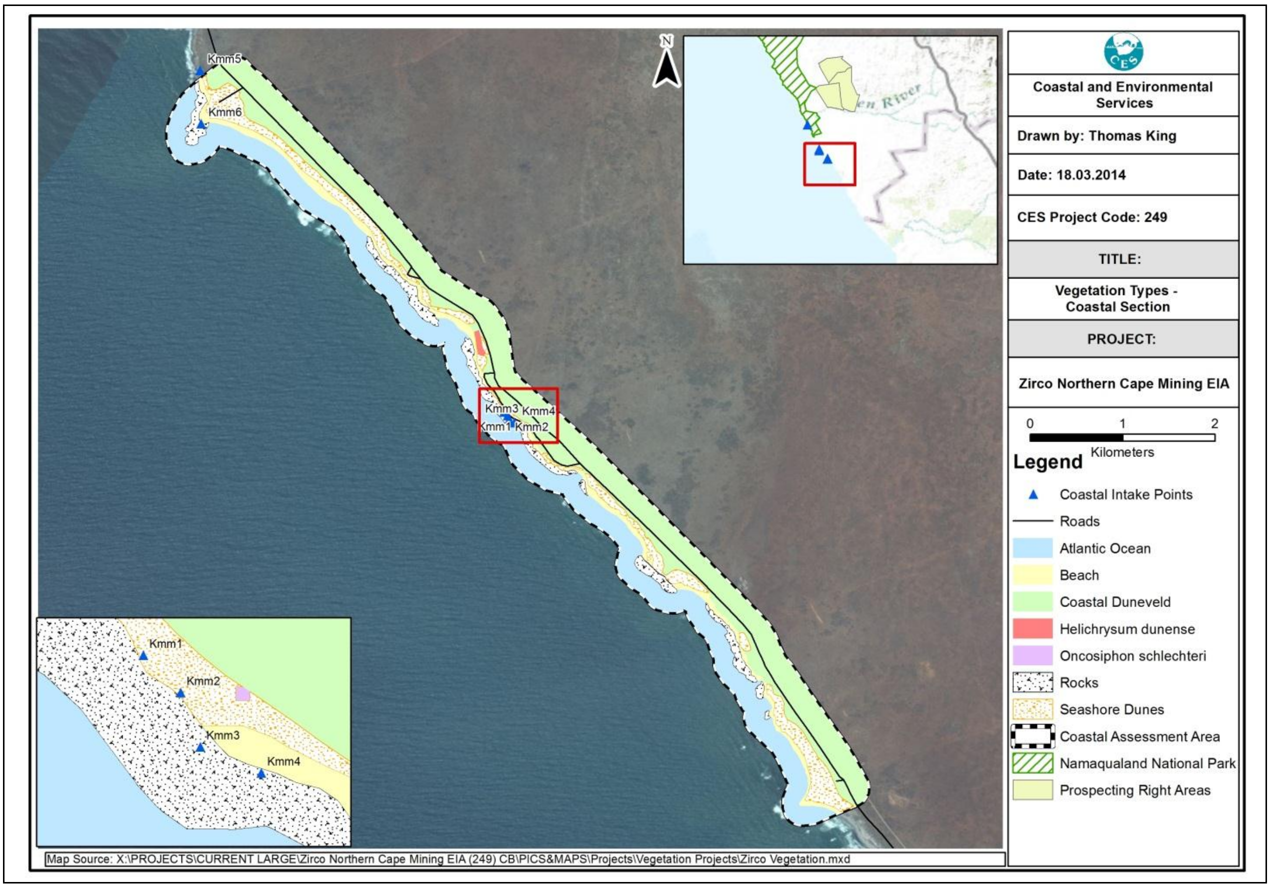


Figure 4.12: Vegetation Map of the coastal assessment area.

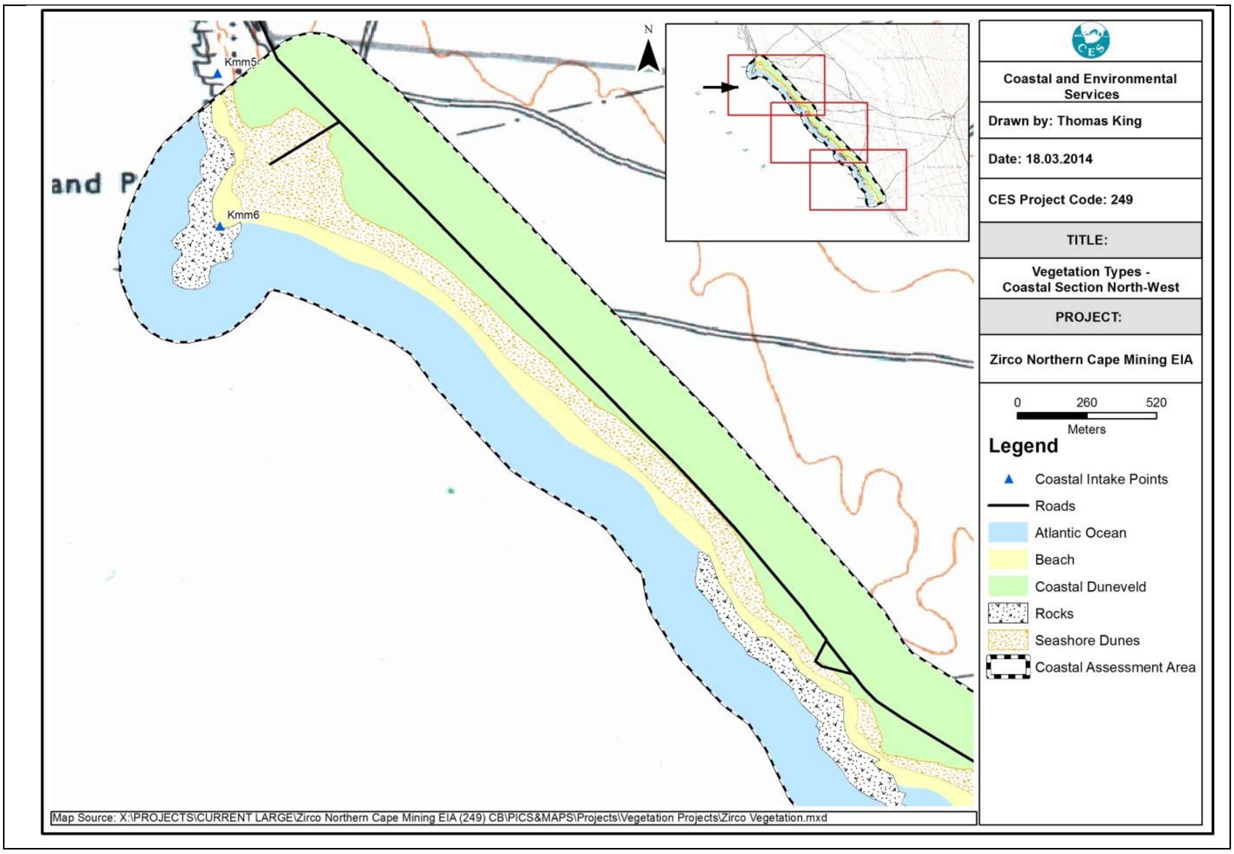


Figure 4.13: Vegetation Map of the coastal assessment area – north western section.

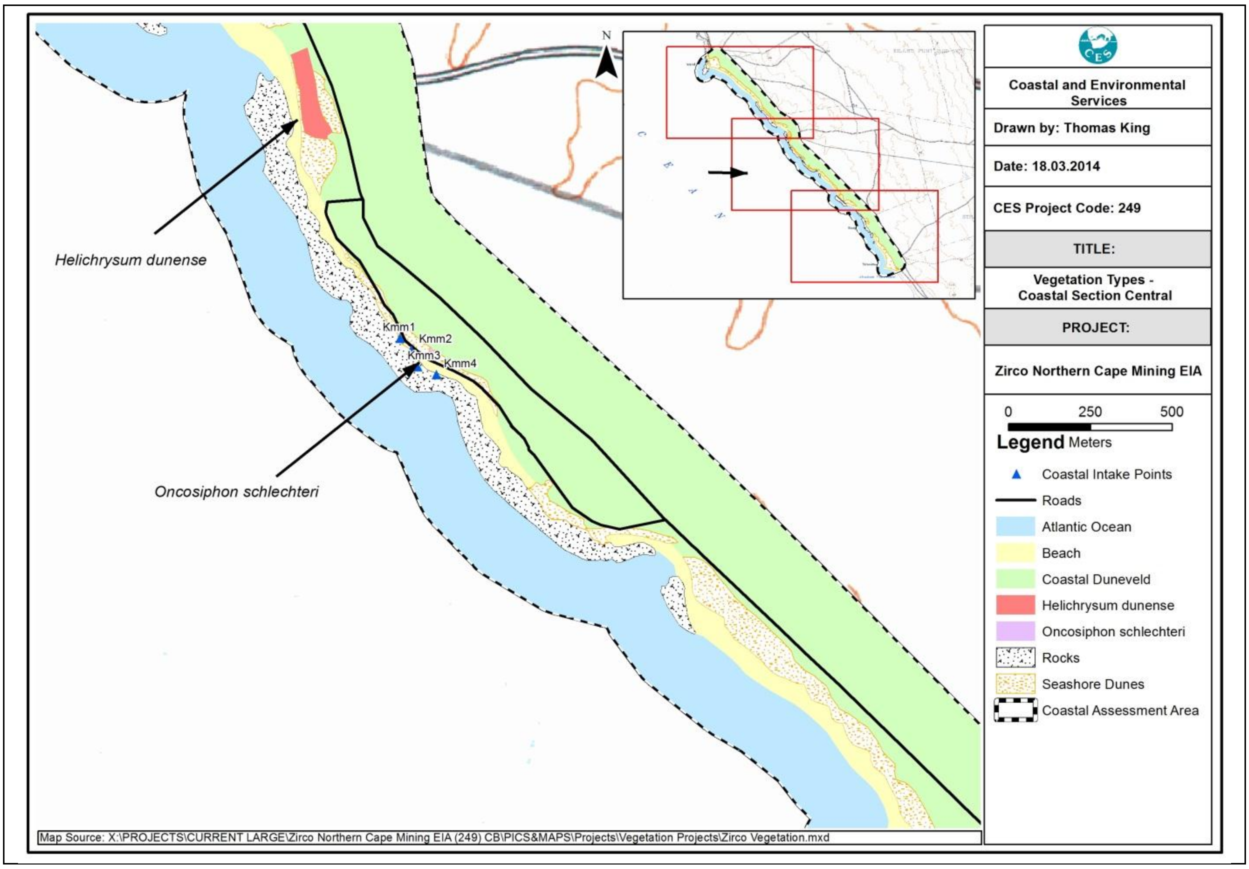


Figure 4.14: Vegetation Map of the coastal assessment area – central section. This map shows the portion of the coastal study area where the two recorded plant Species of Conservation Concern were found

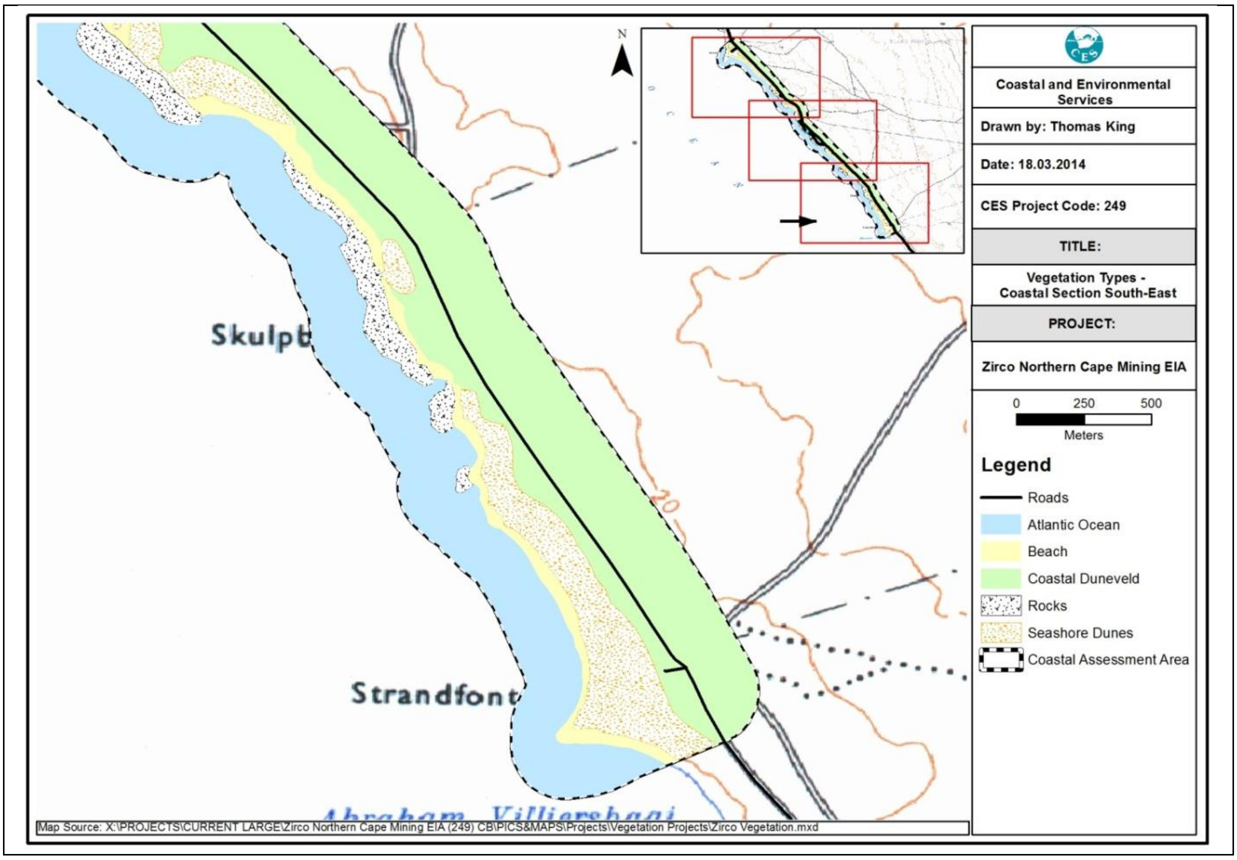


Figure 4.15: Vegetation Map of the coastal assessment area – south eastern section.

iv. Alien Plant Species

Alien invasive plant species are not a major feature of this area, but there are a limited number of invasive species present, most of which occur only in disturbed environments, notably in old lands, around kraals, and along roads. All the invasives currently in the area are likely to become more prominent in an area disturbed by mining, particularly if these areas are grazed after rehabilitation.

Galenia africana (kraalbos) is indigenous, but is also considered as invasive in disturbed and overgrazed areas, as it is unpalatable, and benefits from the lack of competition from more palatable species. The only way to eradicate it is to rest an area from grazing for long periods (>12 years). *Atriplex lindleyi* ssp. *inflata* (klappiesbrak, blasiebrak) is the most common alien invasive in the area, and is likely to be a prominent feature of any areas disturbed by mining. This is a low, grey perennial shrub with wind and water dispersed seeds, and is best removed by mechanical means. *Salsola kali* (Russian tumbleweed; tolbos) is a spiny shrub that also invades disturbed areas, particularly those with higher nutrient loads, such as around kraals, and is common in places. It also has wind dispersed seeds, and can become a problem. The species was noted in the pilot mine rehabilitation areas. *Brassica tournefortii* (wild mustard) is a winter growing annual that can be surprisingly common in sandy soils, even in relatively undisturbed Strandveld. *Erodium moschatum* (cranesbill) is very common annual herb in some areas, but seldom becomes a problem. *Nicotiana glauca* (wildetabak) is most common along watercourses, but is not a problem in the study area. Two species of invasive tree were recorded. *Prosopis glandulosa* (mesquite) also prefers water courses, but will also invade silty soils. It has been planted for shade, firewood and fodder, but can be very difficult to remove once it starts spreading. *Acacia cyclops* (rooikrans) is present in low numbers in the Sand Fynbos areas, mainly in the vicinity of water troughs, and conditions are too arid for it to become a major problem. Various species of alien, annual grasses are likely to be present, including *Vulpia myuros* (ratstail fescue), *Bromus* spp. (brome), *Lolium* spp. (ryegrass), and *Avena* spp. (wild oats), but they are not likely to be a major problem, due mainly to the arid conditions.

v. Floristics and Species of Conservation Concern in the region

Due to the large number of Species of Conservation Concern (SCC) found within the prospecting area, an additional survey was undertaken. This focused on the plant SCC that had been identified within the propecting area and whose populations outside of this footprint area were poorly or not known. The survey was undertaken in August 2014, when most Namakwaland plants are flowering. Two botanist with a good knowledge of the West Coast flora spent over a week in the field specifically to find out if these species occurred elsewhere, and in relatively close proximity to the study area, and if so, where and in what numbers. The secondary aim was to assess possible biodiversity offset areas in terms of the presence of suitable habitat and presence of the focus SCC.

The primary focus was on the following species:

- *Lachenalia* sp. nov. (to be described as *L. arenicola* G. Duncan & N. A. Helme)
- *Elegia* sp. nov.
- *Agathosma elata*
- *Lampranthus procumbens* and
- *Leucoptera nodosa*.

Lachenalia sp. nov.

This species (to be *Lachenalia arenicola* - currently in press) was found to be present as far north as the dunes north of Riethuis, some 63 km north of the project area. It typically occurs as widely scattered plants, in relatively low numbers. Estimated population density in suitable habitat is about 15 plants/ha. The species is thus now known to occur from Riethuis to near Koekenaap, a distance of some 150 km, and the total population, although very difficult to estimate, may be between 35 000 and 100 000 plants, of which as many as 30% may occur within the current boundaries of the Namaqua National Park. The species was found to be widely but sparsely distributed within Focus Areas 10 and 13 (outside the Park, but no data points were taken for this species, and hence it is not mapped in those areas – Figure 4.16)

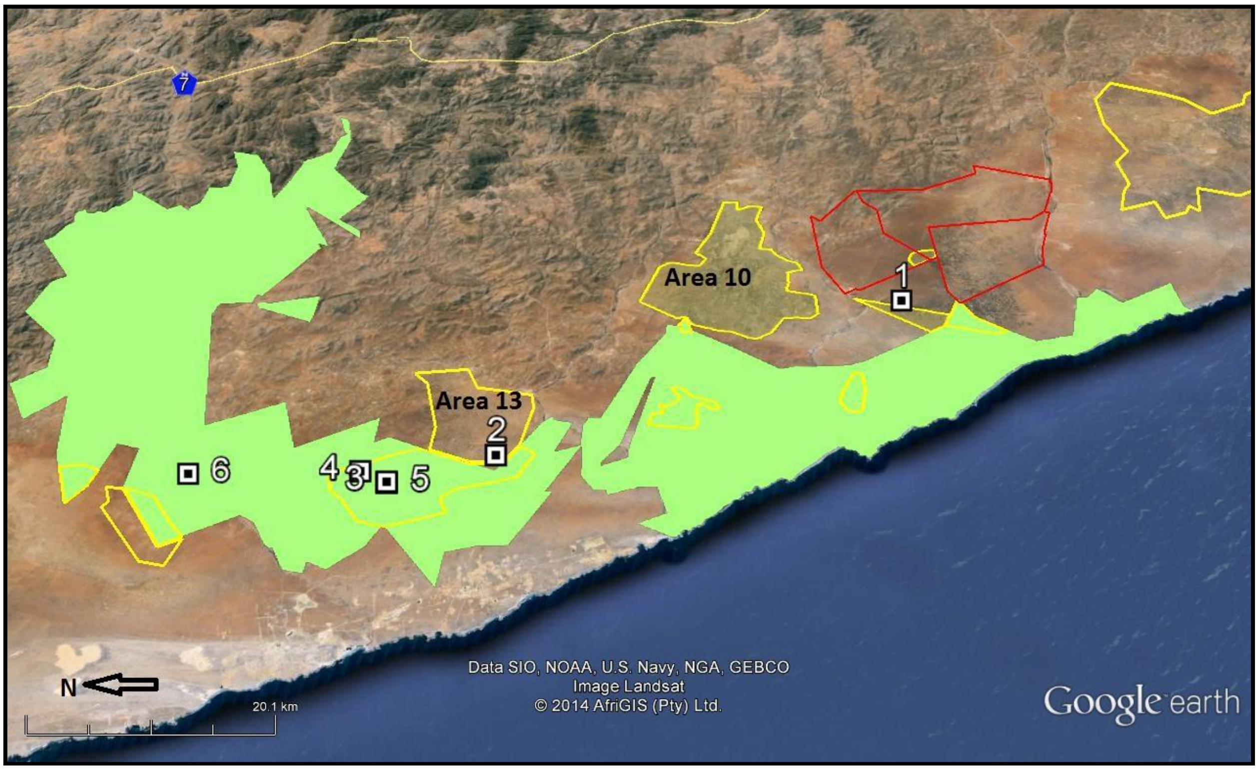


Figure 4.16: The recorded distribution of *Lachenalia* sp nov (numbered squares) in the Namaqua National Park (green shaded area). The Zirco project area is shown as red outlines.

Elegia sp nov.

This species has the most restricted distribution of the focus species, as can be seen in Figure 4.17. In addition to this area it also occurs further south, west of Kotzesrus, where it is also very localised. Its total known range in the study area is 21 km, in which it occupies less than 250 ha. If one includes the Kotzesrus population this expands to a 70 km range, and an occupied area of less than 320 ha. Total population in the current study area is estimated to be about 3000 plants, of which no more than 25% are within the Namaqua National Park. With the inclusion of the Kotzesrus population the total population may be about 4000 plants. The Roode Heuvel project area population occurs in an area of just over 200 ha, which is about two thirds of the total known area for this species, and the property is thus very important in the context of this species.

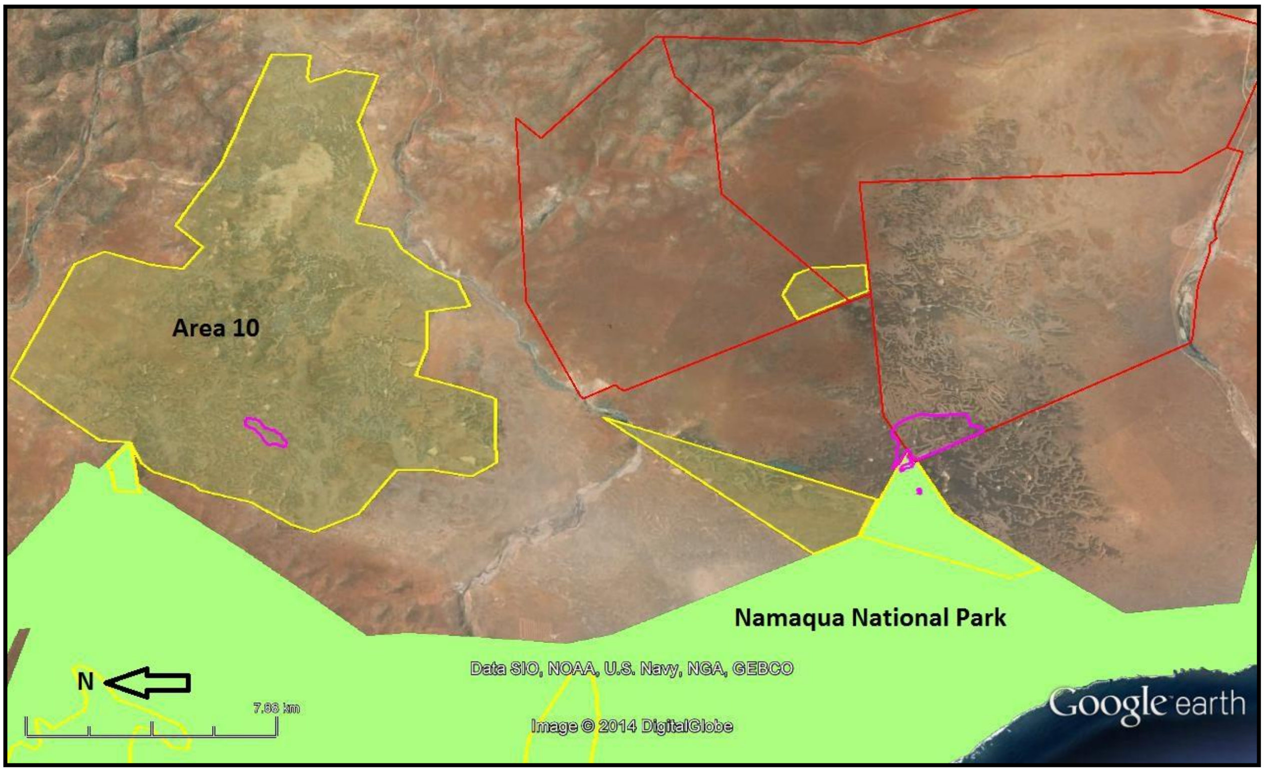


Figure 4.17: The recorded distribution of *Elegia* sp nov (purple polygons) in the total study area. The species is common in the very restricted area where it occurs. The Zirco project area is shown as red outlines.

<u>*Agathosma elata*</u>

This species, although a perennial shrub, is very cryptic when not in flower. Even allowing for this it appears to be sparsely distributed, and is never very common, although it was found as far north as the Hondeklipbaai area. Given that it occurs as far south as the Vanrhynsdorp area, it has a total range of nearly 200 km, and a possible area of occupation of up to 10 000 ha. The species was not found in Focus Area 13, but was found in a large part of Area 10 (<100 plants) (Figure 4.18). The species was found at two locations within the Namaqua National Park (totalling about 50 plants), but there are almost certainly more, undetected populations in the Park. The Roode Heuvel project area is estimated to support about 10% (50 plants) of the total estimated population (500 plants) of this rather rare, yet widespread species.

<u>*Lampranthus procumbens*</u>

This creeping succulent may be locally fairly common, and tends to occur in the transition between Sand Fynbos and Strandveld. It has previously been recorded as far north as the Kommagas dunes, and as far south as Kotzesrus – a total range of about 120 km. The population found within the Namaqua National Park was relatively small (estimated to be 10% of the total population of an estimated 3000 plants), whereas the population on the Roode Heuvel project area may constitute as much as 20% of the total population (up to 600 plants). The main populations were actually found in Areas 10 and 13, together estimated to make up about 40% of the total population (Figure 4.19).

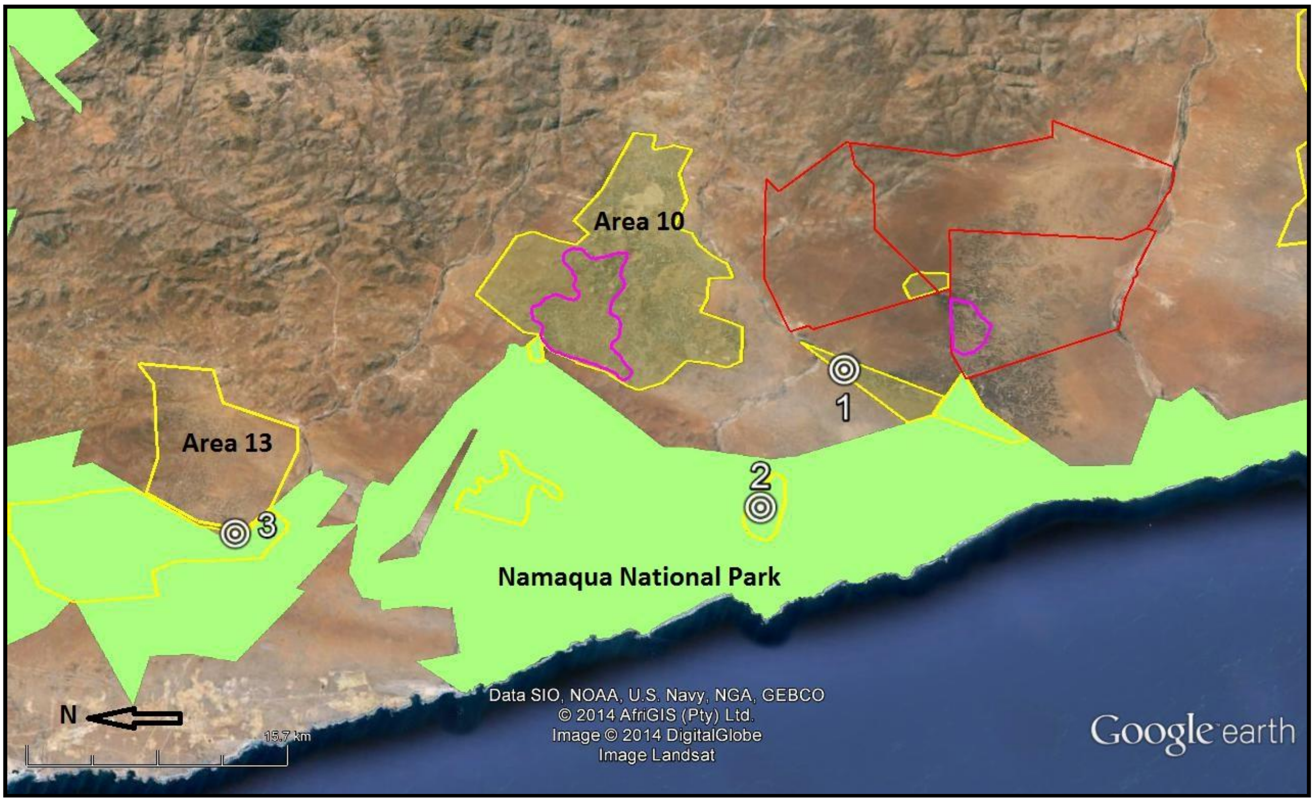


Figure 4.18: The recorded distribution of *Agathosma elata* (purple polygons and numbered circles) in the total study area. The Zirco project area is shown as red outlines.

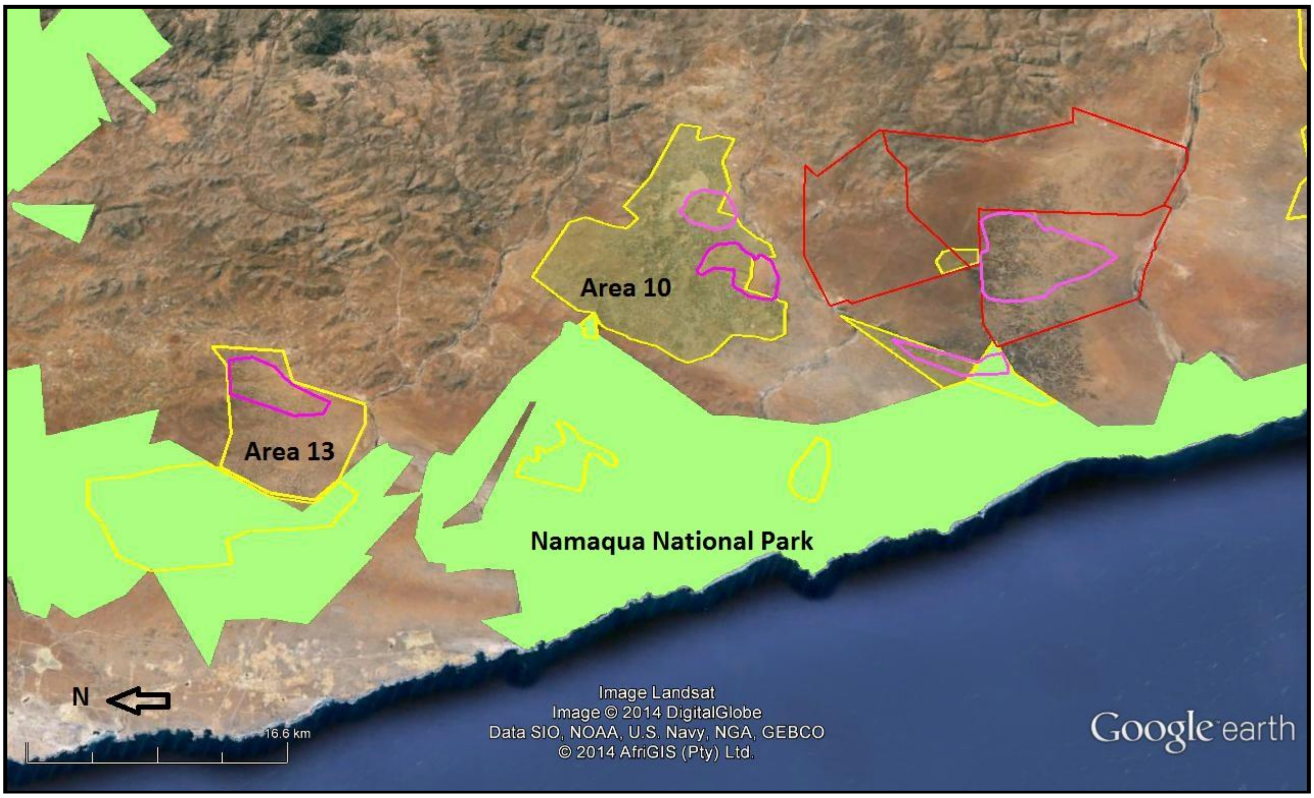


Figure 4.19: The recorded distribution of *Lampranthus procumbens* (purple polygons) in the total study and project area. The Zirco project area is shown as red outlines.

Leucoptera nodosa

This species was found to be fairly common in the Strandveld portions of the Namaqua National Park east of Skuinsbaai (estimated 400 plants), and Simon Todd recorded it as common in Areas 10 and 13 (no estimate of population numbers). The population within the Roode Heuvel project area (<30 plants) is likely to constitute <1% of the total known population, although the population on Leeuvlei (about 400 plants) is still very significant.

Both areas 10 and 13 were found to support significant populations of SCC (including others not discussed in this report), and contain good examples of the key botanical habitats, and are thus identified as potentially suitable biodiversity offset areas, along with the portion of land (De Klipheuvel) shown in Figure 4.18 which includes data point 1.

4.3.2 Fauna

i. Amphibians

Regional Overview of Amphibians

Amphibians are an important and often neglected component of terrestrial vertebrate faunas. They are well represented in sub-Saharan Africa, from which approximately 600 species have been recorded (Frost 2012). Currently amphibians are of increasing scientific concern as global reports of declining amphibian populations continue to appear (Phillips 1994; Blaustein and Wake 1990). Although there is no consensus on a single cause for this phenomenon, there is general agreement that the declines in many areas, even in pristine protected parks, are significant and do not represent simple cyclic events. Frogs have been aptly called bio-indicator species, whose abundance and diversity is a poignant reflection of the general health and well-being of aquatic ecosystems. They are important components of wetland systems, particularly ephemeral systems from which fish are either excluded or are of minor importance. In these habitats, they are dominant predators of invertebrates.

Southern Africa has one of the richest amphibian diversities, comprising 157 species (Du Preez and Carruthers 2009). The arid western region of the Northern Cape Province holds the lowest amphibian diversity (25 species). Only one threatened amphibian species (Desert Rain Frog - *Breviceps macrops:* VU) occurs on the white coastal dunes from Luderitz (Namibia) to Klienzee (South Africa) and is highly threatened by mining and housing developments (Channing and Wahlberg 2011). It is unlikely that this species will occur in the project and associated coastal areas. Amphibians are the least specious group of terrestrial vertebrates in the project area, where only seven species may occur in the study area.

Recorded Amphibians

Only three amphibian species were recorded during the dry and wet season site visits, namely the Namaqua Rain Frog (*Breviceps namaquensis*), Common Platanna (*Xenopus laevis*), and the Cape River Frog (*Amietia fuscigula*). Two are illustrated in Plate 4.11. Two of the three species recorded were not recorded in the immediate region by Minter *et al*. (2004) during their last summary of frog distributions, although their range was likely to include the project area. Both are highly aquatic species, and localized to permanent water sites.


A. Cape River Frog **B. Namaqua Rain Frog**

Plate 4.11: Two amphibian species encountered during the site visit

Amphibians differ in their water requirements for breeding. Rain frogs (*Breviceps* sp.) have direct development, without a free-swimming tadpole stage. The Namaqua rain frog is thus able to breed in sandy habitats throughout the region. Their calls were heard on misty mornings in the Groen River valley, and were likely to also occur on both project sites (inland and coastal). The other frogs in the region have free-swimming tadpoles and their breeding is thus dependent upon standing water. Frogs differ in the length of the tadpole stage and also require non-brackish water for breeding. Species such as the Cape River Frog and Common Platanna have tadpoles that take at least 6-12 months to complete metamorphosis. Their distribution is thus dependent on the presence of permanent water, and the only suitable sites in the region are permanent pools in the Groen River valley (e.g. (30°46'43.3"S, 017°45'54.9"E; 112m asl). No permanent or long-lasting (i.e. 3-4 month) pools occur on either of the two project sites.

<u>*Amphibian SCC*</u>

No threatened amphibian species or SCC occurs in the project area.

ii. Reptiles

<u>*Regional Overview of Reptiles*</u>

Reptiles are one of the most diverse and adaptive terrestrial vertebrate groups in the world. However, nineteen percent of all reptile species are currently threatened with extinction (Böhm et al. 2013), with the main threats being habitat destruction, invasive alien species and illegal pet trade. The same trend exists for South African reptiles, with 22% threatened (Bates *et al*. in press).

South Africa has one of the highest reptile diversities in the world, and the highest in Africa, with the highest diversity occurring in the more arid parts of the country (Branch, 1998). Of the 488 reptile species recorded from South Africa (Bates et al. 2013), at least one third (139 species) occur in the Northern Cape (Branch, 1998, plus subsequent studies). Reptile diversity in the study region is high, with 54 species known or likely to occur (Branch 1998); this includes 17 snakes, 32 lizards, and 4 chelonians.

<u>*Recorded Reptiles*</u>

Of the possible 54 reptile species likely to occur in the project area, 10 were recorded during the dry season survey and an additional four species were recorded during the subsequent wet season survey (Plate 4.12). An additional two, easily recognized species, the Puffadder (*Bitis arietans*) and Cape Cobra (*Naja nivea*) were also known to local farmers. 45 species have been recorded from the general region (SARCA maps; Bates et al. 2013), and an additional 20+ species may be present on the project site.

Reptile SCC

The Leatherback Turtle (*Dermochelys coriacea*) is the only threatened reptile species or SCC that has been recorded from adjacent areas and thus is likely to occur in the project site (See Table 4.5). It has been recorded once along the shores around Groen River mouth, and the rocky coastline and cold water is unsuitable for turtle nesting beaches. This species is rare along the west coast of the subcontinent, although the species is tolerant of cold water.

Four other 'threatened reptiles, i.e. the Armadillo Girdled Lizard (*Ouroborus cataphractus*), the Namaqua Plated Lizard (*Gerrhosaurus typicus*), the Namaqua Dwarf Adder (*Bitis schneideri*) and the Namaqua Day Gecko (*Phelsuma ocellata*), are all currently listed as threatened on the IUCN data base of Red Listed species. However, the status of all four species has been downgraded to Least Concern in the latest South African Red List (Bates *et al*. 2013), and these assessments have been approved by the IUCN and will be incorporated into the global data base. All the species are endemic to South Africa, and are currently threatened by existing impacts such as coastal diamond mining and habitat loss/degradation from agriculture. Two charismatic species, i.e. the Armadillo Girdled Lizard and the Namaqua Dwarf Adder, are also threatened by illegal collection for the pet trade. The status of all species, although currently none are considered of conservation concern, has been recommended for monitoring.

A. Southern Rock Agama

B. Southern Spiny Agama

C. Bibron's Thick-toed Gecko

D. Weber's Thick-toed Gecko

E. Karoo Girdled Lizard

F. Knox's Desert Lizard

Plate 4.12: Six of the common lizards recorded during the site visit

G. Angulate tortoise

H. Speckled padloper

I. Karoo Tent Tortoise

J. Trimen's Tent Tortoise

K. Wedge-snouted Sand Lizard

L. Barnard's thick-toed Gecko

Plate 4.13: Other reptiles were recorded during the site visit

Ten reptile species are also listed in CITES Appendix II, including three girdled lizards, three tortoises, one marine turtle, two chameleon and one gecko species. All are common throughout much of the region, and/or further afield, and all are well protected in existing conserved areas with no evidence of illegal or unsustainable exploitation in the region. Their inclusion on CITES Appendix II is a precautionary measure covering all members of groups that are regularly involved in the international skin (monitor lizards) or pet trade (tortoises, chameleons and girdled lizards).

Table 4.5: Threatened reptile species likely to be encountered in the project area and surrounds

Full Name	*Scientific Name*	IUCN	SARCA	CITES	Possible*	Recorded
Leatherback Turtle	*Dermochelys coriacea*	CR (G)	EN (R)	1	1	
Armadillo Girdled Lizard	*Ouroborus cataphractus*	VU	LC	1	1	
Namaqua Plated Lizard	*Gerrhosaurus typicus*	VU	LC		1	
Namaqua Dwarf Adder	*Bitis schneideri*	VU	LC		1	
Namaqua Day Gecko	*Phelsuma ocellata*	NT	LC	1	1	
Angulate Tortoise	*Chersina angulata*			1	1	1
Speckled Padloper	*Homopus signatus signatus*			1	1	1
Tent Tortoise	*Psammobates tentorius trimeni*			1	1	1
Namaqua Dwarf Chameleon	*Bradypodion occidentale*			1	1	
Desert Ground Chameleon	*Chameleo namaquensis*			1	1	
Karoo Girdled Lizard	*Karusasaurus polyzonus*			1	1	1
Peer's Girdled Lizard	*Namazonurus peersi*			1	1	
Totals	**5**	**5**	**1**	**10**	**12**	**4**

CR = Critically Endangered , EN = Endangered; VU = Vulnerable; NT = Near Threatened, G = Global Assessment, R = Regional Assessment.

* All have been previously recorded from the adjacent areas, except Desert Ground Chameleon.

iii. Birds

Regional Overview of birds

Despite the floral uniqueness of Namaqualand, it shares most of its bird species with the wider Karoo regions of Bushmanland and the Tanqua Karoo. The Karoo supports a particularly high diversity of bird species endemic to southern Africa. Its avifauna characteristically comprises ground-dwelling species of open habitats. Rainfall in the Nama-Karoo falls mainly during the austral summer, while the succulent Karoo lies within the winter-rainfall region. This provides opportunities for birds to migrate between the Succulent Karoo and the Nama-Karoo, to exploit the enhanced conditions associated with rainfall. A high frequency of endemics and near-endemics with their ranges centred in the Karoo are in the lark family (Alaudidae), including Barlow's Lark (*Certhilauda barlowi*), Karoo Lark (*C. albescens*), Karoo Long-billed Lark (*C. subcoronata*), Cape Long-billed Lark (*C. curvirostris*), Red Lark (*C. burra*), Sclater's Lark (*Spizocorys sclateri*) and Large-billed Lark (*Galerida magnirostris*), as well as Black-eared Sparrowlark (*Eremopterix australis*) (Barnes *et al*. 2001).

Many typical karroid species are nomads, able to use resources that are patchy in time and space (Barnes *et al*. 2001). Although a few birds are commensal, rapidly and successfully adapting to modified environments, the majority of birds are sensitive to disturbance and either migrate away from, or suffer greater mortality within, degraded habitats. However, because of their high mobility, birds are capable of rapidly re-colonising rehabilitated habitats.

The study area is not situated in or near an Important Bird Area (IBA - Birdlife International, 2013). However, the Namaqua National Park lies adjacent to the study area. Species in the park include Cinnamon-breasted Warbler, Cape Long-billed Lark, Karoo Lark, Black-headed Canary, Cape Bulbul, and Black Harriers scan the ground in search of rodents.

According to the Cape Birding Route[3], the gravel road that links Garies with the mouth of the Groen River is one of the best areas to find the Ludwig's Bustard, an endangered bustard species. Other birds include Southern Black Korhaan, Karoo Lark, Southern Grey Tit, Mountain Chat, Chat Flycatcher and Bokmakierie. Acacia Pied Barbet and Pririt Batis occur in the scattered patches of trees along the Groen River. The Groen River Estuary and a section of the Groen River itself is listed as a very important aquatic biodiversity area according to SKEP and the Namakawa Biodiversity Sector Plan and offers good waterbird habitat, suitable for Greater Flamingo, South African Shelduck and Cape Teal. African Black Oystercatcher occurs along the coast and Cape Long-billed Lark is common in the coastal scrublands.

Recorded Birds

Of the possible 431 bird species which occur in the Northern Cape province of South Africa, 246 species may occur in or near the project area, including seabirds. Of these 246 species, 83 were observed during the dry season survey and 92 were observed during the wet season survey, together accounting for 112 of the 246 possible species.

Of the recorded species in the project area, 2 species (House Sparrow and Common Starling) have been introduced by humans, while 7 species (Booted Eagle, Common Quail, Grey Plover, Common Tern, Common Swift, Barn Swallow and Willow Warbler) are non-breeding migrants, 3 species (African Black Oystercatcher, Alpine Swift and African Reed Warbler) are breeding migrants, and 19 species (Jackal Buzzard, Black Harrier, Cape Clapper Lark, Karoo Lark, Large Billed Lark, Grey Tit, Karoo Thrush, Karoo Prinia, Namaqua Warbler, Fiscal Flycatcher, Fairy Flycatcher, Layard's Tit-Babbler, Pied Starling, Southern Double-collared Sunbird, Black-headed Canary and Cape Weaver) are near endemics.

It is worth noting that one third of the potential species (79 of the potential 246 species) are oceanic and/or coastal bird species, which are highly unlikely to occur within the terrestrial section of the project area.

Plate 4.14: Secretary Bird (*Sagittarius serpentarius*), northern border of the project area

[3] http://www.capebirdingroute.org/Namaqualand_Garies.htm

Birds SCC

Out of the possible 246 bird species which may occur in the greater project area, 33 may be considered species of conservation concern (SCC) (Table 4.6); 14 of which were recorded on site. Twenty one (21) of these SCC are globally threatened according to IUCN: five Endangered species; seven Vulnerable species; and nine Near Threatened species (Table 4.6).

At a finer scale, the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland identify 28 threatened species made up of one Endangered species; nine Vulnerable species; and 18 Near Threatened species (Table 4.6).

Three bird species (Southern Black Korhaan, Cape Long-billed Lark and Cape Bulbul) are endemic South African species, all of which were recorded during the site visit (Table 4.6).

The most significant avian SCC recorded on site included the Ludwig's Bustard (En), Secretary Bird (Vu) and Black Harrier (Vu). These are all wide-ranging species whose population declines result from numerous and wide-spread anthropogenic threats.

Table 4.6: Bird SCC likely to be encountered in the greater project area

Full Name	*Scientific Name*	IUCN	RD	E	Possible	Recorded
Black-browed Albatross	*Thalassarche melanophrys*	EN	NT		1	
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	EN	NT		1	
African Penguin	*Spheniscus demersus*	EN	VU		1	
Bank Cormorant	*Phalacrocorax neglectus*	EN	VU		1	
Ludwig's Bustard	*Neotis ludwigii*	EN	VU			1
Spectacled Petrel	*Procellaria conspicillata*	VU	EN		1	
White-chinned Petrel	*Procellaria aequinoctialis*	VU	NT		1	
Secretarybird	*Sagittarius serpentarius*	VU	NT			1
Black Harrier	*Circus maurus*	VU	NT	(*)		1
Wandering Albatross	*Diomedea exulans*	VU	VU		1	
Grey-headed Albatross	*Thalassarche chrysostoma*	VU	VU		1	
Cape Gannet	*Morus capensis*	VU	VU		1	
Cape Cormorant	*Phalacrocorax capensis*	NT	NT			1
Crowned Cormorant	*Phalacrocorax coronatus*	NT	NT		1	
Lesser Flamingo	*Phoeniconaias minor*	NT	NT			1
African Black Oystercatcher	*Haematopus moquini*	NT	NT			1
Chestnut-banded Plover	*Charadrius pallidus*	NT	NT		1	
Shy Albatross	*Thalassarche cauta*	NT	VU		1	
Martial Eagle	*Polemaetus bellicosus*	NT	VU			1
Sooty Shearwater	*Puffinus griseus*	NT			1	
Maccoa Duck	*Oxyura maccoa*	NT				1
Southern Giant Petrel	*Macronectes giganteus*		NT		1	
Northern Giant Petrel	*Macronectes halli*		NT		1	
Great White Pelican	*Pelecanus onocrotalus*		NT		1	
Black Stork	*Ciconia nigra*		NT		1	
Greater Flamingo	*Phoenicopterus roseus*		NT			1
Peregrine Falcon	*Falco peregrinus*		NT		1	
Lanner Falcon	*Falco biarmicus*		NT			1
Caspian Tern	*Sterna caspia*		NT		1	
Kori Bustard	*Ardeotis kori*		VU			1

Full Name	Scientific Name	IUCN	RD	E	Possible	Recorded
Southern Black Korhaan	*Afrotis afra*			*		1
Cape Long-billed Lark	*Certhilauda curvirostris*			*		1
Cape Bulbul	*Pycnonotus capensis*			*		1
Totals	**33**				**19**	**14**

* = Endemic to South Africa; (*) = near endemic; EN = Endangered; VU = Vulnerable; NT = Near Threatened.

iv. Mammals

<u>*Regional Overview of Mammals*</u>

Among the vertebrates of South Africa, most lineages display very high incidences of endemism. Some 20% of South Africa's mammals are endemic, as were the famous and now extinct Quaqqa (*Equus quagga quaqqa*) and Blue Antelope (*Hippotragus leucophaeus*). Although most of the endemic mammals are small, primarily among the rodents (*Rodentia*) and golden moles (*Chrysochloridae*), South Africa also has an impressive collection of endemic large ungulates, including Cape Mountain Zebra (*Equus zebra zebra*), Black Wildebeest (*Connochaetes gnou*), Bontebok (*Damaliscus dorcas dorcas*), Blesbuck (*Damaliscus dorcas phillipsi*), Cape Grysbok (*Raphicerus melanotis*) and Grey Rhebuck (*Pelea capreolus*) (Barnes et al. 2001).

Large game makes up less than 15% of the mammal species in South Africa and a much smaller percentage in numbers and biomass. In the Succulent Karoo, large mammals are not generally a feature with the majority of mammals present being small to medium-sized (Driver *et. al.* 2003). Mammal species that have adapted to these harsh conditions include klipspringer, aardvark, baboon, steenbok, duiker, porcupine, black-backed jackal and leopard. In a study done on small mammal community structure in Namaqua National Park, rodents trapped were predominantly *Gerbillurus paeba* and *Aethomys namaquensis*, with fewer *Mus minutoides* and *Petromyscus* sp. The only non-rodent was the elephant shrew *Elephantulus edwardii* (van deventer & Nel 2006).

Seventy-three mammal species occur within the Succulent Karoo with three being endemic. Of these, De Winton's golden mole (*Cryptochloris wintoni*) and Van Zyl's golden mole (*Cryptochloris zyli*) are insectivorous and the Namaqua dune molerat (*Bathyergus janetta*) is herbivorous. Fifty seven of these species are likely to occur in and around the study site, with a further 11 species which occurred in the area historically (e.g. Cape lion, Black rhino, Elephant, Eland etc.). In addition, 25 marine mammals (e.g. Seals, Dolphins and Whales) may occur in the Atlantic Ocean adjacent to the greater project area.

<u>*Recorded Mammals*</u>

Of the 57 terrestrial mammal species which may occur in the study region, 16 were observed during the dry season survey, and 16 were observed during the wet season, accounting for 21 species. These were all small mammals such as rodents and small carnivores, with the exception of a Cape Fur Seal which was observed along the coast. Four of the observed mammals can be considered large, namely, Steenbok (Plate 4.15), Springbok (Plate 4.16), Grey Duiker and Bat-eared Fox.

Plate 4.15: Steenbok (*Raphicerus campestris*) and Springbok (*Antidorcas marsupialis*)

Mammal SCC

Of the 57 terrestrial mammal species which may occur on site, 10 are considered to be SCC. The most relevant SCC includes the Endangered van Zyl's Golden Mole, the Vulnerable Small Spotted Cat, and the Near Threatened Schreiber's Long-fingered Bat (see Table 4.7).

The project area is also highly relevant in terms of the golden moles, which inhabit sandy areas such as that of the dunes and sand fynbos areas of the project area. The Grant's Golden Mole is listed by the South African Red Data Book of the Mammals of South Africa (RDBMSA) as Vulnerable, and the Cape Golden Mole as Data Deficient. Both species are likely to occur on site (refer to Plate 4.16).

It is possible that the van Zyl's Golden Mole could occur in the project area, as the species is known to inhabit the coastal dune belt and adjacent sandy areas in Strandveld Succulent Karoo. Until recently, this species was recorded from only the type locality near Lambert's Bay, South Africa (Helgen and Wilson 2001). Another specimen was collected at Groenriviermond, some 150 km further north (north of Lambert's Bay) along the Namaqualand coast in November 2003, suggesting that the range of this species is more extensive than previously recognized, and this may have consequences for its current conservation assessment (IUCN 2012).

In addition, the Namaqua Dune Molerat (Near Threatened according to RDBMSA) also inhabits areas of coastal sand dunes, and consolidated alluvial soils with mean annual rainfall less than 400 mm. It is a subterranean and largely solitary species. There are three isolated populations, one from Alexander Bay, Orange River, the second from Port Nolloth to Groen Rivier, and the third from Steinkopf to Kamieskroon and the Kamiesberg (South Africa). The species rarely occurs above 300 masl. Evidence of a mole-rat was recorded at an altitude below 300 masl (Plate 4.16).

The Small Spotted Cat (also referred to as the Black-footed Cat) is rare compared to the other small cats of southern Africa (Sliwa 2008). The species is endemic to southern Africa and is found primarily in Namibia and South Africa, but also Botswana, and marginally in Zimbabwe and likely marginally in extreme southern Angola. This species is a cat specialist of open, short grass areas with an abundance of small rodents and ground-roosting birds. It inhabits dry, open savanna, grasslands and Karoo semi-desert with sparse shrub and tree cover and a mean annual rainfall of between 100 and 500 mm at altitudes of 0-2,000 m (IUCN 2012). While this species is rated as Vulnerable by the IUCN, the RDBMSA classify it as Least Concern. This species may occur on site.

Plate 4.16: Left: Evidence of Golden Moles, in the form of a tunnel trail, most likely that of the Grants Golden Mole (*Eremitalpa granti*). Right: Evidence of a Molerat, most likely the Namaqua Dune Molerat (*Bathyergus janetta*)

Schreiber’s Long-fingered Bat may pass through the site, but no appropriate roosting sites were recorded. This species forages in a variety of open and semi-open natural and artificial habitats, including suburban areas. It feeds mainly on moths, and occasionally on flies. It is a colonial species that roosts mostly in caves and mines, often in large mixed colonies with other cave-dwelling bat species. Large warm caves are preferred during the nursing season. In winter it hibernates in underground sites. Schreiber's bat is a migrant species which changes its roosts several times during the year; long-distance movements occur occasionally (IUCN 2012).

Table 4.7 lists the SSC likely to occur on site; 2 of these species were recorded on site. Many species which occurred in the area historically are threatened species which are also listed in Table 4.7.

The large majority of marine mammals which occur along the South African west coast (Table 4.7) are Data Deficient, and thus cannot be assessed, whilst three are endangered and one other is Vulnerable (IUCN, 2012).

Table 4.7: Mammals SCC which are likely to occur or have occurred (indicated as historical) within the project area

English Name	Scientific Name	IUCN	RDB	Historical	Possible	Present
TERRESTRIAL MAMMALS						
Van Zyl's Golden Mole	*Cryptochloris zyli*	EN	CR		1	
Wild Dog	*Lycaon pictus*	EN	EN	1		
Small Spotted Cat	*Felis nigripes*	VU			1	
Cheetah	*Acinonyx jubatus*	VU	VU	1		
Lion	*Panthera leo*	VU	VU	1		
African Elephant	*Loxodonta Africana*	VU		1		
Hook-lipped Rhinoceros	*Diceros bicornis bicornis*	VU	CR	1		
Straw-coloured Fruit Bat	*Eidolon helvum*	NT			1	
Schreiber’s Long-fingered Bat	*Miniopterus schreibersii*	NT	NT		1	
Brown Hyaena	*Hyaena brunnea*	NT	NT		1	
Leopard	*Panthera pardus*	NT		1		
Cape Golden Mole	*Chrysochloris asiatica*		DD		1	
Grant's Golden Mole	*Eremitalpa granti*		VU			1
Cape Horseshoe Bat	*Rhinolophus capensis*		NT		1	

English Name	Scientific Name	IUCN	RDB	Historical	Possible	Present
Geoffroy's Horseshoe Bat	*Rhinolophus clivosus*		NT		1	
Dassie Rat	*Petromus typicus*		NT		1	
Namaqua Dune Molerat	*Bathyergus janetta*		NT			1
Honey Badger	*Mellivora capensis*		NT			
Spotted Hyaena	*Crocuta crocuta*		NT	1		
Sub Total	**18**			**7**	**9**	**2**
MARINE MAMMALS						
Sei Whale	*Balaenoptera borealis*	EN			1	
Fin Whale	*Balaenoptera physalus*	EN			1	
Blue Whale	*Balaenoptera musculus*	EN	EN		1	
Sperm Whale	*Physeter catodon*	VU	VU		1	
Bryde's Whale	*Balaenoptera edeni*	DD	VU		1	
Gray's Beaked Whale	*Mesoplodon grayi*	DD			1	
Strap-toothed Beaked Whale	*Mesoplodon layardii*	DD			1	
Pygmy Sperm Whale	*Kogia breviceps*	DD			1	
Southern Right Whale Dolphin	*Lissodelphis peronii*	DD			1	
Killer Whale	*Orcinus orca*	DD			1	
False Killer Whale	*Pseudorca crassidens*	DD			1	
Pygmy Killer Whale	*Feresa attenuate*	DD			1	
Long-finned Pilot Whale	*Globicephala melas*	DD			1	
Heaviside's Dolphin	*Cephalorhynchus heavisidii*	DD			1	
Dusky Dolphin	*Lagenorhynchus obscurus*	DD			1	
Humpback Whale	*Megaptera novaeangliae*		NT		1	
Sub Total	**12**			**0**	**12**	**0**
Overall Total	**30**			**7**	**23**	**0**

4.3.3 The Namaqua National Park Managament plan and its Buffer zones

The Namaqua National Park Mnagement Plan identifies three buffer zones, namely Priority natural areas, Catchment protection areas and Viewshed protection areas (Figure 4.20).

Priority natural areas (pale green, Figure 4.20) are key areas for both pattern and process that are required for the long term persistence of biodiversity in and around the park. The zone also includes areas identified for future park expansion. Developments and activities should be restricted to sites that are already transformed. Inappropriate developments and negative land use changes (such as additional ploughing of natural veld, development beyond existing transformation footprints, urban expansion, intensification of landuse through golf estates) should be opposed within this area.

Catchment protection areas (light blue, Figure 4.20) are areas important for maintaining key hydrological processes within the park.

Viewshed protection areas (yellow hatching, Figure 4.20) are areas where development is likely to impact on the aesthetic quality of the visitor's experience in a park. Within these areas any development proposals should be screened to ensure that they do not impact excessively on the aesthetics of the park. The areas identified are only broadly indicative of sensitive areas, as at a fine scale many areas within this zone would be perfectly suited for development. In addition, major projects with large scale regional impacts may have to be considered even if they are outside the Viewshed Protection Zone.

The proposed site for mining falls within both the Priority natural area and Viewshed protection area.

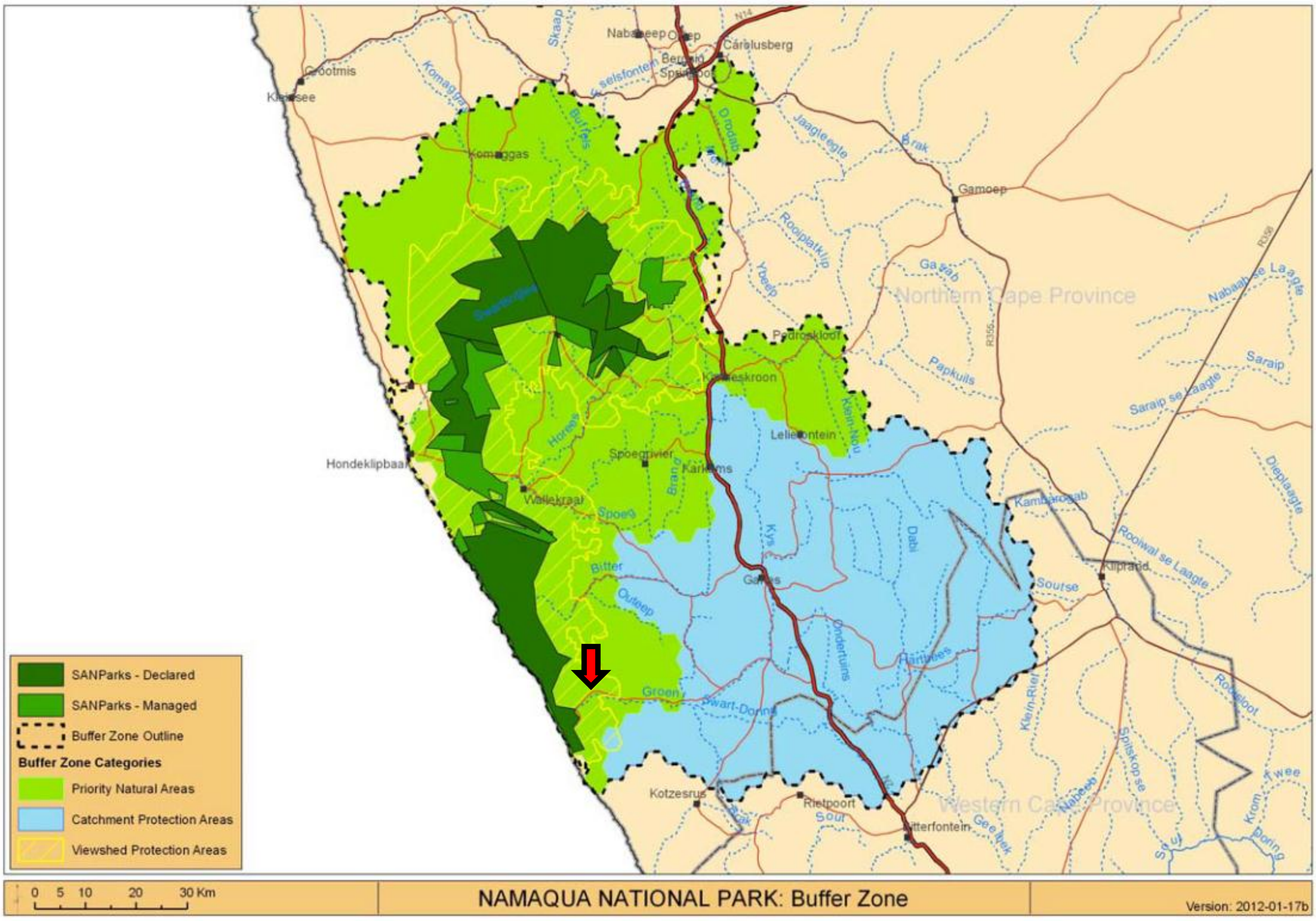


Figure 4.20: The three categories of buffer zone defined around the NNP.

4.4 SOCIO-ECONOMIC ENVIRONMENT

As the proposed project is situated in Ward 2 of the KLM, the next section focuses largely on the socio-economic context of the KLM. The greatest part of the data was obtained from StatsSA (2011), as well as the IDP's of the KLM (2013-2014) and NDM (2012-2016). The chapter has also been informed by primary data obtained through discussions with the municipality, farmer interviews, as well as focus groups held with representatives from the PACs during field work undertaken for the SIA.

The section below is divided into two main sections. The first section considers the socio-economic baseline conditions of the KLM with a specific reference to the PACs from which the labour might be drawn. This section includes migrancy patterns and population trends, followed by the municipality's households' socio-economic living conditions. General livelihood strategies are also elaborated upon, such as occupations and income trends. The data from this section was primarily obtained through an analysis of the KLM's IDP, data from StatsSA (2011), as well as community focus group discussions and municipality engagements. The second section provides a closer look at the area where the mine will be developed with a specific reference to the direct and indirect PAFs. The data for this section was obtained from face-to-face farmer interviews, as well as from key informant interviews.

4.4.1 The Kamiesberg Local Municipality

i. Demographic Overview

The NDM embodies six municipalities. These are:

- The Richtersveld;
- Nama-Khoi;
- Khai-Ma;
- Hantam;
- Hoogland; and
- Kamiesberg.

With an area of 126,747km^2, the NDM represents approximately 35% of the province. It is the largest municipality in South Africa, as well as the most sparsely populated (NDM, 2012-2016).

The population of the NDM is estimated at around 115,842 people, representing around 10% of the provinces' population (StatsSA, 2011). The largest section of the district's population is coloured (83.2%), followed by White (8.7%), Black (6.8%) and Indian/Asian people (1.3%). In terms of gender, the male and female populations are near similar with the male-to-female ratio at 1:0.9. Most of the district's settlements are very poor, whilst the population continues to shrink as young people migrate to larger South African cities in search of job opportunities. For example, according to the KLM's IDP, the district has seen a negative growth rate of around 0.54% per annum (KLM, 2013-2014). One reason for this is the lack in employment opportunities, which force many skilled labourers to migrate to larger cities. Table 4.8 below provides the population breakdown for the NDM, as well as the KLM.

Table 4.8 Population Dynamics

Municipalities	Total Population	Black		Coloured		White		Other	
		Nr	*% (N)*	*Nr*	*% (N)*	*Nr*	*% (N)*	*Nr*	*% (N)*
NDM	115,848	7,905	6.8	96,363	83.2	10,125	8.7	1,455	1.3
KLM	10,188	543	5.3	8,724	85.6	822	8.1	99	1.0

With the KLM's population estimated at 10,188, this local municipality represents an even smaller segment of the province at 0.9% of its entire population. The population seems to have decreased marginally from around 11,064 in 1996 (StatsSA, 2011). As illustrated by Table 4.8 above, the largest section of both the NDM and KLM's population is coloured (83.2% and 85.6% respectively). In terms of gender, the male and female populations are near similar for the entire area; the male-to-female ratio for the NDM as well as KLM is 1:0.9.

During the community meetings, most residents claimed that their towns do not experience an influx of residents apart from occasional government services workers (nurses or school teachers). In Garies some residents mentioned that the town does have its sporadic influx of contract workers (especially road upgrade workers) who are housed in the informal settlements. In terms of age distributions, Table 4.9 below depicts the age categories for the NDM and KLM; the latter at a ward-level.

As illustrated in the Table 4.9, the working-age population (within the age brackets of 15 and 64 years) is the largest for the entire area. For example, 66.1% of the entire NDM's population are within this age bracket, followed by very similar percentages for each ward under the KLM (64.2%, 66.1%, 62.0% and 60.0% for wards 1-4 respectively). A sizeable section of the population can also be considered as youthful members between the ages of 15 and 29 (as defined by the National Youth Policy of South Africa). Using this age category, approximately 24.1% of the entire district's population can be considered youthful. This percentage remains similarly for all the wards under the KLM, with wards 2 and 3 having the highest number of youthful members. Figure 4.20 below provides the age categories for the KML in isolation, revealing that the largest population group is between 30 and 64 years of age (41.26%). Around 64.9% can be considered as the working-age population (15-65 years).

Table 4.9: Age Distribution*

Categories	NDM		KLM							
	N	%	Ward 1		Ward 2		Ward 3		Ward 4	
			N	%	*N*	%	*N*	%	*N*	%
0 – 4	9,746	8.4	189	9.3	250	7.7	221	8.4	205	9.1
5-14	20,135	17.4	351	17.3	493	15.1	520	19.8	470	20.8
15-29	27,916	24.1	429	21.1	762	23.3	624	23.7	433	19.1
30-64	48,682	42.0	875	43.1	1,398	42.8	1,008	38.3	926	40.9
65-79	7,590	6.6	151	7.4	292	8.9	206	7.8	190	8.4
80>	1,773	1.5	34	1.7	69	2.1	51	1.9	41	1.8
Unspecified	6	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL	**115,842**	**100.0**	**2,029**	**100.0**	**3,264**	**100.0**	**2,630**	**100.0**	**2,265**	**100.0**

** Source: KLM (2013-2014)*

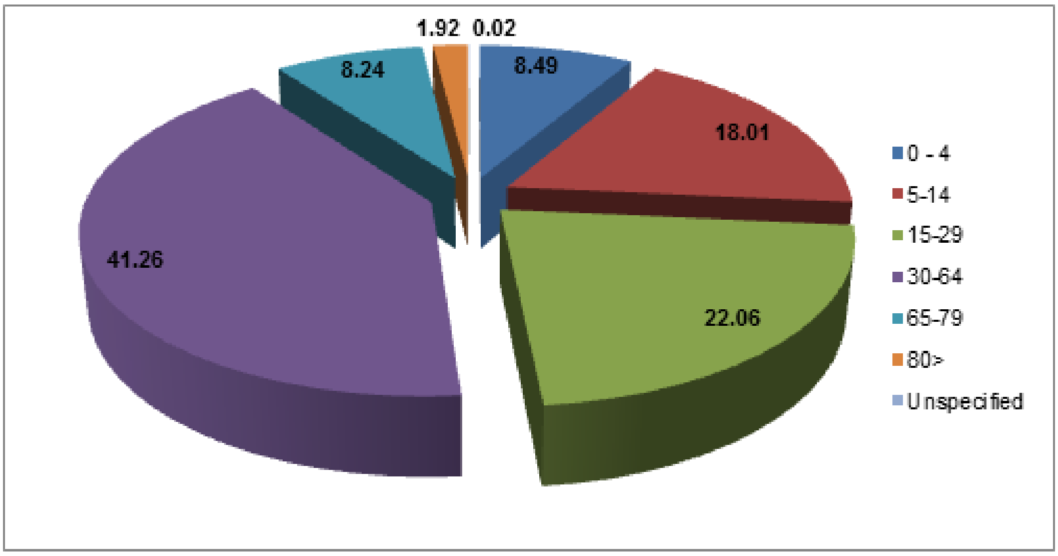


Figure 4.20: Kamiesberg Local Municipality's Age Categories (%)

The NDM's IDP (2012-2016) points out that a quarter of the area's population are under the age of 15 years, whilst the economically active population account for just more than two thirds of the total population of the area. Lastly, there seems to be an out-migration of economically active women in the age group of 20-34 years. This highlights the need for economic investment in order to retain an active workforce and a healthy male-to-female ratio in the area. Apart from this specific group, many young people in the province also tend to migrate to the Western Cape and Gauteng in search of employment opportunities. The reasons for such migration are summarised by the NDM's IDP as follows:

- The absence of tertiary educational institutions;
- Promises of better living and working conditions;
- Poorly developed rural areas; and
- The poverty context and high unemployment levels.

ii. Employment and Household Income and Expenditure Trends

Table 4.10 below depicts the unemployment status of the NDM and KML; the latter at the ward-level.

Table 4.10: Employment Status*

Categories	NDM		KLM							
	N	%	Ward 1		Ward 2		Ward 3		Ward 4	
			N	%	*N*	%	*N*	%	*N*	%
Employed	33,687	29.1	438	21.6	963	29.5	450	17.1	381	16.8
Unemployed	8,475	7.3	258	12.7	330	10.1	123	4.7	273	12.1
Not economic active/discouraged work-seekers	73,680	63.6	1,333	65.7	1,971	60.4	2,057	78.2	1,611	71.1
TOTAL	**115,842**	**100.0**	**2,029**	**100.0**	**3,264**	**100.0**	**2,630**	**100.0**	**2,265**	**100.0**

** Source: StatsSA (2011)*

The largest section of the NDM's population is not economically active (63.6%). This percentage is very similar for all the wards of the KML, with a significantly higher percentage for wards 3 and 4 (78.1% and 71.1% respectively). The labour force (the population within the working-age group) for the NDM is estimated at 42,162 (or 36.4% of the population). For the KLM, this is 3,216 people, or 31.6% of the municipality's population. Using Table 4.10 above, the formal unemployment rate (calculated as a percentage of the labour force)[4] can be calculated (people who are informally employed are also counted as being part of the labour force). This rate is approximately 20.1% for the NDM and 30.6% for the KLM. Considering the various wards under the KLM, the official unemployment rates for wards 1 and 4 are the highest at around 37.1% and 41.7% respectively. These high unemployment rates might be explained by the fact that many community members in this area used to be employed on mines which have closed in recent years. This resulted in many retrenchments. For this reason, there is a strong possibility that the area might harness mining skills that can be utilised and drawn on by the project proponent. Table 4.11 below depicts the employment sectors of the NDM (2012-2016).

Table 4.11: Namakwa District Municipality Employment Sectors (2010)*

Categories	*N*	% (of total nr listed)
Community services	6,789	27.5
Trade	5,093	20.6
Agriculture	4,948	20.0
Mining	3,989	16.1
Finance	1,205	4.9
Construction	1,155	4.7
Transport	749	3.0
Manufacturing	693	2.8
Electricity	98	0.4
TOTAL	**24,719**	**100.0**

** Source: NDM IDP, 2012.*

As can be concluded from Table 4.11, of all the employment sectors listed, community services, trade and agriculture are the largest employment sectors (68.1% combined). This is followed by the mining industry (16.1%). During the community meetings, many residents confirmed that, of those few people who are employed, few are currently working on the roads which are being maintained and constructed as part of the government's Expanded Public Works Programme (EPWP). A limited number of people are employed at the Namakwa NP.

Concerning tourism, although the area's flowers attract numerous tourists during the spring period (August to October), many residents claim that their communities do not reap any benefits from this industry. Some reasons for this might be the communities' lack of capital to invest in tourist infrastructure or training in operating and managing guesthouses. Some residents called upon the need to establish 4x4 tourist routes, which might be an ideal community driven local business

[4]The labour force comprises working-age members between the ages of 15 and 65, however excludes those who are disabled, home-seekers or who are not looking for work.

opportunity.

Few people are also employed as farm labourers, although this work is said to be mostly irregular, seasonal and offered to men. Most seasonal farm work opportunities seem to be offered centred around the Vredendal Wine District and Swartland areas on wine and deciduous fruit farms.

Although the mining sector has been one of the most prominent sectors in the area (contributing 52.0% to the NDM's GPD), the significance of this industry and the employment provided have been declining in recent years as several mining companies (such as De Beers and Trans Hex diamond mines) have closed in the past few years. In light of this, many older residents still have mine-related skills which many say are not being passed on to the younger generation. Some of these skills also include building and carpentry, as well as electrical work. At present, the only mine that seems to be providing contractual employment around the studied areas is the Namakwa Sands operation at Brandsebaai, approximately 65 km south of Groenriviermond.

Today, the largest employment sectors in the KLM are wholesale, retail, catering and accommodation. The latter (catering and accommodation) accounts for around 21.1% of the total employment in the formal sector. However, these sectors are known to be susceptible to economic changes and global recessions. As a result, the KLM stresses the need for the area to diversify its economy to create real and sustainable employment opportunities. The largest majority of households in the area are highly reliant on social grants. Most of these grants include Child Support Grants, Social Disability Grants and Old-Age Pensions.

Table 4.12 below depicts income categories for households living in the KLM.

Table 4.12: Kamiesberg Local Municipality Household Annual Income*

Income Categories	N	% (of households)
No income	339	10.8
R1-4800	120	3.8
R4801-9600	186	5.9
R9601-19600	705	22.5
R19601-38200	750	23.9
R38201-76400	462	14.7
R76401-153800	291	9.3
R153801-307600	189	6.0
R307601-614400	60	1.9
R614001-1228800	18	0.6
R1228801-2457600	9	0.3
R2457601 >	12	0.4
TOTAL	**3,414**	**100.0**

** Source (StatsSa, 2011)*

Table 4.12 illustrates that the bulk of the households (52.3%) receive between R4,801- R38,200 per year. Very few households (only 6.97%) receive more than R307,601per year (or R25,633 per month). In terms of expenditures, during the community meetings, residents were solicited to elaborate upon their households' largest monthly expenses. To this question most mentioned items such as food, electricity, healthcare and school-related expenses (uniforms and books, for example).

Although poverty is defined across a range of socio-economic indicators, generally in terms of an income definition, the World Bank has produced an international poverty line rate. This was calculated in 2013 at around US$2.8/day (World Bank, 2014). This translates to around R26.6 per day (using a 9.5% rate), or around R611.8/month (23 working days a month). Using this poverty line, households that earn under the R7,341.6/year bracket in the table above (around R800/month) can be considered as poor in terms of the World Bank's poverty line, measures against Purchasing Power Parity (PPP). For this income-bracket, around 20.5% of households in the KLM can be defined as being poor.

iii. Socio-Economic Living Conditions

Land-Use, Residency and Households

Apart from around 700 to 750 farms in the local municipality (StatsSA, 2011), the area is largely comprised of residential-based households. Some of these households have been established in areas (such as Molsvlei, Stofkraal and Holdeklipbaai) which are currently under a land claim in accordance with the South Africa Restitution of Land Rights Act No. 22 of 1994. According to StatsSA (2011), there are approximately 33,852 households in the NDM, whereas this number is significantly less for the KLM (3,141). According to the KLM's IDP (2013-2014), the average household size is around 3.2 members. Within the KLM, about 95.6% of all households live in a formal dwelling. Yet, fewer households seem to have formal ownership of their houses (only 63.9%). Table 4.13 below depicts the household residential status of the NDM and KLM, in addition to the types of household dwellings.

Female-headed households account for around 40% of all households. According to some residents, this high percentage can be accrued to single female-headed households as, increasingly, women have a desire to be independent and chose not marry after a pregnancy. A meeting with Mr Cloete, Municipal Manager of the KLM, clarified this tendency. As he explains, many young women prefer to remain single with child dependants in order to obtain state social grants. Moreover, single female-headed households with dependants also seem to quality for state housing, as some claim.

Table 4.13: Dwelling and Housing Types *

Type of dwelling	NDM	KLM			
		Ward 1	*Ward 2*	*Ward 3*	*Ward 4*
House or brick/concrete block structure on a separate stand or yard or on a farm	29,312	592	913	703	667
Traditional dwelling/hut/structure made of traditional materials	662	0	8	2	15
Flat or apartment in a block of flats	682	26	49	24	2
Cluster house in complex	33	1	0	1	0
Townhouse (semi-detached house in a complex)	31	2	2	0	0
Semi-detached house	852	0	0	0	0
House/flat/room in backyard	337	2	2	8	2
Informal dwelling (shack; in backyard)	430	4	6	2	10
Informal dwelling (shack; not in backyard; e.g. in an informal/squatter settlement or on a farm)	416	7	2	2	9
Room/flatlet on a property or larger dwelling/servants quarters/granny flat	519	8	5	0	0
Caravan/tent	133	5	20	0	0
Other	445	14	13	6	7
TOTAL	**33,852**	**661**	**1,020**	**748**	**712**

** Source: Adjusted from KLM IDP (2013-2014)*

It is clear from Table 4.13 above that the largest majority of all the households in the NDM and KLM live in brick and/or concrete block structures on a separate stand, yard or farm. Approximately 2,875 of all households in the KLM live in such structures (i.e. 84.2% of all households in the KLM). Some of these built houses are self-constructed, whereas many are government-provided houses.

Figure 4.21 below portrays the household residential status of the KLM's in percentages of all the households in the municipal area.

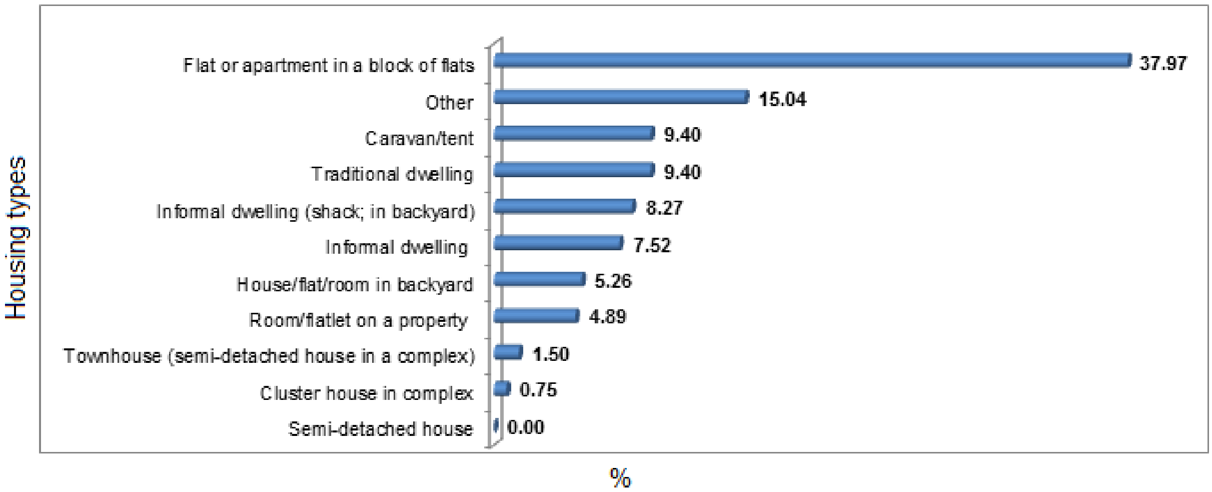


Figure 4.21: Kamiesberg Local Municipality's Dwelling and Housing Types (% of households).
(Source: Adjusted from KLM IDP (2013-2014))*

Figure 4.21 above illustrates that, of those households in the KLM that do not live in a brick and/or concrete block structure, the bulk of the remaining households (37.97%) reside in a flat or apartment block. Only 9.4% of the remaining households live in traditional structures, whereas a higher number (15.79%) live in informal settlements (either a shack in a backyard, or a separate informal dwelling). As indicated in the Table 4.13, only around 42 households seem to live in informal dwellings. Presently, the municipality does not have a Human Settlement Plan (HSP), although such a plan is in the pipeline to address housing in the future.

Lastly, the KLM is comprised of nearly 3,138 households (KLM, 2013-2014). StatsSA data (2011) indicates that this number increased since 1996 (from 2,592), although the population decreased. Although this data could be interpreted and analysed in many ways, it could possibly indicate that, despite a population decrease, households have become smaller as youth tend to out-migrate. This is indeed reflected by the data, as the average household size in 1996 was estimated at around four members. Today, households are comprised of around three people. Furthermore, nearly 41% of households seem to be female-headed. This is noteworthy, as it might point to a cultural change where women are being empowered with responsibilities. This should not be surprising, as the GoSA strongly advocates the rights of women and, in particular, their contribution to the economy. Many Expanded Public Works Programmes (EPWPs) are being implemented in the area (especially road upgrades), which empowers women not only with employment, but also with skills to strengthen their traditional roles in their households. Still, in light of the area's limited economic opportunities, many of these female-headed households are reliant on social grants to make ends-meet. Women in particular might therefore benefit significantly from employment and skills opportunities.

<u>Education</u>

In terms of education, each of the possible labour-sending wards has one primary school (Gr1-7), whereas a high school is located in Garies and Kharkams. The latter mentioned high schools attract pupils from as far as the central areas of the Northern Cape and even the northern parts of the Western Cape, who are housed in hostels. Table 4.14 below depicts the educational levels of those above 18 years of age for the NDM and KML (per ward).

Table 4.14: Educational Status in Numbers (2010 – those above 18 years of age)

Category	NDM	KLM	Ward 1	Ward 2	Ward 3	Ward 4
No schooling	4,794	329	77	94	53	105
Some primary	12,928	1,363	275	321	317	450
Completed primary	7,332	776	207	233	159	176
Some secondary	28,743	2,579	567	845	626	541
Grade 12/Std 10	13,737	1,044	191	420	295	137
Higher	5,396	277	61	141	49	26
Unspecified	184	10	1	2	2	4
Not applicable	2,657	177	0	122	55	0
TOTAL	**75,771**	**6,554**	**1,379**	**2,178**	**1,557**	**1,439**

According to most of the community members interviewed, the general educational status of the residents is low. This is confirmed by Table 4.14 above, showing that a small but significant percentage of the population do not have any schooling (6.33% for the NDM and 5.02% specifically for the KLM), whereas the largest section of the population have some secondary schooling (37.93% for the NDM). There seems to be no significant difference between the schooling status data for the NDM and the KLM, as both data sources indicate that few members in the region have Grade 12 (18.13% for the NDM, and 15.93% for the KLM). Significantly more people within wards 2 and 4 of the KLM do not have any schooling, whereas Ward 4 of the KLM also accommodates a section of the population with the most number of Grade 12 and higher educational graduates. This data makes sense, as the town of Garies is situated in Ward 2 where there is a combined primary and secondary school. The school has a current enrolment of 326 learners, with 10 staff members.

When considering school attendance, it appears that only around 68% of children (roughly in the 5 to 24 age-bracket) actually attend school (Stats, 2011). This is more than the average for the district (65%). Although this percentage increased since 1996 (from approximately 60%), it still illustrates that many parents do not send their children to school.

During the community meetings, many residents explained that, although children are often sent to the nearest high school (either in Kharkams or Garies), the high school drop-out rate remains very high. A reason for this might be the fact that these high schools are far from the majority of the local communities, forcing parents to send their children to the high school hostels in Kharkams and Garies. The government is subsiding hostel accommodation, which is around R550 per child per year. One of the most serious challenges that might contribute to such a high drop-out rate is said to be poor transportation between these hostels and the local communities, as well as rising school-related expenses, such as school uniforms, books and general school supplies.

However, other social ailment factors are also contributing to high drop-out rates. According to Garies High School Principal, Ms Vottering (pers. comm., 2014), few children are sent to Further Educational Training (FET) facilities, such as colleges or universities. In illustration, of around 52 matric graduates in 2013 from Garies' High School, less than 20 have left Garies for FET's in areas such as Cape Town or Wellington in the Western Cape.

As confirmed by Ms Vottering, some of the most serious challenges that contribute to high school drop-out rates include teenage pregnancies and drug and alcohol-abuse. Drug-usage is said to have been on the increase as it follows in suit of the Rastafarian Culture, which are apparently becoming widespread amongst the youth. According to Ms Vottering, this culture (or religion) tends to attract youth members into a culture of drug-use; rationalising drug usage on the grounds of their religion and spiritual growth path.

Plate 4.17: A) Garies High School; B) The Garies High School Hostels; C) The Kharkams High School Hostels.

In addition to social ailments, the schools are also faced with additional challenges, such as a lack of youth leisure and sport activities, as well as a lack in government support. This was supported by Ms Vottering, who mentioned that her school only receives around R179 per child per year from the government. Moreover, in some schools, parents seem to have to pay for the school fees, which might be one reason for a low school attendance rate.

Lastly, general up-keeping of school buildings and facilities also appears to be a problem in the area. This in particular relates to up-keeping safety measures and burglar bars to safeguard the school against outside violence.

Transport

In most of the communities studied, few households own cars. Those that do have cars, offer transport that can become costly. For example, a car ride from Spoegrivier to Springbok is roughly around R800 per person, whereas a ride from Lepelsfontein to Garies is usually estimated at R400 per person. Many members do their monthly grocery shopping in Vredendal (around 150 km from Garies), which costs approximately R1,200 per person.

Many members also complain about the current conditions of the road, requesting the mine to take responsibility by investing in road infrastructure and improve access to other towns. Some are also positive about the prospects of seeing more economic development alongside new constructed roads, such as businesses or even shops.

Water, Electricity and Sanitation

Water

The project area is drained by the Bitter and Outeep rivers to the north of the Leeuvlei prospecting area. The Outeep River is a tributary of the Bitter River. To the south is the Groenrivier, which defines the southern border of the Roode Heuvel prospecting area. All these rivers are ephemeral, meaning that they only flow temporarily after heavy rainfall. Most of the communities receive their water from boreholes, whilst some towns, such as Spoegrivier and Klipfontein, have their own desalination plant. However, several members are complaining about the quality of the water which is often, according to some, undrinkable. According to StatsSA (2011), an estimated 27,024 of the 33,852 households (i.e. 79.8%) have access to piped water services. For the KLM, this figure drops slightly to 75% (2,358 of the 3,138 households). Table 4.15 below depicts the number of households in the KLM at a ward-level that have access to piped water services.

As illustrated in Table 4.15, the bulk of the households in each ward have access to piped water services. However, Wards 1 and 2 have the least number of serviced households, whereas Wards 3 and 4 have the most. According to the KLM's IDP, only 105 households have water tanks, which represent 3.34% of all the households. Clearly, a need exists to provide not only potable water services to more households within the municipality, but also to assist the municipality with sustainable and clean water provision. Providing water tanks at a household-level is therefore a great way to make a real difference in the municipality. At present, the KLM has 16 water schemes under its area of jurisdiction and applies several technologies for water provision at household-level (KLM, 2013-2014). Some of these include reverse-osmosis/desalination technologies, boreholes and surface water schemes. According to the KLM's LED Manager, Mr Jenner (pers. comm., 2014), there is a great need for investment in bulk infrastructural services such as water provision around the town of Garies.

Table 4.15: Kamiesberg Local Municipality Access to Piped Water*

Wards	Access to Serviced Water	
	N	*% of Household in Ward*
Ward 1	390	58.8%
Ward 2	744	72.9%
Ward 3	648	86.7%
Ward 4	579	81.4%

** Source: StatsSA (2011)*

The municipality specifically calls upon investments to establish a desalination project for the area since the water's salt content is very high. In addition to such a plant, providing water tanks to various households remains an option.

Electricity

According to the LED Strategies for the NDM and KML approximately 91.0% of all households in the district municipality have access to electricity, whereas 88% of households have access to electricity within the KML. As noted by the KLM's IDP, through the Electro-Technical Department of Kamiesberg Municipality, the municipality receives funding for electrification from the National Department of Energy (DoE). According to the KLM LED Manager (Jenner, 2013)[5], the KLM currently has access to 800kVA from Eskom. With the proposed future mining developments in the area, the municipality has recently applied to Eskom for a power increase to 3000kVA. Support is needed to realise such a power supply upgrade to all households.

Sanitation and Refuse Removal

The NDM's LED Strategy reveals that 67% of households in the district have a flush toilet that is connected to a sewage system. For the KLM, this percentage is significantly lower at around 39% (KLM, 2013-2014). A larger section of the KLM's households' have a Ventilated Improved Pit (VIP) latrine or septic tank flush toilets (45.0% and 7.0% respectively). Sanitation remains a challenge for the KLM, as large areas still rely on VIP toilets. This is predominantly the case in the smaller settlements around and near the town of Garies.

Demand during the peak holiday seasons, especially on septic tanks, exceed the municipality's capacity to provide an effective service in this regard. It is therefore unsurprising that many community members complained about poor sanitation services, especially (in some areas) the absence of a refuse system. Considering refuse removal, StatsSA (2011) reveals that around 86% of households in the KLM have their refuse removed by the municipality. The remaining households either have their own disposal dumps, or do not remove their refuse.

Culture and Recreation and Social Ailments

The predominant religion in the area is the Christian faith that cultivates a belief that the man is the head of the household. Often, a patriarchal system exists amongst the households in this area; a belief which has undoubtedly been shaped and reinforced by traditional farm labour practices - especially in the Western Cape - where work preference was given to men. This system can be defined as a, "[…] social system based on the authority of male heads of households" (Scott and

[5]Jenner, S. 2013. Correspondence.15 October, Garies.

Marshall, 2005: p.482).

However, much of this system has been eroded with the government's commitment to gender equality, as well as the introduction of the South African Social Grant System. The latter system bestows more rights upon women to take-up the responsibility of household finances.

More frequently, women are generally becoming more independent in the area and many young women seem to choose not to marry into a relationship, but rather to become sole breadwinners. There also seems to be a tendency for men to leave their partners after a pregnancy, which might force women to become single-headed households. Still, community members confirmed that men are generally regarded as the household heads in their culture.

Still, most members press upon the mine to employ both men and women in equal numbers.

During the community meetings and key informant interviews, most residents verified that their communities have few cultural or recreational activities especially for the youth. Some older residents explained that the youth themselves are also partly to blame for an absence in cultural activities. A reason put forward is that many young people are highly uninvolved in community and youth affairs and would rather choose activities that involve alcohol. Although some communities have music and game stores, these are said to have become dangerous areas where drugs are often being traded. Although many communities have soccer and rugby fields, in addition to their own soccer and rugby clubs that compete against other towns, many assert that such facilities need an upgrade. Safer recreational activities and areas are clearly needed, such as playgrounds, whilst there seems to be a particular need for after-school care and activities for school children.

Drug- and alcohol-abuse is said to be one of the most serious challenges in the area. This was a community perception, although the consultant has reason to believe that drug-use in particular could be over-exaggerated in fear thereof, and probably not yet such a serious problem. According to the Garies Police Station Warrant Officer, Mr Spogter (pers. comm., 2014), alcohol-abuse is a more serious problem for the municipality.

According to him, such abuse heightens at month ends when pay checks are received. In his view, alcohol-abuse is also generally tied to household violence (particularly women abuse) and tends to aggravate this. In illustration, the municipality received around 25 serious violence cases per month (mostly intra-household - i.e between households); a number which he confirms to have decreased in the last few years as more employment opportunities have been created by the EPWP for road upgrades in the area. Mr Spogter believes that the most serious problems in the area (related and aggravated by substance-abuse) are household violence and rape.

In his view, such acts can be attributed to low-income households in which adults are constantly entrapped in arguments related to money and debt. The same problem was identified during most community meetings, as well as by the Garies High School Principal, Ms Vottering. According to Ms Vottering, children learn to use substances at a young age either within their households or at school. Household violence, alternatively, becomes a trap during which children and especially boys are taught to behave violently. Some community members are of the opinion that such violence is often tolerated by women who do not stand up for their rights.

As argued by many residents, unemployment is the root cause for crime and violence in the area. Many explain that the unemployed are forced to find alternative means to generate income, which frequently leads such residents to start trading in drugs. Most crime and violent incidents are reported to the nearest police stations which, in some cases, are only satellite offices such as in Kamieskroon. Several community members complained of poor services offered at these stations and of a long waiting period for police officers to reach their communities.

There seems to be a fear that substance-abuse might worsen with the development of the mine, related to an influx of job-seekers and outside workers. As explained by Mr Spogter, often, outsiders are responsibility for teaching the local children wrong codes of conducts, such as stealing. Moreover, sex work or risky sexual behaviours and trade in drugs, such as Methamphetamine (Tik) and Mandrax, are said to have increased with an influx of job-seekers in towns such as Garies. It is therefore not surprising that some community members seem fearful that such an influx might increase the current prevalence of HIV/AIDs as well (which is high in the area, although often unreported).

On a positive note, many agree that employment opportunities can also improve this situation with the stimulation of the area's economy. This is argued to be the case as employment is believed to stimulate skills development, elevate household incomes and preoccupy household members throughout the day who would otherwise have been looking for alternative (illegal) ways to generate money.

Organisations and Important Groups

During the community meetings and key informant interviews, residents were asked whether there are any important organisations or groups in their communities which the proponent should consult and work with. To this question, few communities seem to have community organisations and centres which Zirco could consider to support or work through. Some of these include Garies' Drop-Inn Centre, the Spoegrivier Development Forum, as well as the Hardeveld Ontwikkelings Trust, an organisation that represents the interests of the communities around Stofkraal. Some communities also have old-age clubs. More organisations are needed, however, especially youth organisations.

4.4.2 The Direct and Indirect Project-Affected Farms

i. Land and Farmer Characteristics

The farms affected by the project range from 4.5 ha to 6,420 ha in size, with a mean of 1,196 ha. Almost all the farms are sparsely populated. Most have one or two permanent dwellings, which are occupied by a farm-owner (mostly also the farmer him or herself) and his/her partner. As the work required on these farms is not labour-intensive, most farms do not really accommodate much labour. On some farms, one or two residential buildings have been observed and confirmed by the farm-owners to be labour housing. The majority of the farms obtain stock water from boreholes and potable water from rainwater harvesting as the groundwater is brackish. Nearly all the farms have several (usually between two and five) water tanks and reservoirs (Plate 4.18). These are usually for permanent dwellings and for the livestock held. Some farms also have wind and sun-driven pumps. As water is a scare-resource in the area (the average rainfall per year is 95 mm falling mostly in the winter months between May and August), the area is not under any form of irrigation.

Plate 4.18: Most Project-Affected Farms have water tanks for house drinking water and livestock

Some farms have been in family holdings since the early or middle 1900s. Many of these landholdings have been through several decades of subdivision, as farms have been passed down generations and inherited by family members. Consequently, nearly all the farms under consideration are today only remnant portions of larger farms that were originally bought by families for its investment, subsistence and commercial potential. Farm-owners are typically also the farmers of the land. Most are above forty or fifty years of age, although a small number are still from a younger generation who inherited their farms from their parents. Few farmers live with their families on the farms, as many farmers are either unmarried or have children who out-migrated (i.e left the farm). In most cases, farms have been held in generations and are currently being managed by the farmers themselves, as opposed to renting the land out to lessees or even hiring foremen. Few are the lessees of the land. For example, farms Roode Heuvel Nr RE/502 and 634 both indirectly affected by the proposed water pipe servitude line) are held by a farm-owner who also rents the farm 1/550 (Kambrolandskap Koop Ltd.) primarily for cattle breeding.

ii. Land-Use

The area is largely used for stocked monocultures of small livestock husbandry, such as sheep (black- and white-headed Dorper Sheep varieties), Boer Goats and, in some cases, a mixed-breed of cattle. On some farms, ostriches and, in rare cases, Emu's are bred. In addition, several farms have a number of Springbok breeding herds. A number of farms also cultivate general small grains (such as barley and oats) primarily for supportive livestock feed or veld amplifiers.

Discussions with some of the PAF-owners revealed that farmers' income is predominantly derived from sheep farming alone. Consistent with one farmer's claims, the land's sheep-carrying capacity is around seven ha per sheep. Sheep generally produce lambs at a rate of 120%. This means that a flock of 500 sheep, for example, would be able to produce around 600 lambs. Lambs are said to be sold to abattoirs (in Springbok, for example) twice annually or directly to livestock agents or middlemen. According to one farmer, sheep are often weighed on the farms before being sold for around R20 per kilogram. According to this farmer, one lamb normally weighs around 40kg. Therefore, depending on their weight and health, lambs are generally sold at around R600-R800 per lamb. Using these estimates, the income of an average size farm can be calculated. As the mean affected land size is 1,196ha, this equates to around 171 sheep. Assuming a 120% breeding capability, around 205 lambs can be sold either directly to abattoirs or livestock agents. If, as many claim, lambs are sold twice annually, it means that approximately 410 lambs can be sold on a yearly basis. Assuming the best case scenario that one lamb weighs 40kg and can be sold at R800, this equates to an annual gross income of R328,000 prior to general farming expenses.

Most tourists are attracted to the area during the flower season (spring), although few people actually navigate off the main tourist routes of Garies, the Namakwa and West Coast NPs. It therefore makes sense that few farm-owners are drawing, and catering for, the tourism industry. A self-catering guesthouse was identified at Soutkraal (farm nr 1/437), a farm which is directly affected by the mine. According to its owner, the guesthouse is a five-sleeper unit that they rent for guests at R400 per night. The farmer claims that income from this guesthouse is insignificant and maintenance expensive.

Plate 4.19: A) Most project-affected farms are sheep farms; B) An example of a sheep kraal; C) A self-catering guesthouse at Soutkraal (1/437).

iii. Farm Labour

Most of the PAF-owners employ farm labour from the two nearest local communities of Stofkraal and Molsvlei. As the farms are not labour-intensive, few employment opportunities are provided by these farms. Although farm work varies between farms, it appears that particular activities require manual labour, such as erecting fences, sheep shearing and injections.

Many of the local community members work seasonally on deciduous fruit and wine farms in the Western Cape. However, for those members who are employed on the PAFs, employment ranges from fixed monthly contracts to several weeks at a time. Some labourers are housed on the farms on a weekly basis and return to their homes either on weekends or at month-ends. According to some workers, farm-owners prefer for them to stay on the farms, as it is argued that weekly transportation costs to the local communities become expensive. Farm workers are paid at the South African minimum farm worker rate, which is currently standing at R11.66 per hour (Mywage, 2014). Some workers mentioned that they receive around R105 per day, which is a negotiation between the workers and farm-owners. Although many workers claim that their salaries are taken back to their households, according to the Police Warrant Officer of the Garies Police Station, Mr Spogter, alcohol-abuse is a serious problem in the area on which many workers spend their entire salary before it reaches their households.

Many of the farm workers interviewed seemed positive about the mine as they perceive mine employment in a more favourable light than farm work. Many are also of the opinion that farm work is irregular, whereas mine work is argued to be more permanent. Such perceptions should be expected, as many workers in the area (especially older community members) are used to mine work. The reasons for these opinions vary, although most claim that farm work does not offer the same benefits as mine work. These benefits are said to include a higher salary, daily food packages, motivations to study further and opportunities to obtain portable skills (i.e. workplace-related skills). In addition, some prefer working on a mine that might offer them the opportunity to return to their household daily. This preference stems from the fact that workers in the area are often seasonally employed on farms in the Western Cape where they are inclined to stay for several weeks on end.

iv. Place Attachment

Place attachment (or sometimes referred to as ‘sense of place’), or the value that people attach to a piece of land or area, can be a difficult concept to study. In order to understand the value people place on land, several factors are at play that influences each other on different levels. In order to understand this, Scannell and Gifford (2010) have studied what they refer to as ‘place attachment’. Place attachment can be conceptualised as, “[…] *bonding that occurs between individuals and their meaningful environments*” (*ibid.*, 2010: p. 1).

In order to simplify this, the authors have conceptualised place attachment through a tripartite organising framework (*ibid.*). In this way, place attachment is defined by and through three dimensions, namely a) Individual and collective place attachment; b) Psychological process of place attachment; and c) A physical place attachment itself.

Firstly, at an individual and collective level, people might be attached to a place for cultural reasons related to religions or historical events. Personally, some people might have valued experiences, realisations or milestones attached to a place that shape their attachment to it. Secondly, people might be attracted to a place as a result of a psychological process. This involves the affect that a place has on a person (happiness, pride or love), a person’s own cognition (such as his/her memory, knowledge of an area and meaning attached to a place), as well as a person’s behaviour. The latter refers to actions that a person performs to manifest such attachment, such as proximity maintaining behaviour (staying at a place for a long time) or reconstruction of place. The latter refers to a person’s nostalgia and desire to restore meaningful areas to which they were attached. Lastly, through physical place attachment itself, people might have an attachment to the social symbol of a place, the natural or built environments.

Understanding place attachment from these perspectives, most farm-owners might be attached to the land by exhibiting behaviours and feelings for all these dimensions. This reasoning could have merit as most of the landholdings have been held within families for generations. Although some farms have been bought in the last few decades as investments (land therefore not held in a family), the majority of farms have been within families for several decades. This surely aroused historical relationships on the land at a cultural, but also individual level.

Farmers might have individual or shared memories of the land that evoke certain past affects and behaviours. The latter is especially evident in some farmers owning Springbok or using natural rocks from the area for house building material. This presumably speaks to a sense of cultural preservation, which simply means that many farm-owners feel a cultural attachment to the area and the physical natural environment. Similarly, some farmers would nostalgically recall their youth when they used to camp at Groenriviermond during the summer holidays before the area was turned into a NP.

In some cases, discussions with the farm-owners also reinforced a sense of place attachment as some would refer to their children and grandchildren visiting their farms annually. Such visits presumably strengthen place attachment, as it involve memory sharing, place knowledge transferal (i.e. sharing the history of the area with the family) and ultimately love, happiness and pride. Many owners also claimed that their farms would someday be inherited by their children. Some explained that they would prefer their children to continue farming the land, although many agreed that the younger generation is poised to find alternative livelihood opportunities in larger towns and cities. Some farmers also believe that farming is ‘in their blood’, and that there is no other alternative for their children but to inherit and farm the land in the future.

Even though the area is definitely culturally sensitive in terms of place attachment, it should be noted that many farmers did not really express such a strong social connection to the land. Many factors are responsible for farmers who welcomed land-change. Some of these factors include what many believe to be an out-migration of potential future family farmers, or a perception that the land’s livestock carrying capacity is too low and the area too dry (referring to droughts). Concern has also been raised with regard to the rate at which young people are out-migrating. This, as it is claimed, might eventually contribute to a decline in the cultural family ties to the land as a place of heritage. Moreover, those farmers who bought landholdings for investment purposes tend to have less place attachment to the land, presumably as they do not have any cultural experiences on the land or cognitive memories that assigned meaning to the land.

Although much discussion and interaction are still pending regarding the nature of the mining operation and how the land will be affected and subdivided for mining activity, many farmers persist that they will remain on ‘their’ land. It therefore follows that many are still greatly uncertain as to how the mining will in actual fact affect their farming, predominantly as the size of their land will be reduced and, with it, the land-carrying capacity for sheep breeding.

4.4.3 Project Perceptions

Taking into account many perspectives from a variety of interest groups and stakeholders, generally, PAC members and the KLM seem to be receptive of the development. Some of the most important reasons and perceptions in favour of the mine include:

- The need for employment generation;
- The possibility for the mine to provide needed skills, bursaries and portable skills training to community members;
- The need for the mine to assist the KLM with LED;
- The need to expand the area’s economic growth path and possibly even to attract more tourists by an increase in services and accommodation; and
- The possibility for the mine to assist the KLM specifically in areas such as crime and substance-abuse.

Some community members from Kamieskroon have raised concern with the project. Many of its residents (and some from other areas) are familiar with mining developments, as many used to work on mines which have closed down in recent years. With this in mind, some cautioned that mining developments in the area tend to uplift communities for several years, where after mine closures leave communities without any alternative, sustainable income-earning opportunities. To this effect, some urge the proponent to consider community benefit-sharing schemes as a means for community residents to become involved in the mining operation. Lastly, over-dependence by the mine to use outside labour was raised as a serious concern. Many feel that they should be the beneficiaries of employment since the mine will be developed on their land and amidst their communities. In a similar argument, people claim that they have mining skills in their communities, and that local labour should thus be used as far as possible.

Perceptions from the PAF-owners vary greatly and are influenced by several factors. Some of these are:

- Whether a farm will actually be affected by the mine in terms of land acquisition and the subdivision of land;
- Whether the farm will only be affected by the pipeline servitude;
- Proximity to the proposed mining activities; and
- Place attachment, which might be influenced by the length that the farm has been in a generation (amongst many factors).

Foremost, it should be stressed that farmers are not accustomed to mining developments and could therefore not easily conceptualise how the landscape might change. Still, some farmers voiced strong opposition to the development. Some of the arguments against the development are that farmers prefer to farm on their farms and chose the area for its location and tranquillity. Some are of the opinion that income from land acquisition would have relatively little value *vis-à-vis* their cultural land attachment. Moreover, many were uncertain as to the future of their land, expressing concern that their land's sheep-carrying capacity will be reduced as their land will be subdivided. As illustrated, in most cases, sheep-farming is farmers' main income source. It therefore makes sense that, in many ways, land is extremely important for some farmers who are reliant on its livestock carrying capacity.

Several farmers affected by the pipeline servitude expressed a set of different issues specifically related to the pipeline development. These included a concern that, should a desalination plant be planned at the mining site, pipes could burst and salt water could affect the land. A more serious unease was that a pipeline above the ground would possibly divide and compartmentalise farms into smaller portions. This would generally not be a serious issue by itself, however it is rightfully noted that sheep cannot graze over such pipelines. Alternatively, many pipeline affected farm-owners encouraged the proponent to rather consider laying the pipeline alongside the existing road network to avoid any of these above-mentioned issues.

Some farmers are more positive of the development, arguing that they bought the land initially as an investment only. It is reasonable to assume therefore that these farmers have a weaker socio-cultural attachment to the land, and claimed that the land would most likely not stay within their family. In a different view, one farm-owner appraised the project as he argued that it might attract more tourists. The reasoning behind this is that more guesthouse accommodation would potentially be needed as the area develops economically. This, in turn, could allow for more tourists to visit the area.

From a nature conservation perspective, no farmer seemed to oppose the project. A general argument upheld is that most tourists do not explore these farming areas, and that the mine should thus not deter tourists from the area either.

These specific project-related impacts and issues as well as suggested mitigation measures are discussed in full in Chapter 9 of this report.

4.5 HEALTH

The following section describes the baseline health status in the proposed project area and at local level with reference to the Environmental Health Areas (EHAs). It is important to note that only the EHAs relevant to the proposed project have been discussed in the section below. EHA #1 (vector-related diseases), EHA #3 (veterinary medicine and zoonotic diseases) and EHA #10 (Cultural health practices) have not been discussed as, during the field visit and analysis, these were found to be immaterial in the proposed project area.

4.5.1 EHA #2: Acute respiratory infections and respiratory effects from housing

Although all key informants interviewed listed TB as one of the top five most common illnesses treated at their respective Healthcare facilities, the spread of this disease may not be linked to housing design and overcrowding in this instance.

Tuberculosis is spread from person to person through the air. If another person breathes in these germs there is likelihood that they will become infected with TB. Repeated contact is usually required for infection. Individuals may contract the disease at their place of work or at social gatherings.

i. Respiratory Effects from Housing

Within the KLM, 77.1 % of the population live in formal housing, with 5.5% of the population living in informal dwellings and 0.9% in traditional huts. Approximately 14% of the population reside in worker's hostel accommodation (StatsSA, 2011).

There are 3,143 households in this municipality, with an average household size of 3.7 persons per household (*ibid*.). From observation, discussions with key informants, as well as Focus Group Discissions (FGDs), it was evident that there is enough housing and that overcrowding was not a matter of concern in these communities. During the Key Informant Interview (KII), one of the Registered Nurses stated that although there very little-to no overcrowding in the community, housing conditions are generally not very good. Based on this information, it is understood that the spread of TB is not as a result of overcrowding.

During the field visit, it was observed that, although the majority of the households have access to electricity for cooking and lighting (some solar power), a few households still use wood for cooking and heating that may cause a risk from indoor air pollution and associated respiratory health concerns.

As waste removal from households is a challenge many households burn waste that can emit harmful by-products especially with plastics. No illegal and uncontrolled dump sites were identified during the field visit.

4.5.2 EHA #4: Sexually-transmitted infections, including HIV/AIDS

i. HIV/AIDS: Knowledge, attitude and behaviour

All respondents in the FGDs reported to having heard about HIV/AIDS. With numerous respondents across the PACs stating that HIV/AIDS is a serious problem in their communities it is clear to see that HIV/AIDS has affected all levels of these communities –from the youth to the elderly. Many people stated that the disease is one of grave concern as it is "killing the people and leaving orphans". The community of Lepelsfontein asserted that HIV/AIDS is not a serious problem in their communities as nurses educate them about this disease, and therefore expect that everyone should have knowledge on this disease. This community also stated that because HIV positive people are secretive about their HIV status, it is difficult to see how the disease impacts on their lives and the lives of their loved ones.

FGD results suggest that the general levels of awareness and consistent knowledge on the disease and preventive behaviours is exceptionally good. However, the mere acknowledgement of the disease in the absence of the relevant preventive behaviours will not support any form of behaviour change or risk taking practices. With regards to family planning and contraceptives, the Stofkraal community reported that a lot of the men and women in their communities were opposed to the use of any form of contraceptives due to their religion – Catholicism. The Roman Catholic

Church is opposed to artificial contraception and orgasmic acts outside of the context of marital intercourse. Such acts are considered intrinsically disordered because of the belief that all sexual acts must be both unitive (express love), and procreative (open to procreation). The only form of birth control permitted is abstinence. There is, somewhat, a paradox in their beliefs versus their behaviour as a lot of the young people engage in sexual activities, and even have children, but are not married. Others, such as residents of the Molsvlei community, refuse to use condoms, pleading ideas of trust –"we trust each other, so there is no need to use condoms" said one of the respondents during the FGD.

There are high levels of stigma in the communities with associated discrimination as, although individuals were willing to purchase food from someone who they knew was HIV positive, three out of the five communities engaged with during FGDs stated that they would keep their HIV positive family member's status a secret – mainly due to the stigma attached to the disease. Apart from this being attributable to a general respect for their family member's privacy, part of this is due to the poor levels of knowledge and beliefs. Religious beliefs make it difficult to inform behavioural change information. The high levels of illiteracy also makes behavioural change communication somewhat challenging.

Information collected during the FGDs shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use, abstaining and having one uninfected sexual partner (monogamy – being faithful).

Four out of five of the interviewed key health personnel listed HIV/AIDS as one of the top five major illnesses facing their respective communities. Joe Slovo CHC was the only Healthcare facility that did not mention this disease. When probed as to why this was the case, the key informant, stated that all the HIV positive patients obtain their ARV treatment from their respective clinics, and not that HIV/AIDS was not a major illness of concern as it may have seemed.

ii. Commercial Sex

Transactional sex is increasingly being incorporated into casual labour on a global scale. With regard to the negative impacts of the proposed project development it was reported by key health personnel that there are no known commercial sex workers in the broader project area. This aligned with the situation as described by the respondents during FGD. All five communities reported that commercial sex was not common in their respective communities and thus not rendered as a community challenge. Given that commercial sex has not been reported in the study communities, the challenge going forward will be to maintain this situation when the practice is considered to be a challenge in the broader community. Should the proposed mine lead to the emergence of prostitution in these communities, there would be negative social and health connotations. The concern of the specialist is that an influx of (single) male workers from outside the area may place a burden on scarce resources and may also cause an increase in the incidence of HIV and STI. It is anticipated that disadvantaged young girls and child-headed households could be extremely vulnerable to single men with disposal income.

4.5.3 EHA #5: Soil-, water- and waste-related diseases

In the project area, water is obtained from subterranean sources. Some of the water is pumped by windmills, but most of the water to the communal areas comes from natural springs. Many of these springs are semi-perennial and the salt content of the water can vary from year to year, causing unpredictable, unstable water supply.

During FGDs, respondents claimed to receive borehole water, which is piped to their respective dwellings by the municipality. Most respondents in the communities also said that they have their own latrines in their yards and do not share with other households.

Water is recognised as a scarce resource in the district and municipal area and management systems are generally poor. The KLM achieved a relatively low blue drop grading at 126 out of 153

Local Municipalities. A municipality's Blue drop status refers to the safety of water, which is made available for human consumption. Concerns were raised by farmers about the availability of water for the proposed Project area to support the mine and related operations, as well as the needs for agriculture and domestic use.

During FGDs, it was noted that when there has been heavy rainfall, children play and swim in open water bodies. This correlates to information provides by two KIIs, that during rainy season, children are often brought to the Healthcare facilities, and diagnosed with Schistosomiasis, also known as Bilharzia – a disease caused by parasitic *Trematode schistosome* worms. No relevant schistosomiasis statistics for the KLM, nor the Northern Cape were found to support the respondents' claims.

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water borne diseases including cholera and diarrhoea. Observation and FGDs indicated that the majority of households do not have access to adequate sanitation services. With the exception of Garies, households in all communities visited use pit latrines and Ventilated Improved Pit-latrine (VIP) toilets in their own yards. Households in Garies were observed to have adequate sanitation facilities (flush toilets) inside their houses and yards.

4.5.4 EHA #6 Food- and nutrition-related issues

Food security has a profound impact on health. Food security incorporates several aspects: food availability, individual access to food, utilisation of food and stability of food availability. Under-nourishment is a key impact indicator of food security and is defined as having an energy consumption that is continuously below a minimum dietary energy requirement for maintaining a healthy life and carrying out light physical activity (SAHR, 2008).

Nutritional status is determined by the degree of nourishment. Under-nourishment, an indicator of food security, means consumption is continuously low. Food security is an important consideration in understanding potential health impacts of development projects. This EHA is affected by influx of people resulting in increased demand for food.

Based on the key informant interviews and FGDs, food shortage is a serious problem in the area. Surprisingly and somewhat contradictory, malnutrition was not rendered as a serious disease. A few respondents stated that malnutrition was a problem. This was for both children and also the elderly as vulnerable groups. Much of this was linked to poverty and general unemployment in the communities. Food shortage has been noted as one of the main health needs in the area. Malnutrition is linked to poverty and food security issues, as the population cannot afford basic foodstuffs, or that towns and decent grocery stores are not accessible (as transport costs are also unaffordable). Most children in the visited communities are fed bread and tea throughout the day, with little or no fresh fruit or vegetables. Poor feeding practices related to poor education and illiteracy are bound to worsen the existing situation.

4.5.5 EHA#7: Accidents/Injuries

Materials and equipment required for construction will be transported by road. Road transport is also the preferred option for transporting the mined product from the project site to the port at Saldanha.

Accidents and injuries were only reported in one out of the five KIIs. The PHC facilities (clinics) reported that if an individual was involved in a Road Traffic Accident (RTA), that individual would go straight to Joe Slovo CHC as they would not receive any form of medical assistance in the clinics. RTAs are not very common in the communities. Gender-based violence and crime related injuries such as assault are more common. There is a strong link to alcohol in domestic violence and assault accidents as "people like to fight when they are drunk" (Kamieskroon Clinic).

4.5.6 EHA #9: Social determinants of health

Substance misuse such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health (Prince et al., 2007) – the use of the drug *Cannabis sativa*, referred to as “dagga” by the locals, was reported (during the KIIs and FGDs) to being heavily misused in four out of the five communities (with the exception of Lepelsfontein). Substance misuse is associated with assault and domestic violence. Several respondents admitted that most members of their communities drink a lot of alcohol, especially during the weekends and at the end of the month when individuals have received their wages and salaries. The key health personnel validated this by asserting that alcohol and drug abuse was a major contributor of disease in several communities.

4.5.7 EHA #11: Health Systems Issues

Five Healthcare facilities within the proposed project area were visited with the aim of identifying the major health concerns for the community. These facilities are listed below:

- Stofkraal Community Health Centre;
- Garies Clinic;
- Kamieskroon Clinic;
- Kharkhams Clinic; and
- Joe Slovo Community Health Centre

Generally, management of the facility infrastructure requires attention, especially at PHC level. The quality of physical infrastructure has a major impact on the functioning of services and patients’ satisfaction with the healthcare services they receive. Facility Infrastructure Management needs the most improvement. Prioritised attention should be given to those facilities without provision for a constant and stable supply of water and electricity at the time of the field visit –Garies Clinic and Kharkhams Clinic. Some of the visited facilities are subject to intermittent interruption of these services or seasonal interruptions where the electricity supply is dependent on wind and rainfall – “when there is too much rain and wind, the lights go off and we do not have a generator here” said one of the interviewed key informants.

Three out of the visited five Healthcare facilities were observed to have carpeted flooring, and not tiled. The floor is the place where bacteria normally gather. This increases the risk of infection in Healthcare facilities where, if floors are not properly cleaned and sanitised. This is because carpeted or un-cleaned floors may facilitate the easier spread of disease and contaminate other patients. Numerous epidemiological and microbiological studies have been conducted (worldwide) in hospital rooms with carpeted floors and those with bare flooring/tiles. Microbiological profiles were determined with specimens obtained from patients admitted to these rooms. Patient records were then reviewed to note infection status and other case identities. In each sampling period, higher microbial counts per square meter were measured for the carpet that the bare floor (Gray, 2010).

The Joe Slovo CHC and all the PHC facilities visited show a high percentage success in compliance to the vital measure dealing with the availability of medicines as per the Essential Drug List, with Stofkraal CHC being the only Healthcare facility which reported to experiencing shortages in medication. The rest of the Healthcare facilities stated that it was very unusual that medication ran out, and in the rare event that a shortage was experienced; the respective facility would obtain/ “borrow for” medication from neighbouring clinics. This was said to be a common practice.

The availability of functional and essential medical technology equipment in three out of five visited facilities needs priority attention. Garies Clinic and Joe Slovo CHC were the only two Healthcare facilities which reported to having adequate supply of functional equipment to serve the needs of the facility. Some of the vital equipment required in the other three Healthcare facilities is listed below:

- Blood pressure machines;
- Blood for transfusion purposes (blood bank);
- Refrigeration for vaccine and blood samples;
- Pap smear equipment - disposal speculums;
- Glucometers;
- Knowledgeable technicians to maintain broken equipment;
- Suction machinery (which may be used to clear the passageways/airway for saliva, blood, or other secretions so that a patient may breathe; and
- Immobile oxygen machines.

The key informant at Joe Slovo CHC did however raise a few structural needs, such as the need for an operating theatre, more beds in the labour ward (as the facility currently has only two), as well as a pathology lab as it wastes unnecessary time sending blood to Springbok for analysis in emergency cases. She further indicated that the facility was experiencing a shortage in staff as one of the Professional Nurses had died, and since not been replaced, as well as the need for a Pharmacist to control the dispensing of vital medication.

All Healthcare facilities do not provide the full spectrum of PHC services. The likely reason for this is that two out of five of the visited Healthcare facilities are owned by local government and many of these do not provide the same spectrum of services expected of provincially owned and managed facilities. Dental and optometric services are only offered by Garies Clinic and Joe Slovo CHC – those owned by provincial government. Figure clearly illustrates the correlation between the types of services offered by the various Healthcare facilities visited, and the proportion of those facilities thereof. All five visited Healthcare facilities offer the majority PHC services such as ARV therapy, antenatal care, and TB treatment. This is a great positive for the communities serviced by these facilities.

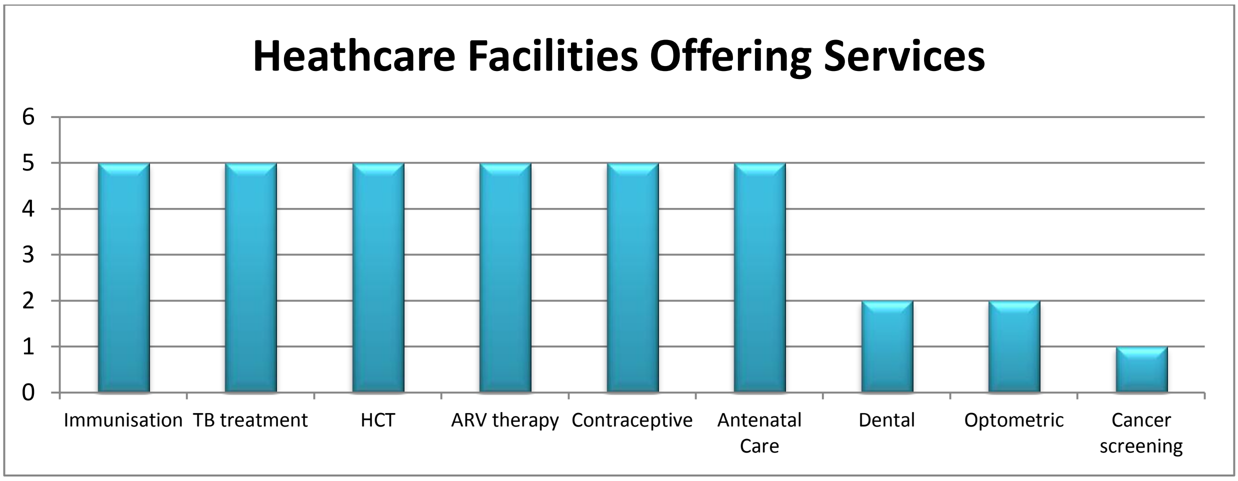


Figure 4.22: Healthcare facility services observed

4.5.8 EHA #12: Non-Communicable Diseases

The chief chronic conditions observed in the visited communities include chronic diseases such as hypertension, diabetes, and cancer. This is also asserted by information obtained during the KIIs, where all five interviewed key health personnel listed diabetes and hypertension in their top five major illnesses facing their respective communities.

4.6 CULTURAL HERITAGE ENVIRONMENT

A Phase 1 Heritage Assessment was undertaken for the proposed development. The findings of which include the following:

4.6.1 Roode Heuvel

- Isolated quartz flakes and chunks were recorded in the application area.
- One Early Stone Age (ESA) handaxe and an ESA flake were found.
- Nearly 30 quartz flakes, chunks and cores were recorded in the proposed airstrip, but the tools occur in a severely degraded context (old agricultural land). One Middle Stone Age (MSA) silcrete flake was also found.
- Scatters of Later Stone Age (LSA) tools, marine shellfish, decorated pottery and ostrich eggshell were recorded in a number of wind deflated sites.
- Large numbers of quartz, silcrete, quartzite, indurated shale, and several 100 fragments of ostrich eggshell were recorded on Brandkop on the north eastern boundary of the application area.

Plate 4.20: A) Collection of quartz lithics, including chalcedony flake (Site 096) (scale in cm)

4.6.2 Leeuvlei

- Single, isolated and a few dispersed scatters of quartz flakes and chunks were encountered in the application area.
- Outcroppings of quartz are likely sources of raw material targeted by Stone Age hunter-gatherers.
- Dispersed scatters of tools and a fragment of pottery were recorded near an outcropping of granite.
- Scatters of quartz (chunks & flakes), fragments of weathered ostrich eggshell and a piece of pottery were found south west of the granite dome, but the site (located among small Heuweltjies) is heavily bioturbated.
- Thousands of pieces of stone, including flakes, chunks, chips, bladelets, cylindrical, round and bipolar cores, hammerstones, anvils, manuports and grindstone fragments, were recorded in a cluster of wind deflated sites in the south western corner of the application area. More than 95% of the material is in quartz, but tools in silcrete and chalcedony were also counted. It is maintained that the source of the raw material are the outcroppings of quartz described above. No pottery was found, but about 40 pieces of ostrich eggshell were counted in a single site.

4.6.3 Seawater intake, pump station and pipeline to the desalination plant

- Archaeological remains are extremely rich at the coast. Typically, these comprise scatters of shellfish dominated by limpets and Black Mussel. A few stone flakes, some ostrich eggshell and pottery was also found. Shell scatters are essentially the remains of processing sites where meat was extracted, cooked in pots, or even dried like biltong for transport to campsites further inland.
- Large numbers of quartz, including flakes, chips, chunks, cores, a hammerstone and grindstone fragment was recorded in a dune blow out in the pipeline route about a kilometre south of the Groenrivier.
- Outcroppings of quartz in the pipeline route are likely sources of raw material targeted by Stone Age hunter-gatherers
- Diffuse scatters of stone implements, including a sherd of undecorated pottery were recorded on the south bank of the Groenrivier.
- A few stone implements and fragments of weathered shellfish (limpets) were documented on the north bank of the Groenrivier, directly below the Garies/Groenrivier road.

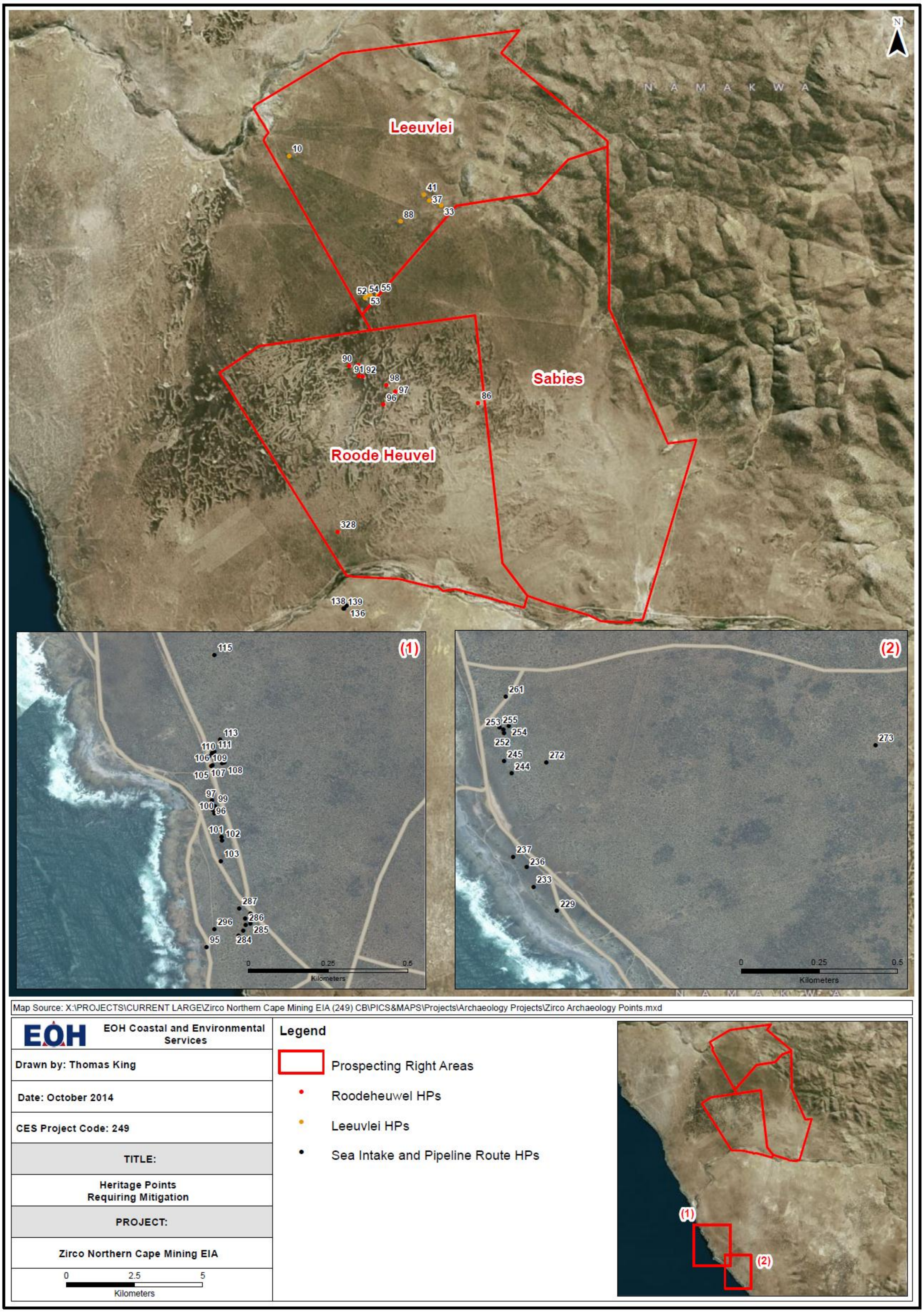


Figure 4.23: Heritage sites that require mitigation

5. NEED AND DESIRABILITY ASSESSMENT

5.1 NATIONAL SCALE

The mining industry is the third largest sector in the South African economy after the agriculture and industrial manufacturing sectors. It accounts for approximately 8% of Gross Domestic Product (GDP) and creates approximately one million jobs (500 000 direct and 500 000 indirect) (The Mining Sector Innovation Strategies Implementation Plan 2012/13 – 2016.17). In addition to this, exported minerals and metals account for as much as 60% of all export revenue and is a critical earner for foreign exchange. The project will also contribute to the South African economy through the payment of taxes and royalties.

5.2 BENEFITS TO LOCAL COMMUNITIES

5.2.1 Employment

At an average output of approximately 520,000 tons per annum, the total labour force at the mine production's steady state (2019/2020) is projected at 318 employees. The number of construction workers required is estimated at 243, and will be outsourced to construction companies. It should be noted that these employment figures are still preliminary projections. As far as reasonably possible, Zirco will employ the local population from the labour-sending communities. In order to do this, a skills audit will be conducted to establish whether the required skills are available and to advise any potential training programmes. The contractor labour force will gradually be replaced by the permanent labour force.

For those construction workers who might be sourced from towns further away, temporary accommodation units will be constructed on-site for the duration of the construction period (2015/2016). Prefabricated two-roomed housing units are planned with built-in bathrooms. For those permanent employees employed by the mine, some labour housing will be considered outside the town of Garies, as well as assistance to the KLM in terms of municipal service delivery. The table below provides a labour forecast for years 1-5.

Table 5.1: Labour Forecast

Occupational Level	Grade*	Forecast						
		2015/16		2016/17		2017/1	2018/19	2019/
		Year 1		Year 2		Year 3	Year 4	Year 5
		Construction		Construction	Production	Steady State Production		
		Contractor	Permanent	Contractor	Permanent	Permanent		
Top Management	F	0	0	0	0	0	0	0
Senior management	E	1	2	1	3	3	3	3
Professionally qualified & experienced specialists and mid-management	D	5	4	5	11	11	11	11
Skilled technical and academically qualified workers, junior management, supervisors, foremen and superintendents	C	68	10	34	60	78	82	86
Semi-skilled and discretionary decision-making	B	169	24	80	126	159	168	176
Unskilled and defined decision-making	A	0	0	0	20	38	40	42
Total employees		**243**	**40**	**120**	**220**	**289**	**304**	**318**

** Patterson Gradinghas been applied*

As depicted above approximately 243 staff will be needed during the construction phase. Gradually, the permanent labour force will build up moving from the construction phase to production, starting at around 220. A projected 318 staff will be needed by 2019/2020 at the mine's steady production state. The labour forecast is based upon the mine's production ramp-up rates, estimating that, roughly, a 15% labour force increase (for 2017-2020) can be expected for the skilled, semi-skilled and unskilled labour in order to realise its optimum labour requirements of 318 at the steady state production (2019/2020).

5.2.2 Skills development

Through the Skills Development Plan (SDP), the mine will ensure that its labour force has sufficient occupational skills to enable the continuous recruitment of local labour, but also to allow such labour to reach higher operational levels within the mining project. Providing such skills can be considered as mini-qualifications to the employees in itself, as such qualification can contribute towards credits towards a registered qualification under the South African National Qualification Framework (NQF).

5.2.3 Bursaries and internships

Zirco is committed to provide an opportunity for people in the labour-sending areas to obtain the necessary post-graduate qualifications necessary either to be absorbed within the mining industry in general, or to pursue their fields of interests. According to the MQA, there is a shortage of engineering skills in the South African labour market (*cf.* MQA, 2011)[6], which means that Zirco could play a key role in the KLM in terms of providing a means for prospective students to enter this field. A shortage in engineering skills has also been noticed by JIPSA, which identified engineering as of its five priority skills area. To this effect, JIPSA proposes to increase the number of practicing engineers, ensure that engineer graduates register as practising engineers, as well as that engineering skills are retained (*cf.* JIPSA, 2008)[7].

A key challenge in South Africa is that many engineers, once trained, move to other countries (especially Australia and Canada who are active recruiters). It is therefore critical for the mining industry in particular to provide an opportunity to HDSAs to obtain such qualifications to not only be absorbed in the country's labour market, but also to ensure that mines such as the Kamiesberg mine continue to have local labour from which to recruit.

It therefore makes sense that Zirco provide school leaving HDSAs who wish to study in the engineering field with a means to pursue a career in engineering, through a bursary scheme. Engineering degrees currently considered by Zirco include mining engineering, electrical engineering and mechanical engineering. Additional fields of study to be considered by Zirco might include bursaries in geology, metallurgy and chemical engineering.

5.2.4 Procurement

Zirco is committed to the preferential purchasing and procurement objectives of the Mining Charter and the MPRDA. The Company will implement measures to advance procurement to Historically Disadvantaged suppliers and will continually seek to allocate a significant portion of its annual expenditure in capital goods, services and consumables to preferred suppliers of this status. The commitment to purchasing will also extend to creating long term partnerships with suppliers so as to mentor and support the supply business.

Zirco believes that enterprise development is an integral part of promoting and fostering HDSA SMME development in South Africa. It is acknowledged that, generally, local communities do not

[6] MQA. 2011. *Sector Skills Plan for the Mining and Minerals Sector.* [Online]. Available: http://www.npconline.co.za/MediaLib/Downloads/Home/Tabs/Diagnostic/MaterialConditions2/Mining%20Qualifications%20Authority-%20Sector%20skills%20plan%20for%20the%20mining%20and%20minerals.pdf [2013, October 25].

[7] JIPSA. 2008. *Joint Initiative on Priority Skills Acquisition (JIPSA) Annual Report: briefing by Deputy President.* [Online]. Available: http://www.pmg.org.za/briefing/20080423-joint-initiative-priority-skills-acquisition-jipsa-briefing-annual- [2013, October 25].

benefit from enterprise development initiatives. Therefore, the Company will develop a local Procurement and Supplier Development Programme to overcome this challenge. This programme should assist in increasing spend within the local communities resulting in economic improvement within the host communities close to the mining operation.

As Zirco will be developing a new mining operation, the local Procurement and Supplier Development Programme will assist, where feasible, in identifying small business development opportunities and suppliers at the local level. The focus would be on procuring services such as garden, security, food, and other services from the local community. During mine development, the largest expenditures are generally directed at capital goods and specialised services that are normally procured from large urban businesses as well as international suppliers. In the long-term, the Company will aim to shift the balance of its expenditures where feasible from these large businesses to smaller, developing businesses located near or in the mine community. The objective will be to maximise both job creation and the economic benefit of the mining operation at the mine community level.

5.2.5 Local economic development

Zirco is committed to invest in basic service and infrastructural development projects within the KLM. Providing financial support in this sector is also the preference of the municipality, especially to ensure the future growth of the area’s economy. In addition, the Company is also very aware of the health not only of its employees, but also the communities in and around Garies. With the future cumulative mining developments in the area, a centralised healthcare facility, such as Garies’ Joe Slovo Community Clinic, might certainly need financial support in terms of equipment and maintenance. Therefore, investing in this clinic has been identified by the Company and KLM as an ideal LED project that would benefit the entire area.

Zirco will assist KLM with implementing sustainable LED projects that can benefit the local population. In light of this needs analysis, as well as reviewing the IDP, the following three projects are proposed:

- Supporting KLM with constructing a desalination plant in Garies to alleviate growing water pressure on the municipal area and supply good quality water to the communities in and surrounding Garies;
- Assist the Joe Slovo Community Clinic in Garies with restoring its own small desalination plant and equipment that is needed by the clinic; and
- Assist Lepelsfontein with the provision of household water tanks.

These three projects are listed in the tables below. Each project has been designed in such a way as to maximise the number of employment opportunities, but also to ensure that sufficient portable skills training and learnerships are provided:

Table 5.2 Proposed Local Economic Development Project 1

Project Name:	Project Type:	Project Classification:	Project Start Date	Project End Date
Garies Bulk Water Supply: Ground Water Desalination, Bulk Water and Borehole Development	Bulk water provision and local portable skills training	Infrastructural project	2015/2016	2016/2017

Project Background	Through consultations with KLM, an urgent need has been identified to erect a desalination plant in the town of Garies to alleviate growing water pressure on the municipal area and supply good quality water to the communities of and surrounding Garies. At present, the municipal area and its households are very dependent on boreholes for domestic water. However, these existing boreholes cannot supply sufficient water to Garies and its surrounding ward towns as the supply of good quality drinking water cannot meet the existing demand. As the population of Garies and its surrounding towns increases demand for clean drinking water will increase, putting additional demands on the municipality to deliver this service. In order to alleviate this pressure on water supply, KLM initiated the Garies Bulk Water Supply Scheme. According to a technical study conducted of the schemein 2010, with a project budget of around ZAR10,836,612, the scheme would involve several components. These include the construction of the desalination plant at the location of existing water reservoirs in Garies, upgrading existing reservoirs, drilling and equipping new boreholes, constructing evaporation ponds and supplying needed electricity to the plant and new boreholes. The plant will have an estimated capacity of 64,2kl/h (taking into account the water consumption of the residents of Garies, the schools and clinic), and will be required to supply clean water to Garies. Zirco will invest ZAR4,000,000 to assist the municipality with thisproject which will contribute towards the plant. . The construction of this plant will generate some employment, and people from the surrounding communities will be provided with skills training, through the relevant SETA, to enable them to gain new skills to find decent work after the construction and implementation phases of this plant. As far as possible, Zirco recommends that local suppliers be used with a key skills training element to the local labour attached to this. Training the local labour of Garies and its surrounding towns is vital, especially since routine follow-up and maintenance work will be needed in future; employment which should be offered foremost to those employees who have been involved in the project from the start. Additional training to employees, and interested community members, will also include sanitation, health and hygiene, as well as water conservation and sustainable utilisation. A similar training programme would be considered for enrolment at primary schools.
Geographical Project Location	Kamiesberg Local Municipality, Ward 2 (Garies)

Project output:	Key Performance Area	Key Performance Indicator	Responsible Entity	Budget allocation					Total
				2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	
A Desalination Plant for KLM			KLM	ZAR2,000,000	ZAR2,000,000	ZAR0	ZAR0	ZAR0	ZAR4,000,000

Job Classification	No of jobs	Male adults	Female adults	Male Youth	Female Youth	Total	Comments
Short-Term	To be determined	To be determined	To be determined (at least 10% of the employees will be females)	To be determined	To be determined (at least 10% of the employees will be females)	To be determined	
Medium-Term							
Long-Term							
Exist Strategy							

Table 5.3: Proposed Local Economic Development Project 2

<table>
<tr><th>Project Name:</th><th colspan="3">Project Type:</th><th colspan="4">Project Classification:</th><th colspan="2">Project Start Date</th><th colspan="2">Project End Date</th></tr>
<tr><td>The Joe Slovo Community ClinicImprovement Project</td><td colspan="3">Clean water provision and supporting the clinic with needed equipment</td><td colspan="4">Infrastructural project and providing equipment</td><td colspan="2">2016/2017</td><td colspan="2">2017/2018</td></tr>
<tr><th>Project Background</th><td colspan="11">Although a labour clinic will be constructed at the mine site, services provided by this clinic will be limited to employees only. Subsequent to discussions with KLM and a visit to Garies' Joe Slovo Community Clinic, a need has been identified to assist this particular clinic which is struggling to cope with an increasing demand for healthcare. Foremost, the clinic has its own small desalination plant for reliable clean water. However, the plant is defective. Apart from requiring repair work, appropriate mechanical skills are also highly needed in Garies for maintaining the plant in future. Based upon this needs-analysis, Zirco proposes to invest ZAR2,000,000 to repair this desalination plant, but also to contribute towards needed equipment which the clinic requires. A key focus of this project will involve training local labour to perform most of the work required for the desalination plant, as well as to provide appropriate portable skills to [a] suitably qualified community member/sto maintain this plant for a specified number of years (this will be aligned with the Company's Portable Skills Training Targets).</td></tr>
<tr><th>Geographical Project Location</th><td colspan="11">Kamiesberg Local Municipality, Ward 2 (Garies)</td></tr>
<tr><th rowspan="2">Project output:</th><th rowspan="2">Key Performance Area</th><th rowspan="2">Key Performance Indicator</th><th rowspan="2">Responsible Entity</th><th colspan="7">Budget allocation</th><th rowspan="2">Total</th></tr>
<tr><th colspan="2">2015/2016</th><th colspan="2">2016/2017</th><th>2017/2018</th><th>2018/2019</th><th>2019/2020</th></tr>
<tr><td>A repaired desalination plant, a suitably qualified community member to maintain the plant in future and clinic equipment</td><td></td><td></td><td>KLM</td><td colspan="2">ZAR0</td><td colspan="2">ZAR1,000,000</td><td>ZAR1,000,000</td><td>ZAR0</td><td>ZAR0</td><td>ZAR2,000,000</td></tr>
<tr><th>Job Classification</th><th>No of jobs</th><th>Male adults</th><th>Female adults</th><th>Male Youth</th><th colspan="2">Female Youth</th><th>Total</th><th colspan="4">Comments</th></tr>
<tr><th>Short-Term</th><td rowspan="4">To be determined</td><td rowspan="4">To be determined</td><td rowspan="4">To be determined (at least 10% of the employees will be females)</td><td rowspan="4">To be determined</td><td colspan="2" rowspan="4">To be determined (at least 10% of the employees will be females)</td><td rowspan="4">To be determined</td><td colspan="4" rowspan="4">The clinic was visited by CES and a representative from the Company during November 2013 to assess its needs. The project description is therefore largely based upon the clinic's needs, as well as the Company desire to meet the future healthcare needs of the area.</td></tr>
<tr><th>Medium-Term</th></tr>
<tr><th>Long-Term</th></tr>
<tr><th>Exist Strategy</th></tr>
</table>

Table 5.4: Proposed Local Economic Development Project 3

Project Name:	Project Type:	Project Classification:	Project Start Date	Project End Date
Lepelsfontein Water Tank Project	Providing household rainwater tanks to households in Lepelsfontein	Infrastructural project and income generating	2018/2019	2019/2020

Project Background	KLM needs assistance in providing rainwater tanks to households. Rainwater harvesting reduces dependency on municipal water, and allows individual households to have reliable and clean water. Zirco considers this as an ideal project which is well-aligned with its proposed LED projects 1 and 2. Providing LED projects within the same sector has many advantages, especially in terms of aligning all these three LED projects with the Company's Portable Skills Training targets and bursary programmes to ensure that local skills are harnessed and retained to maintain Garies' bulk water infrastructure. Zirco therefore proposes to invest in a third project which would entail the erection and installation of rainwater tanks in Lepelsfontein, in consultation with KLM. The size of the rainwater tanks to be considered will depend on several factors which will be assessed, such as the rainfall, house roof areas and household water usage. The price for an average 5,000L rainwater tank is around ZAR3,500 whereas installation costs can increase this amount to around ZAR5,000. Zirco intends to invest ZAR2,000,000 in this particular project, which would be able to assist the municipality to provide and install between 300 and 400 water tanks to households. As with the other two LED projects, a key component will be employment opportunities, as well as skills training. As the tanks need to be installed and maintained, local labour will be required. Zirco would also consider aligning its Portable Skills Training targets with this project to ensure that members of the local community receive appropriate training that would allow them to maintain such infrastructure or even possibly starting a Small, Medium and Micro Enterprise (SMME) that could supply such services to the entire area. A local service provider will be employed for manufacturing and delivering the rainwater tanks.
Geographical Project Location	Kamiesberg Local Municipality, Wards 1 and 2

Project output:	Key Performance Area	Key Performance Indicator	Responsible Entity	Budget allocation					Total
				2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	
Household rainwater tanks to around 300-400 households			KLM	ZAR0	ZAR0	ZAR0	ZAR1,000,000	ZAR1,000,000	ZAR2,000,000

Job Classification	No of jobs	Male adults	Female adults	Male Youth	Female Youth	Total	Comments
Short-Term **Medium-Term** **Long-Term** **Exist Strategy**	To be determined	To be determined	To be determined (at least 10% of the employees will be females)	To be determined	To be determined (at least 10% of the employees will be females)	To be determined	

5.3 MARKET CONDITIONS

Under currently foreseen market conditions, and in the absence of major new entrants to the titanium feedstock supply industry, adequate market opportunities exist for the sale of the total output from the Kamiesberg project.

5.3.1 Sulphate Ilmenite

Forecasts indicate that the overall global demand for sulphate ilmenite will increase at a rate of 4.2% over the next 7 years (up to 2020).

Based on the forecast by TZ Minerals International (TZMI) (TZMI, 2012), the global sulphate ilmenite supply/demand is expected to be close to the balance between 2012 and 2013, before moving into moderate surplus in 2014 and 2015 as new supply from a number of approved projects come on line. The market is then expected to move into a progressively larger deficit beyond 2016 if no new supply is brought online to meet the demand for the product. As such, it is expected that the planned 500 000 tpa of sulphate ilmenite from the Kamiesberg Project, which compares favourably to most other competing products, can be absorbed by the market. Figure 5.1 below shows the global sulphate ilmenite supply/demand balance up to 2020. This includes supply from new projects.

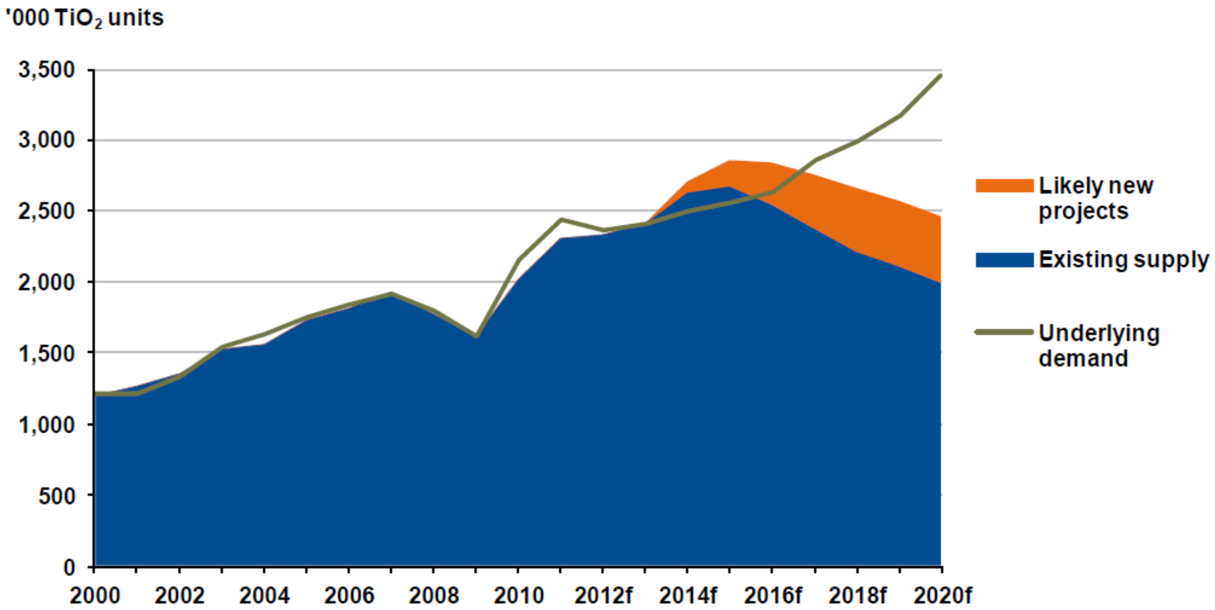


Figure 5.1: Global sulphate ilmenite supply/demand balance up to 2020
(Source: TZMI)

5.3.2 Zircon

Based on the forecast by TZMI, the global zircon supply is expected to remain relatively steady after 2014 even with new supply from several potential projects to be commissioned over the next few years taken into account. Thus beyond 2020 a sharp decline in global supply is inevitable. For this reason new discoveries will be required to sustain supply levels. As such, it is expected that the zircon from the Kamiesberg Project, which compares favourably to most other competing products, can be absorbed by the market. Figure 5.2 below shows the global zircon supply/demand balance up to 2020. This includes supply from new projects.

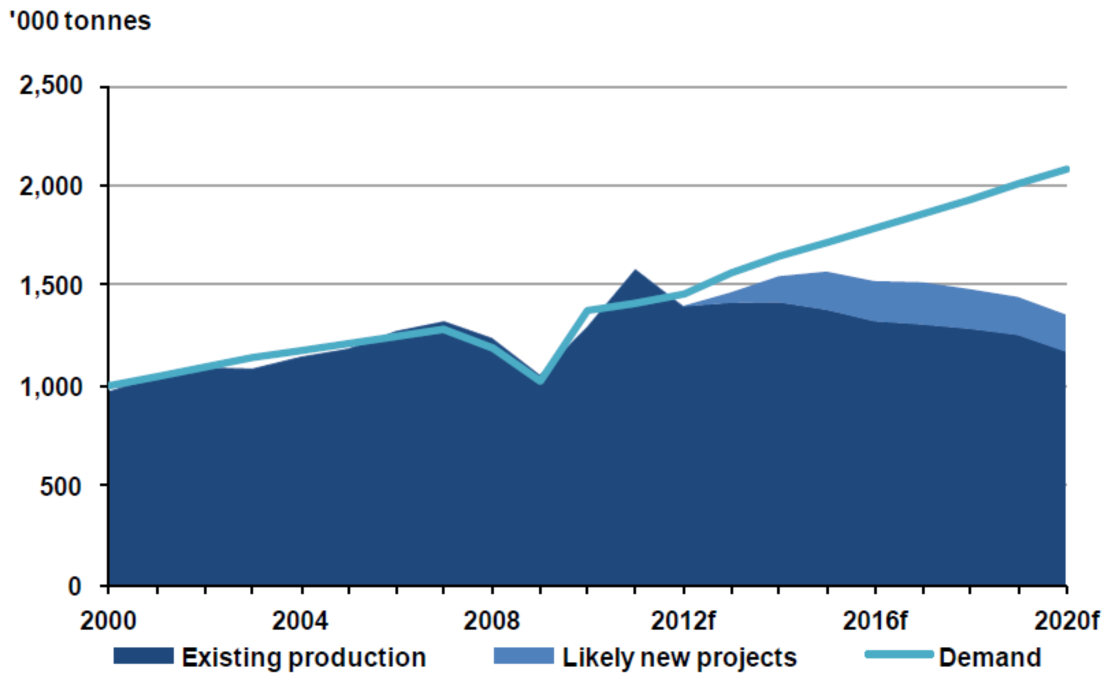


Figure 5.2: Global zircon supply/demand balance up to 2020
(Source: TZMI)

5.3.3 Rutile

Based on the forecast by TZMI, global rutile supply deficits are expected to occur after 2014, unless new sources of supply are commissioned. If no new supply becomes available global underlying demand will decrease to match supply. Consumers of rutile pigment will therefore need to use alternative feedstocks such as synthetic rutile and chloride slag. As such, it is expected that the rutile from the Kamiesberg Project, which compares favourably to most other competing products, can be absorbed by the market. Figure 5.3 below shows the global rutile supply/demand balance up to 2020. This includes supply from new projects.

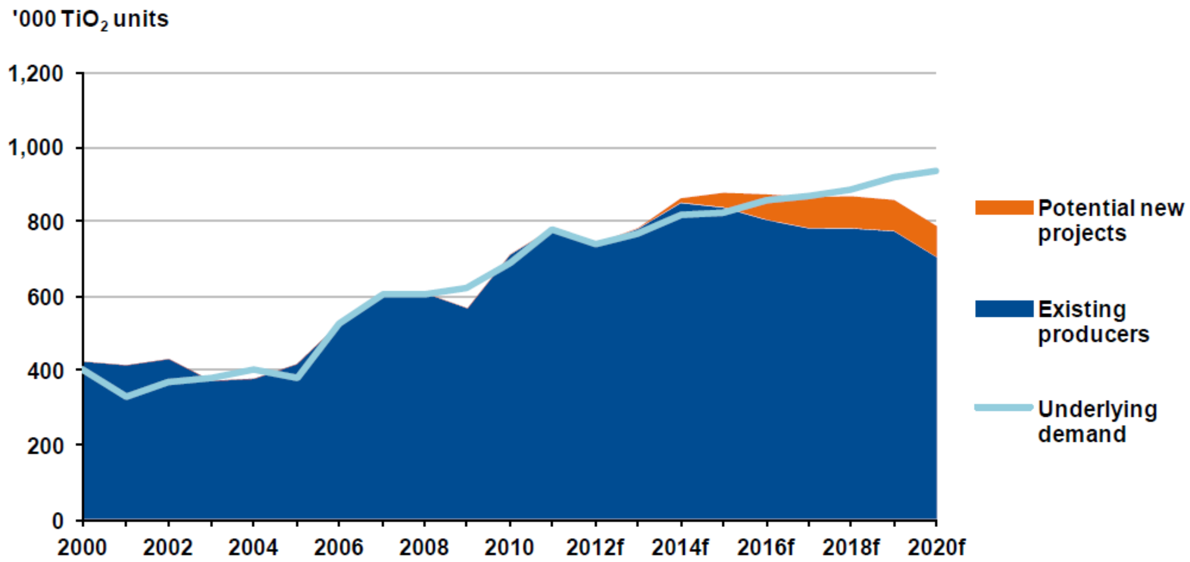


Figure 5.3: Global rutile supply/demand balance up to 2020
(Source: TZMI)

5.3.4 Monazite

A shortage of rare earth elements (REE) has re-energised interest in monazite as a source of REE. According to TZMI, should monazite become a serious source of REE, the trade for this mineral would be expected to develop quickly into a classic supply/demand scenario as there are many existing sources of monazite that are simply replaced in mine tailings due to the lack of markets. It is therefore assumed that the 4 800 tpa of monazite could be absorbed by the market.

6. PUBLIC PARTICIPATION PROCESS

According to regulation 31 (2) of the EIA regulations (2010), An environmental impact report must include –
(e) details of the public participation process conducted in terms of regulation 31(1) including –
(i) the steps undertaken in accordance with the plan of study;
(ii) a list of all persons, organisations and organs of state that were registered as interested and affected parties;
(iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments;
(iv) copies of any representations and comments received from registered interested and affected parties.

In line with the above-mentioned legislative requirement, this Chapter of the report provides the details of the Public Participation (PPP) followed during the Scoping and EIA Phases of the proposed development.

The Scoping phase of the EIA provides for the involvement of Interested and Affected Parties (I&APs), in forums that allow them to voice their opinions and concerns, at an early stage of the proposed project. Such engagement is critical in the EIA, as it contributes to a better understanding of the proposed project among I&APs, and raises important issues that need to be assessed in the EIA process.

During the Impact Assessment Phase of an EIA the public participation process provides the opportunity for Interested and Affected Parties (I&APs) to review and comment on the findings of the Draft EIA Report, which contains the integrated findings of the specialist studies undertaken to assess the environmental impacts of the proposed project. For completeness, and in order to provide an overview of the PPP during the entire study, this Chapter contains details of the PPP carried out during the Scoping Phase as well as the process being undertaken in the Impact Assessment Phase.

6.1 OBJECTIVES OF PUBLIC PARTICIPATION

Public Participation aims to:

- Disclose activities planned by the project proponent and the EIA team.
- Identify concerns and grievances from interested and affected parties.
- Harness local expertise, needs and knowledge from the interested and affected parties.
- Respond to grievances and enquiries of project-affected people.
- Identify additional or new stakeholders.
- Gather perceptions and comments on the proposed terms of reference for the specialist studies.
- Ensuring that all issues raised by stakeholders have been adequately assessed.
- Sharing the findings, mitigation measures, management actions, management and monitoring programmes and recommendations of the specialists.
- Including any new concerns or comments that arise.

This information is used to:

- Identify underestimated or unanticipated impacts.
- Alert the project to possible communication breakdowns and emerging problems and concerns.
- Encourage the use of local resources and knowledge in the project.
- Identify development opportunities and community projects.

6.2 BENEFITS OF PUBLIC PARTICIPATION

The benefits from a successful PPP process are as follows:

- Interested and affected parties (I&APs) can influence the project to reduce adverse effects, maximise ancillary benefits and ensure they receive appropriate compensation.
- Additional opportunities will arise during project design to ensure that equity issues are considered and the needs of the poor receive priority.
- Management plans which result from the environmental assessment process are more effective.
- Fewer conflicts will develop and where they develop they can be addressed timeously.

6.3 INTERNATIONAL PRINCIPLES OF PUBLIC PARTICIPATION

The principles for the PPP have been adopted from the guidelines for stakeholder engagement developed by the International Finance Corporation (IFC). These are listed below:

- ***Inclusiveness***: Inclusion of all stakeholders in the process is ensured and the Stakeholder Engagement Team (SET) remains alert to the emergence or formation of new stakeholder groups during the process. Attempts are made to ensure that the voices of the least powerful stakeholders are heard.
- ***Communication:*** Communication on different aspects of the project (i.e. ESHIA procedures, mining operations, infrastructure, etc.) is co-ordinated in a coherent and efficient communication mechanism in order to avoid excessive meetings and duplication.
- ***Communication mechanisms***: The mechanisms are familiar, culturally accepted and convenient to all stakeholders.
- ***Consistent communication***: There is consistency and continuity in the communication mechanisms used, and in the SET, to avoid contradiction and confusion within and between the stakeholder groups.
- ***Communication techniques:*** Information is communicated in a form that is appropriate and meaningful to all stakeholders. This implies that different materials and methods of communication may be needed for different stakeholders. Written and oral communications in local language and readily accessible formats is used. Use of visual methods to explain information to non-literate people is important.
- ***Genuine Consultation:*** Two-way communication is enabled in which both the SET and the stakeholders contribute to discussions and to the shaping of the ESHIA and the project.
- ***Grievances:*** From stakeholders must be heard and addressed.
- ***Transparency and trust:*** The SEP builds on a relationship of trust and respect between all stakeholders. This can be achieved through an attitude of transparency and openness to different cultural values and knowledge bases.

- ***Flexibility:*** The planning of the engagement activities is flexible in order to allow appropriate and timely responses to changes in the process.
- ***Evaluation:*** The efficiency of the SEP process is evaluated.

6.4 REGULATIONS AND REQUIREMENTS FOR PUBLIC PARTICIPATION

6.4.1 South African Legislation

According to Section 54(2) of the National Environmental Management Act, 107 of 1998 as amended (NEMA) "*the person conducting a public participation process must take into account any guidelines applicable to public participation as contemplated in section 24J of the Act and must give notice to all potential interested and affected parties of the application which is subjected to public participation by*:

(a) Fixing a notice board at a place conspicuous to the public at the boundary or on the fence of
   (i) The site where the activity to which the application relates is or is to be undertaken; and
   (ii) Any alternative site mentioned in the application."

Site notices were placed on the boundary of the project area as well as along the main access road to the Groen River Estuary (Plate 6.1). In addition to this smaller notices (A3) were placed on notices boards at the Agrimark and the OK Bazaars in Garies as well as the tourist centre in Garies and SANParks offices close to the Groen River Estuary (Plate 6.2).

Plate 6.1: (A) Site notice along property boundary; (B) Site notice along main access road

Plate 6.2: (A) Site notice at agrimark in Garies; (B) Site notice at OK in Garies (C) Site notice at tourist centre in Garies (D) Site notice at SANParks Office

(b) Giving written notice to:

(i) The owner or person in control of that land if the applicant is not the owner or person in control of the land;
(ii) The occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
(iii) Owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
(iv) The municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area;
(v) The municipality which has jurisdiction in the area;
(vi) Any organ of state having jurisdiction in respect of any aspect of the activity; and
(vii) Any other party as required by the competent authority;

Contact details of all stakeholders identified are available in Tables 6.1 – 6.4 below. Copies of the letters of notification and proof of receipt are available in Appendix F of this report.

(c) Placing an advertisement in:
(i) One local newspaper; or
(ii) Any official Gazette that is published specifically for the purpose of providing public notice of applications or other submissions made in terms of these Regulations.

(d) *Placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or local municipality in which it is or will be undertaken: Provided that this paragraph need not be complied with if an advertisement has been placed in an official Gazette referred to in [subregulation (c)(ii)] paragraph (c)(ii); and*

Vrydag 1 November 2013 DIE BURGER

Geklassifiseerd 9

KENNIS GESKIED HIERMEE VIR DIE VOORNEME VAN 'N BESTEKOPNAME-EN-OMGEWINGSIMPAKEVALUERING VIR DIE VOORGESTELDE DROOG MYN VAN SWAAR MINERALE EN DIE BOU VAN VERWANTE INFARUKTUUR IN DIE GARIES AREA IN DIE NOORD-KAAP

Coastal & Environmental Services (CES) het 'n aansoek ingedien ingevolge die Wet op Nasionale Omgewingsbestuur (NEMA) 1998, soos gewysig, by die Noord-Kaapse Departement van Omgewingsake en Natuurbewaring om die Omgewingsimpakevaluering (OIE) te onderneem vir die Kamiesberg Swaar Minerale Myn Projek, Namakwaland, Noord-Kaap. As gevolg van die aard en omvang van die projek sal 'n volledige Bestekopname-en-Omgewingsimpakevaluering in terme van die NEMA regulasies gedoen moet word.

Zirco Roode Heuwel (Pty) Ltd het die prospekteerregte vir die Roode Heuwel en Leeuvlei depositos, geleë ongeveer 500 km noord van Kaapstad en ongeveer 35 km suidwes van Garies in die Noord-Kaap Provinsie. Hul is tans in die proses om die prospekteerregte te bekom vir verdere depositos ommiddelik oos van en aangresend aan die Roode Heuwel, verwys na as "Sabies".

Vir meer inligting of om te registreer as 'n Belanghebbende Party Kontak asseblief: Mej Lara Crous, Posbus 934, Grahamstad, 6140 Tel: 046 622 2364, Faks: 046 622 6564, Epos: l.crous@cesnet.co.za

Plate 6.3: Copy of the advertisement placed in Die Burger notifying I&APs of the proposed development

(e) Using reasonable alternative methods, as agreed to by the competent authority, in those instances where a person is desiring of but unable to participate in the process due to:
- *(i) Illiteracy;*
- *(ii) Disability; or*
- *(iii) Any other disadvantage."*

In addition to the above and according to Section 55 (1) of the NEMA Regulations "*an EAP managing an application must open and maintain a register which contains the names, contact details and addresses of:*

(a) All persons who, as a consequence of the public participation process conducted in respect of that application in terms of regulation 54, have submitted written comments or attended meetings with the applicant or EAP;
(b) All persons who, after completion of the public participation process referred to in paragraph (a), have requested the applicant or the EAP managing the application, in writing, for their names to be placed on the register; and
(c) All organs of state which have jurisdiction in respect of the activity to which the application relates."

According to Section 56(1) of the NEMA Regulations "*a registered interested and affected party is entitled to comment, in writing, on all written submissions, including draft reports made to the competent authority by the applicant or the EAP managing an application, and to bring to the attention of the competent authority any issues which that party believes may be of significance to the consideration of the application, provided that:*

(a) Comments are submitted within:
- *(i) The timeframes that have been approved or set by the competent authority; or*
- *(ii) Any extension of a timeframe agreed to by the applicant or EAP.*

(b) A copy of comments submitted directly to the competent authority is served on the EAP; and
(c) The interested and affected party discloses any direct business, financial, personal or other interest which that party may have in the approval or refusal of the application."

Lastly, Section 57(1) states that: "*the EAP managing an application for environmental authorisation must ensure that the comments of interested and affected parties are recorded in reports and that such written comments, including records of meetings, are attached to the report, submitted to the competent authority in terms of these Regulations*."

6.4.2 International Guidelines

In terms of international standards, the IFC's environmental and social performance standards are regarded as the benchmark for international best practice. IFC Performance Standard 1 stipulates the following for stakeholder engagement:

- When local communities may be affected by risks or adverse impacts from a project, the project will include consultation with them.
- Community engagement will be free of external manipulation, interference or coercion and intimidation and conducted on the basis of timely, relevant, understandable, inclusive, culturally appropriate and accessible information.
- Disclosure will occur early in the social and environmental assessment process (scoping phase) and on an ongoing basis.
- The project proponent will disclose the ESIA assessment document, which is the

result of a social and environmental assessment. It will focus on the social and environmental risks and adverse impacts and the proposed measures and actions to address impacts.
- Affected communities will be provided with opportunities to express their views on project risks, impacts and mitigation measures and allow the project proponent to consider and respond to them.
- The proponent will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the proponent's environmental and social performance. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the community at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies.

Stakeholder engagement must be underpinned by the principle of free, prior and informed consent, which states that individuals and communities should be informed, in appropriate accessible language, about projects that might take place on their land. It also "guarantees that they are given the opportunity to give, withhold or negotiate land use and related issues" (IFC, 2007). The principle of free, prior and informed consent is also subscribed to in IFC Performance Standard 1.

6.5 PUBLIC PARTICIPATION TO DATE

6.5.1 Notification of interested and affected parties

At the commencement of the project Zirco provided a list of all landowners of the proposed farms directly affected by the mining activities (Table 6.1) and adjacent landowners (Table 6.2). Members of CES conducted a site visit on the 22nd to the 26th of July 2013. During this time members of CES met which each available landowner (landowners not available are shown in red in Table 6.1 below) personally to inform I&APs of the proposed development and provide them with a background information document (Appendix F-1). In addition to this, all landowners and adjacent landowners were notified of the proposed development via registered mail (see Appendix F-2 for copies of the letters and proof of receipt). Figure 6.1 below shows the various properties directly affected by mining activities and adjacent to mining activities.

In addition to the above, letters of notification and background information documents were sent to landowners that may be affected by the pipeline. Since the servitude for the proposed pipeline has not yet been finalised all property owners within the overall area where notified of the proposed project (list provided in Table 6.3). Figure 6.2 below shows all properties from the proposed mine site to Khynp Punt.

A number of key stakeholders were identified at national, provincial and local level, information on these are available in Table 6.4 below. These stakeholders were notified of the proposed development via registered mail (see Appendix F-2 for copies of the letters and proof of receipt). Members of CES met personally with Ms Deidre Williams from the Department of Mineral Resources and Ms Lucille Karsten from the Northern Cape Department of Environment and Nature Conservation in Springbok on the 25th of July 2013.

Table 6.1: Details of landowners and occupiers directly affected by mining activities (names in red were not met personally)

Farm Name	Portion Number	Landowner	Contact Number	Postal Address
Klipdam No 633	633	Jacob van Zyl	027 531 1014	P.O. Box 334, Garies, 8220
Roode Heuwel 502	1/502	Marius van Zyl	027 531 1010	P.O. Box 8, Garies, 8220
Roode Heuwel 502	5/502	Izak Engelbreght	027 531 1027	P.O.Box 190, Garies, 8220
Roode Heuwel 502	6/502	Izak Engelbreght	027 531 1027	P.O.Box 190, Garies, 8220
Roode Heuwel 502	9/502	Alwyn van Zyl	083 353 4598	P.O.Box 905, Vredendal, 8160
Leeuvlei 642	642	Jan C. Engelbrecht	027 531 1030	P.O. Box 10, Vanrhynsdorp, 8170
Soutkraal 437	1/437	Johan Engelbrecht	027 581 1095	P.O. Box 338, Garies, 8220
Klipheuwel 435	9/435	Jan C. Engelbrecht	027 531 1030	P.O. Box 10, Vanrhynsdorp, 8170
Klipheuwel 435	10/435	Jan C. Engelbrecht	027 531 1030	P.O. Box 10, Vanrhynsdorp, 8170
Klipheuwel 435	11/435	Ian Coetzee	082 726 9297	P.O.Box 133, Lutzville, 8165
Sabies 505	2/505	Jan C. Engelbrecht	027 531 1030	P.O. Box 10, Vanrhynsdorp, 8170
Hawerland 503	1/503	Deon Engelbreght	021 851 2420	P.O. Box 1163, Somerset West, 7129
Hawerland 503	2/503	Izak Engelbreght	027 531 1027	P.O. Box 190, Garies, 8220
Hawerland 503	3/503	Miemie Englebrecht	027 531 1029	P.O. Box 190, Garies, 8220
Hawerland 503	RE/503	Miemie Englebrecht	027 531 1029	P.O. Box 190, Garies, 8220

Table 6.2: Details of landowners and occupiers adjacent to proposed mining activities (names in red were not met personally)

Farm Name	Portion Number	Contact Person	Contact Number	Postal Address
Roode Heuwel 502	4/502	Tronox Mineral Sands (Pty) Ltd	022 701 3911	115 West Street, Sandton, 2196
Roode Heuwel 502	RE/502	Dirk van Zyl	027 531 1016	P.O. Box 8, Garies, 8220
Klipheuwel 435	3/435	Johan Engelbrecht	027 581 1095	P.O. Box 338, Garies, 8220
KWASS 501	RE/501	NamaquaNational Park Petrus Schreuder	0276721948	P.O. Box 117, Kamieskroon, 8241
Rooiheuwel 634	634	Dirk van Zyl	027 531 1016	P.O. Box 8, Garies, 8220

Klipheuwel 435	RE/435	Gert and Hestelle Engelbrecht	027 581 1021	P.O. Box 79, Garies, 8220
Klipheuwel 435	7/435	Gert and Hestelle Engelbrecht	027 581 1021	P.O. Box 79, Garies, 8220
Klipheuwel 435	3/435	Johan Engelbrecht	027 581 1095	P.O. Box 338, Garies, 8220
Soutfontein 436	2/436	J.C.C de Villiers	021 581 1020	P.O. Box 113, Garies, 8220
Soutfontein 436	3/436	J.C.C de Villiers	021 581 1020	P.O. Box 113, Garies, 8220
Soutfontein 436	6/436	Gert and Hestelle Engelbrecht	027 581 1021	P.O. Box 79, Garies, 8220
Soutkraal 437	3/437	J.C.C de Villiers	021 581 1020	P.O. Box 113, Garies, 8220
Soutkraal 437	4/437	J.C.C de Villiers	021 581 1020	P.O. Box 113, Garies, 8220
Groenrivier's Vallei 504	2/504	W.D.Engelbrecht	027 531 1032	P.O. Box 48, Garies, 8220
Groenrivier's Vallei 504	3/504	G.G Kotze	027 531 1026	P.O. Box 1, Garies, 8220
Groenrivier's Vallei 504	5/504	G.G Kotze	027 531 1026	P.O. Box 1, Garies, 8220
Groenrivier's Vallei 504	6/504	W.D.Engelbrecht	027 531 1032	P.O. Box 48, Garies, 8220
Groenrivier's Vallei 504	7/504	W.D.Engelbrecht	027 531 1032	P.O. Box 48, Garies, 8220
Sabies 505	RE/505	W.D.Engelbrecht	027 531 1032	P.O. Box 48, Garies, 8220
Sabies 505	1/505	Jan C. Engelbrecht	027 531 1030	P.O. Box 10, Vanrhynsdorp, 8170
Sabies 505	6/505	W.D.Engelbrecht	027 531 1032	P.O. Box 48, Garies, 8220
Klipheuwel 435	3/435	Johan Engelbrecht	027 581 1095	P.O. Box 338, Garies, 8220

Table 6.3: Details of landowners and occupiers which may be affected by the construction of the pipeline

Farm Name	Portion Number	Landowner	Contact Person	Contact Number	Postal Address
Klipkuil 547	2/547	Willem Petrus Auret	Willem Petrus Auret	083 275 9791	P.O. Box 85 Lamberts Bay 8130
Klipkuil 547	8/547	Groenriviersmond Trust	A.A. Niewoudt	027 531 1046	P.O. Box 37 Garies 8220
Klipkuil 547	10/547	Groenriviersmond Trust	A.A. Niewoudt	027 531 1046	P.O. Box 37 Garies 8220
Rooiheuwel 634	634	Dirk van Zyl	Dirk van Zyl	027 531 1016	P.O. Box 8, Garies, 8220
Roode Heuvel 502	RE/502	Dirk van Zyl	Dirk van Zyl	027 531 1016	P.O. Box 8, Garies, 8220
Eiland Punt Noord 549	1/549	Willem Petrus Auret	Willem Petrus Auret	083 275 9791	P.O. Box 85 Lamberts Bay 8130
Eiland Punt Noord 549	2/549	De Beers Consolidated Mines (Pty) Ltd		053 839 4111 053 839 4210	P.O. Box 616 Kimberley 8300
Eiland Punt Noord 549	3/549	Groenriviersmond Trust	A.A. Niewoudt	027 531 1046	P.O. Box 37 Garies 8220
Eiland Punt Noord 549	4/549	Groenriviersmond Trust	A.A. Niewoudt	027 531 1046	P.O. Box 37 Garies 8220
Eiland Punt Noord 549	RE/549	De Beers Consolidated Mines (Pty) Ltd		053 839 4111 053 839 4210	P.O. Box 616 Kimberley 8300
Strandfontein 559	RE/559	Sedex Desalination	Stuart Smith	021 446 6040	P.O. Box 8399, Cape town, 8012
Eiland Punt Zuid 550	1/550	Kambrolandskap Koop Ltd	onia@ telkomsa.net	082 773 2524	P.O. Box 95 Orania 8752
Eiland Punt Zuid 550	2/550	Willem Petrus Auret	Willem Petrus Auret	083 275 9791	P.O. Box 85 Lamberts Bay 8130
Eiland Punt Zuid 550	3/550	Groenriviersmond Trust	A.A. Niewoudt	027 531 1046	P.O. Box 37 Garies 8220
Eiland Punt Zuid 550	RE/550	De Beers Consolidated Mines (Pty) Ltd		053 839 4111 053 839 4210	P.O. Box 616 Kimberley 8300

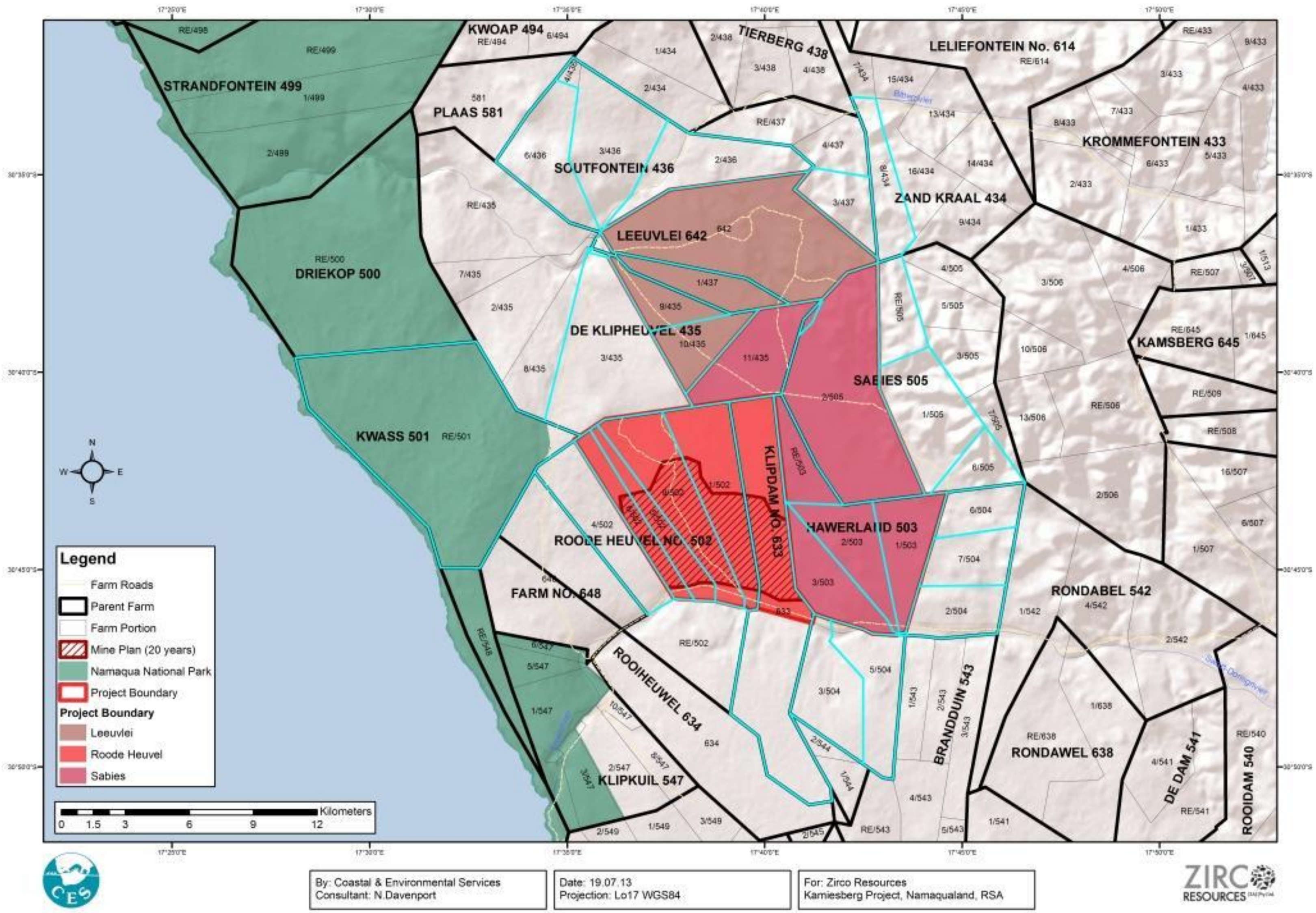


Figure 6.1: Map showing the proposed prospecting areas as well as properties adjacent to these

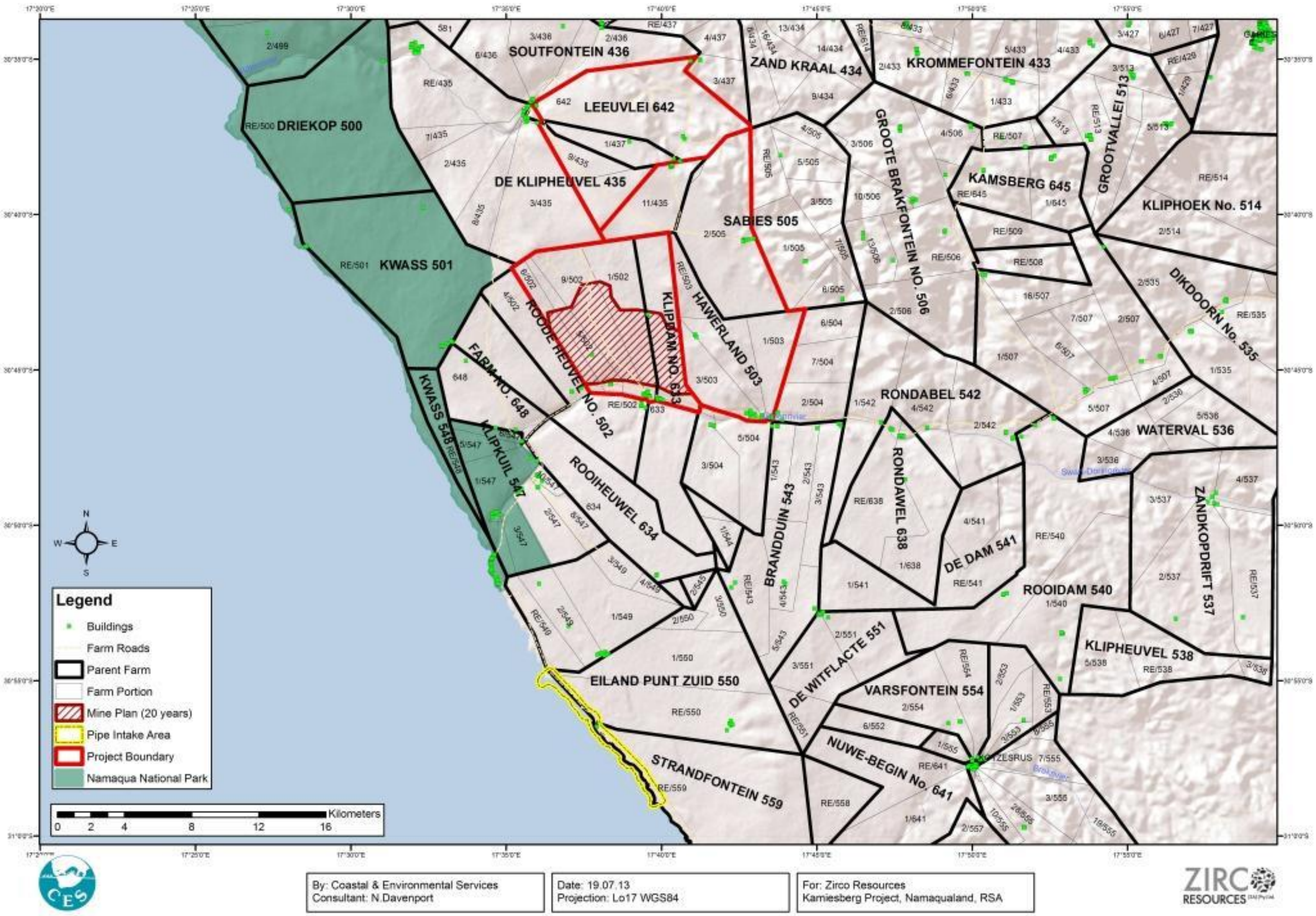


Figure 6.2: Map showing all properties south of the mining area that may be affected by the pipeline

Table 6.4: Key Stakeholders identified during the Scoping Phase

Stakeholder	Contact Person	Contact Number	Postal Address
National			
DEA: Oceans and Coasts	Chief Directorate - Integrated Coastal Management: Dr Razeena Omar	021 819 2432	Private Bag X447, Pretoria, 0001
South African National Roads Agency (SANRAL)	SANRAL Corporate Office	012 426 6000	PO Box 415, Pretoria, 0001
Department of Agriculture, Forestry and Fisheries	Office of the Minister : Mr Andrew Bartlett	012 319 7150 (PTA) 021 467 4502 (CPT)	Private Bag x9087, Cape Town, 8000
Department Of Agriculture	Minister For Agriculture And Land Affairs: Ms Tina Joemat-Petterson	053 831 4049	Private Bag X5018, Kimberley 8300
Department Of Agriculture	Head Of The Department: Mr Viljoen Mothibi	053 838 9100.	
Eskom Transmission: Grid connectivity and capacity	Itumeleng Moeng	011 800 4114	Megawatt Park – D1 Y39, PO Box 1091, Johannesburg, 2000
Transnet National Ports Authority (TNPA)	Transnet National Port Authority Head Office	011 351 9001	P O Box 32696, Braamfontein, 2017
Department Of Water Affairs (DWA)	Media Liaison Officer: Mr Mandla Mathebula	Tel: 012 336 8733 / 90 Cell: 083 235 8675	Private Bag X313, Pretoria,0001
South African Heritage Resources Agency (SAHRA)	Head Office	021 462 4502	PO Box 4637, Cape Town, 8000
Department of Mineral Resources (DMR)	Director General's Office: Mr Khayalethu Matrose	012 444 3308	Private Bag X59, Arcadia, 0007
Provincial – Western Cape			
SANRAL (Western Region)		021 957 4600	Private Bag X19, Bellville, 7535
Department: Roads and Public Works (Western Cape)	Head of Department: Johan Fourie	021 483 2826	Private Bag X9185, Cape Town, 8001
Transnet National Ports Authority (TNPA)	Port of Saldanha	022 701 4302/4	Private Bag X1, Saldanha, 7395
Department of Agriculture – Western Cape	Media Liaison Officer: Agriculture Mr Wouter Krie	Tel: 021 483 4930 Cell: 079 694 3085	Private Bag X9179, Cape Town, 8000
Department Of Water Affairs (DWA)	Chief Director: Western Cape Mr R Khan	Tel: 021 941 6000 Cell: 082 809 2218	Private Bag X16, Sanlamhof, 7532
Heritage Western Cape	Andrew Hall	021 483 5959	3rd Floor, Protea Assurance Bldg, Greenmarket Square, Cape Town, 8000
Department of Mineral Resources (DMR)	Regional Manager: Sivuyele Mpakane	021 427 1000	Private Bag X 9, Roggebaai, 8012
Provincial – Northern Cape			
Department: Roads and Public Works (Northern Cape)	Director: Roads	053 861 9600	P.O. Box 3132, Kimberley, 8301
SANRAL (Western Region)		021 957 4600	Private Bag X19, Bellville, 7535

Department of Agriculture, Land Reform and Rural Development – Northern Cape	Media Liaison Officer: Agriculture, Land Reform and Rural Development Mr Ali Diteme	Tel: 053 838 9159 Cell: 083 4529 851	Private Bag X5018, Kimberley, 8300
Department Of Water Affairs	Chief Director: Northern Cape Mr A Abrahams	Tel: 053 830 8803 Cell: 082 883 6741	Private Bag X6101, Kimberley, 8300
Department of Mineral Resources (DMR)	Regional Manager: Ntsundeni Ravhugoni (Acting)	053 807 1700	Private Bag X 6093, Kimberley , 8300
WESSA Northern Cape	Regional Chairperson: Suzanne Erasmus	053 839 2717	PO Box 316, Kimberley, 8300
ESKOM (Northern Cape Regional Office)	Andre Malgas	053 807 2660	Eskom Building, 3rd Floor, 66 Jones Street, Kimberly, 8300
PHRA Northern Cape	Andrew Timothy	079 036 9294	PO Box 4637, Cape town, 6000
Local			
Namakwa District Municipality	Municipal Manager: Ms. Madeleinne Brandt	027 712 8000	Private Bag X20, Van Riebeeckstreet Springbok, 8240
Kamiesburg Local Municipality	Municipal Manager: Municipal Manager	027 652 8011	Private Bag X200, Garies, 8220
Bird Life – Northern Cape	Gariep Bird Club: Chairman: Spangenberg	079 494 4525 153 833 1948	16 Milner Street, Kimberley, 8301
BirdLife South Africa Headquarters	Terrestrial bird conservation: Dr Hanneline Smit-Robinson	011 789 1122	P O Box 515, Randburg, 2125
Ward Councillor	Councillor 2: Patro Willems	082 266 5871	Private Bag X200, Garies, 8220
Namaqua National Park		027 672 1948	P O Box 117, Kamieskroon, 8241

Table 6.5: Other interested and affected parties which have registered

Organisation	Name	Contact number	Address	Email address
Individual	Lambertus Sebastian van zyl	0818193404	Po Box 334 Garies	
Namaqua National Park	Bernard van Lente	0276721948	Posbus 117, Kamieskroon	bernard.vanlente@sanparks.org
	Petrus Schreuder			petrus.schreuder@sanparks.org
University of Cape Town - Bolus Herbarium	Dr. Cornelia Klak	Tel: 021 6503724	7701 Rondebosch	Cornelia Klak cornelia.klak@uct.ac.za
Hoof Uitvoerende Beampte Weskus Ontwikkelings	D.J. du Plessis	(082-495 7378)	Kambrolandskap Posbus 11206 Universitas 9321	duplessisdavid@yahoo.com
Frontier Rare Earths SA (Pty) Ltd (Vice President Project Development)	Derick R de Wit	27 11 234 6216	Sound Mining House. 2A Fifth Avenue, Rivonia, 2128	Derick de Wit ddewit@frontierrareearths.co.za
Individual	Nellie Spangenberg			Spangenberg spang@intekom.co.za
Individual	Karen van der Sandt		27 De Villiers Drive Durbanville 7550	
WESSA	Suzanne			se@museumsnc.co.za

Organisation	Name	Contact number	Address	Email address
Chairman Northern Cape region.	Erasmus			
Chairman of the Succulent Society : Gauteng area	Judd Kirkel			juddkirkel@yahoo.com
Griqua Gnus (editor)	Beryl Wilson			berylwa@museumsnc.co.za
Exigo	Lelani Stolp	012 751 2160		lelani@exigo3.com
Tronox	Johan Bornman			Johan.Bornman@ZA.Tronox.Com

6.5.2 Draft Scoping Report Public Review

Scoping was initiated using the stakeholders listed in Tables 6.1-6.4 above as a starting point. Public participation during the Draft Scoping Report review period focused on providing information on the new project and gathering stakeholders' views on the proposed terms of reference for the EIA specialist studies, to identify additional or new I&APs, and to gather perceptions and comments on the proposed terms of reference for the specialist studies.

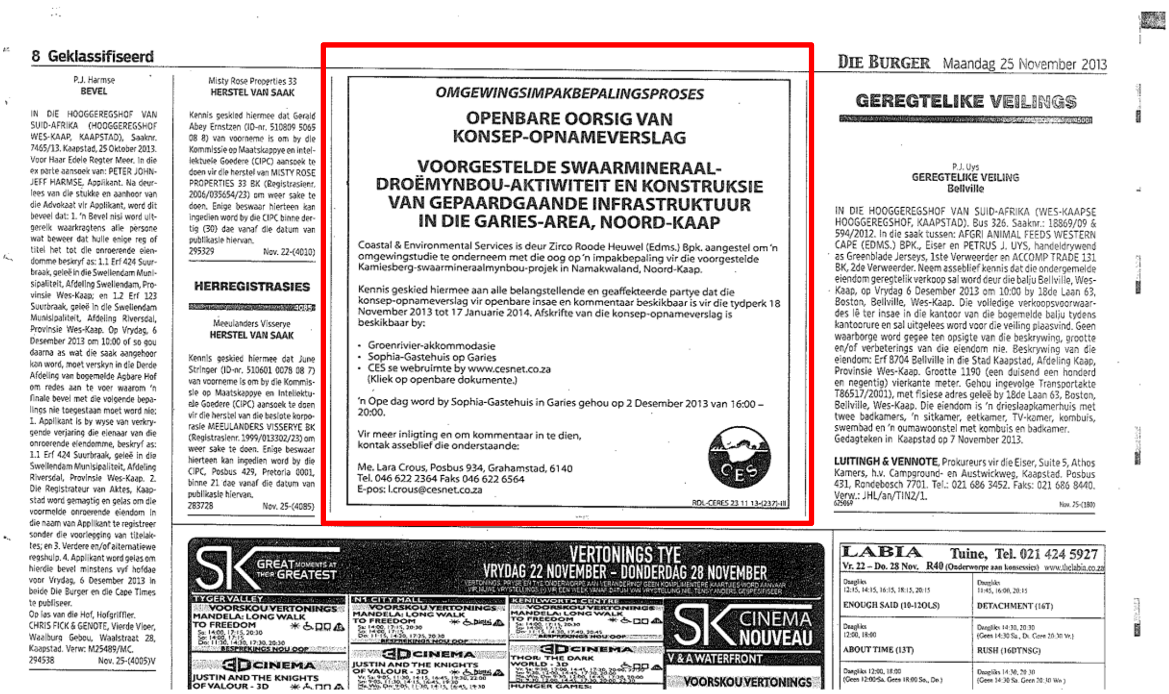
An advertisement was placed in Die Burger on Monday 25 November 2013 (Figure 6.3) announcing the availability of the draft scoping report for public review as well as details regarding the public meeting on 02 December 2013 in Garies.

Notification emails, letters as well as cellphone messages (sms) were sent to registered I&APs as well as key stakeholders on the 14th of November 2013 (Appendix F-3). These letters informed I&APs that the draft scoping report was available for review, that it could be found on the CES website, at Sophia's Guesthouse in Garies or at the Groenriviermond Accommodation in close proximity to the site and that two public meetings would be held on 2 December 2013 (at Sophia's Guesthouse in Garies) and on 3 December 2013 (at Groenriviermond Accommodation in close proximity to the site). The notification letters also stipulated that the review period for comment was from 14 November 2013 until 17 January 2014. Attendance registers for these meetings are available in Appendix 5 of this report. The comments received at these meetings have been included in a comments and response table (Table 6.6 and Table 6.7). No additional comments were received via emails, SMS's or as written correspondence.

Consultations were held with a diversity of I&APs at national, provincial, district and local level. All efforts were made to follow a broad and inclusive consultation process to ensure that any new I&APs are identified and included in the EIA process.

In addition, a grievance mechanism was developed and presented to the local communities during the scoping disclosure. The grievance mechanism will enable local communities to submit grievances about the mining and EIA process and receive responses in a formalised manner.

Comments received thus far have been incorporated into an issues and response trail tabulated below.



8 Geklassifiseerd

DIE BURGER Maandag 25 November 2013

P.J. Harmse
BEVEL

IN DIE HOOGGEREGSHOF VAN SUID-AFRIKA (HOOGGEREGSHOF WES-KAAP, KAAPSTAD), Saaknr. 7465/13. Kaapstad, 25 Oktober 2013. Voor Haar Edele Regter Meer. In die ex parte aansoek van: PETER JOHN-JEFF HARMSE, Applikant. Na deurlees van die stukke en aanhoor van die Advokaat vir Applikant, word dit beveel dat: 1. 'n Bevel nisi word uitgereik waarkragtens alle persone wat beweer dat hulle enige reg of titel het tot die onroerende eiendomme beskryf as: 1.1 Erf 424 Suurbraak, geleë in die Swellendam Munisipaliteit, Afdeling Swellendam, Provinsie Wes-Kaap; en 1.2 Erf 123 Suurbraak, geleë in die Swellendam Munisipaliteit, Afdeling Riversdal, Provinsie Wes-Kaap. Op Vrydag, 6 Desember 2013 om 10:00 of so gou daarna as wat die saak aangehoor kan word, moet verskyn in die Derde Afdeling van bogemelde Agbare Hof om redes aan te voer waarom 'n finale bevel met die volgende bepalings nie toegestaan moet word nie: 1. Applikant is by wyse van verkrygende verjaring die eienaar van die onroerende eiendomme, beskryf as: 1.1 Erf 424 Suurbraak, geleë in die Swellendam Munisipaliteit, Afdeling Riversdal, Provinsie Wes-Kaap. 2. Die Registrateur van Aktes, Kaapstad word gemagtig en gelas om die voormelde onroerende eiendom in die naam van Applikant te registreer sonder die voorlegging van titelaktes; en 3. Verdere en/of alternatiewe regshulp. 4. Applikant word gelas om hierdie bevel minstens vyf hofdae voor Vrydag, 6 Desember 2013 in beide Die Burger en die Cape Times te publiseer.
Op las van die Hof, Hofgriffier.
CHRIS FICK & GENOTE, Vierde Vloer, Waalburg Gebou, Waalstraat 28, Kaapstad. Verw: M25489/MC.
294538 Nov. 25-(4005)V

Misty Rose Properties 33
HERSTEL VAN SAAK

Kennis geskied hiermee dat Gerald Abey Ernstzen (ID-nr. 510809 5065 08 8) van voorneme is om by die Kommissie op Maatskappye en Intellektuele Goedere (CIPC) aansoek te doen vir die herstel van MISTY ROSE PROPERTIES 33 BK (Registrasienr. 2006/035654/23) om weer sake te doen. Enige beswaar hierteen kan ingedien word by die CIPC binne dertig (30) dae vanaf die datum van publikasie hiervan.
295329 Nov. 22-(4010)

HERREGISTRASIES

Meeulanders Visserye
HERSTEL VAN SAAK

Kennis geskied hiermee dat June Stringer (ID-nr. 510601 0078 08 7) van voorneme is om by die Kommissie op Maatskappye en Intellektuele Goedere (CIPC) aansoek te doen vir die herstel van die beslote korporasie MEEULANDERS VISSERYE BK (Registrasienr. 1999/013302/23) om weer sake te doen. Enige beswaar hierteen kan ingedien word by die CIPC, Posbus 429, Pretoria 0001, binne 21 dae vanaf die datum van publikasie hiervan.
283728 Nov. 25-(4085)

OMGEWINGSIMPAKBEPALINGSPROSES

OPENBARE OORSIG VAN KONSEP-OPNAMEVERSLAG

VOORGESTELDE SWAARMINERAAL-DROËMYNBOU-AKTIWITEIT EN KONSTRUKSIE VAN GEPAARDGAANDE INFRASTRUKTUUR IN DIE GARIES-AREA, NOORD-KAAP

Coastal & Environmental Services is deur Zirco Roode Heuwel (Edms.) Bpk. aangestel om 'n omgewingstudie te onderneem met die oog op 'n impakbepaling vir die voorgestelde Kamiesberg-swaarmineraalmynbou-projek in Namakwaland, Noord-Kaap.

Kennis geskied hiermee aan alle belangstellende en geaffekteerde partye dat die konsep-opnameverslag vir openbare insae en kommentaar beskikbaar is vir die tydperk 18 November 2013 tot 17 Januarie 2014. Afskrifte van die konsep-opnameverslag is beskikbaar by:

- Groenrivier-akkommodasie
- Sophia-Gastehuis op Garies
- CES se webruimte by www.cesnet.co.za
  (Kliek op openbare dokumente.)

'n Ope dag word by Sophia-Gastehuis in Garies gehou op 2 Desember 2013 van 16:00 – 20:00.

Vir meer inligting en om kommentaar in te dien, kontak asseblief die onderstaande:

Me. Lara Crous, Posbus 934, Grahamstad, 6140
Tel. 046 622 2364 Faks 046 622 6564
E-pos: l.crous@cesnet.co.za

CES

RDL-CERES 23 11 13-(237)-III

GEREGTELIKE VEILINGS

P.J. Uys
GEREGTELIKE VEILING
Bellville

IN DIE HOOGGEREGSHOF VAN SUID-AFRIKA (WES-KAAPSE HOOGGEREGSHOF, KAAPSTAD). Bus 326. Saaknr.: 18869/09 & 594/2012. In die saak tussen: AFGRI ANIMAL FEEDS WESTERN CAPE (EDMS.) BPK., Eiser en PETRUS J. UYS, handeldrywend as Greenblade Jerseys, 1ste Verweerder en ACCOMP TRADE 131 BK, 2de Verweerder. Neem asseblief kennis dat die ondergemelde eiendom geregtelik verkoop sal word deur die balju Bellville, Wes-Kaap, op Vrydag 6 Desember 2013 om 10:00 by 18de Laan 63, Boston, Bellville, Wes-Kaap. Die volledige verkoopsvoorwaardes lê ter insae in die kantoor van die bogemelde balju tydens kantoorure en sal uitgelees word voor die veiling plaasvind. Geen waarborge word gegee ten opsigte van die beskrywing, grootte en/of verbeterings van die eiendom nie. Beskrywing van die eiendom: Erf 8704 Bellville in die Stad Kaapstad, Afdeling Kaap, Provinsie Wes-Kaap. Grootte 1190 (een duisend een honderd en negentig) vierkante meter. Gehou ingevolge Transportakte T86517/2001), met fisiese adres geleë by 18de Laan 63, Boston, Bellville, Wes-Kaap. Die eiendom is 'n drieslaapkamerhuis met twee badkamers, 'n sitkamer, eetkamer, TV-kamer, kombuis, swembad en 'n oumawoonstel met kombuis en badkamer. Gedagteken in Kaapstad op 7 November 2013.

LUITINGH & VENNOTE, Prokureurs vir die Eiser, Suite 5, Athos Kamers, h.v. Campground- en Austwickweg, Kaapstad. Posbus 431, Rondebosch 7701. Tel.: 021 686 3452. Faks: 021 686 8440. Verw.: JHL/an/TIN2/1.
625069 Nov. 25-(180)

SK GREAT MOMENTS AT THEIR GREATEST

VERTONINGS TYE
VRYDAG 22 NOVEMBER – DONDERDAG 28 NOVEMBER

TYGER VALLEY
VOORSKOU VERTONINGS
MANDELA: LONG WALK TO FREEDOM
BESPREKINGS NOU OOP
3D CINEMA
JUSTIN AND THE KNIGHTS OF VALOUR - 3D

N1 CITY MALL
VOORSKOU VERTONINGS
MANDELA: LONG WALK TO FREEDOM
3D CINEMA
JUSTIN AND THE KNIGHTS OF VALOUR - 3D

KENILWORTH CENTRE
VOORSKOU VERTONINGS
MANDELA: LONG WALK TO FREEDOM
BESPREKINGS NOU OOP
3D CINEMA
THOR: THE DARK WORLD - 3D
HUNGER GAMES:

SK CINEMA NOUVEAU
V & A WATERFRONT
VOORSKOU VERTONINGS

LABIA Tuine, Tel. 021 424 5927
Vr. 22 – Do. 28 Nov. R40 (Onderworpe aan konsessies) www.thelabia.co.za

Daagliks 12:15, 14:15, 16:15, 18:15, 20:15 ENOUGH SAID (10-12OLS)	Daagliks 11:45, 16:00, 20:15 DETACHMENT (16T)
Daagliks 12:00, 18:00 ABOUT TIME (13T)	Daagliks 14:30, 20:30 RUSH (16DTNSG)

Figure 6.3: Copy of advertisement placed in Die Burger

Table 6.6: Comments and response trail (Public Meeting in Garies)

Comment	Response
Where will the desalination plant go?	The desalination plant will be located at the mine site.
What is the cost of the desalination plant?	The detailed design for the desalination plant has not yet been undertaken and thus costing is not yet available. However, it is important to note that the costing of the desalination plant does not fall within the ambit of the EIA process.
Have farmers asked for freshwater?	Not at this stage.
What is the feedback from the parks?	The proposed boundary for the Namaqualand Marine Protected Area extends south to 30°55'00.000 S and 17°36'27.106 E. This has been extensively work-shopped and planned with DMR and other stakeholders. The land portion of the park will thus also expand down to this point (the Admiralty land- state land). SANPARKS is therefore concerned that the seawater intake will be situated within this area. There is also a possibility that the park will be extended south to include the whole Admiralty Zone/ State land up to Strandfontein.
How far is Knhyp Punt from Groenriviermond?	Approximately 20 km
Is Zirco Resources an Australian company?	The applicant is Zirco Roode Heuwel Pty Ltd a RSA company
How long has Zirco been busy with this process?	Exploration began in 2011
How deep will you mine?	15-20 meters
Is there sufficient quantity and quality of material	Yes, no fatal flaws have been identified
What is the lifetime of the mine expected to be?	20 years
How many work opportunities will there be?	Approximately 300 during the operational phase of the project.
Where will the workers come from?	As far as reasonably possible, Zirco will employ the local population from a number of labour-sending communities, including Garies, Kamieskroon, Karkams, Spoegrivier, Lepelsfontein, Kheis and Tweerivier.
What roads will be used?	The existing access road currently utilised by the farmers in the area and the National Road 7 (N7).
This is important to the area in terms of work opportunities	Noted and agreed.
What is the response from farmers to mine their farms?	To date we have had limited responses from the farmers in the region, however a focus group meeting is scheduled for the 3rd of December 2013. All comments from this meeting will be incorporated into the comments and response trail which will be made available in the Final Scoping Report.
The construction camp to upgrade the road (current) is located in Garies and there is prostitution there. What will you do to prevent a similar situation?	A Social Impact Assessment will be undertaken for the proposed development that will assess the impacts of increased social pathologies such as prostitution within the area as a result of the project and provide mitigation measures in accordance with these.
How many farms / farmers are involved?	15 Farm Portions and 9 landowners
What is the plan with the farms after 20 years of	The mining area will be rehabilitated and returned to its current land use

Comment	Response
mining?	
How far is Garies to the mine?	±60km
Will there be onsite accommodation?	It is anticipated that labour will be sourced from the labour sending communities and thus no on-site accommodation will be required.
Are you definitively going to use seawater?	Yes, seawater will be used for processing in the PCP as there is not sufficient groundwater available for this purpose. However, for freshwater requirements (washing of HMC and potable water) both the use of groundwater and the use of seawater will be assessed in the EIR.
How many skilled vs unskilled positions will there be?	The following is anticipated: Professionally qualified and experienced specialists and mid management (11) Skilled technical and academically qualified workers, junior management, supervisors, foremen and superintendents (86) Semi-skilled and discretionary decision making (176) Unskilled and defined decision making (42)
It is important to get a bank here as there is only one ATM but it doesn't get 'replenished'	Noted
How many houses will be built for workers of the mine?	Zirco will help employees get financing to buy/build houses in labour sending areas, not on the mine. Zirco will not provide housing.
Water is very important in Garies. There will be an increased strain on water resources should mine workers be housed in Garies.	CES is currently in the process of compiling a social and labour plan for the proposed development. The KLM has identified the need for assistance to provide rainwater tanks to households (especially in wards 1 and 2). Zirco therefore proposes to invest in a project which would entail the erection and installation of rainwater tanks in consultation with KLM. In addition to this Zirco will invest funds to assist the municipality with the erection of a desalination plant to provide Garies with potable water.
If it rains the electricity goes out. It has been on the books to upgrade the electricity line from Springbok to Garies for years now.	Noted
The sewerage treatment works does not have sufficient capacity. The sewerage runs in the river.	Noted

Table 6.7: Comments and response trail (Focus Group Meeting at Groenriviermond Accommodation)

Comment	Response
Will the MSP occur here at the mine site?	Yes
What type of road will be used? Tar road?	Two options are currently being assessed. The first is to tar the existing access road and the second is to keep it as a well maintained gravel road. These options will be fully assessed in the EIR.
If gravel is used for the road what about dust?	Various mitigation measures for the control of dust will be suggested in the EIR, one of which will be to water down areas during periods of increased dust levels.
Where will the desalination plant go?	The desalination plant will be located at the mine site.
Do you have to be BBEEE compliant?	Yes
Will you have to hire previously disadvantaged people from outside Garies area?	The project is obligated to hire previously disadvantaged people in accordance with the Mineral and Petroleum Resources Development Act (2002) and the Broad-Based Socio-Economic Empowerment Charter of the South African Mining and Minerals Industry (2010). Although people from outside the area will be recruited to perform higher skilled positions, the proponent is committed to ensure that most of the labour is sourced from Garies and its surrounding areas.
How will people in the surrounding area benefit?	Apart from employment, community members will benefit from skills development opportunities, higher educational training opportunities (both to the workers and community members), community learnerships and bursaries. In addition, the client will also be investing in several Local Economic Development Programmes in Garies.
How long until the mine is in operation?	It is anticipated that production will commence in 2017
I have heard that houses will be built in Garies, is that for this project?	The client is obligated to budget for its workforce's housing and living conditions in accordance with the Mineral and Petroleum Resources Development Act (2002) and the Broad-Based Socio-Economic Empowerment Charter for the South African Mining and Minerals Industry (2010). Several housing options for employees only are currently being considered in consultation with the local municipality.
Will the workers be bussed to work every day or will they use their own transport?	There will be a bus service from the mine to Garies. Should large amount of workers be sourced from other labour sending communities the bus route could potentially be extended.
Are you using an Eskom line for electricity and are you paying for it?	Yes, Zirco pays for the construction of the line. If some-one else wants to 'tap' into the line they have to pay a proportional fee.
Will white people also be employed?	Yes
I understand the importance of protecting the environment but I feel that giving people work who need it is more important.	Noted.

Table 6.8: Comments received after disclosure period closed

I&AP	Comment	Response
Bettie van Zyl	Ms Bettie van Zyl requested that hard copies of the Vegetation and Faunal Reports are send to her.	Copies of these reports were couriered to Ms Bettie van Zyl on the 21st of October.
Lelani Stolp	Requested to be registered as an I&AP for the proposed project.	Lelani Stolp was added to the I&AP Database. Please refer to Table 6.5 above.
Johan Bornman	Mr Johan Bornman requested the following information: I will appreciate it if Tronox Namakwa Sands (J Bornman) can be registered as an Interested and Affected Party and provided with the following information if available: • Current status of the Mining Right application and other environmental authorisation processes; • Draft/Final Scoping Report; • EMP as required by the MPRDA; • EIA as required by NEMA; • All specialist studies conducted as part of the EMP/EIA process.	Please note that you have been registered on the project as an interested and affected party. In regards to your queries below: • Both the processes for the mining right and the approval in terms of NEMA are still in progress. In terms of the mining rights application, the Scoping Report has been submitted to the DMR and the EMPr is due for submission on or before the 3rd of December. In terms of the application for environmental authorisation in terms of NEMA, the Final Scoping Report has been accepted by the authorities and we are currently in the process of finalising the Draft Specialist Volume and EIR for disclosure. At this stage it is anticipated that disclosure will start on the 20th of October and the public meetings will be the week of the 27th. However, these dates can only be finalised once the reports are completed and are thus subject to change. • Please find the final Scoping Report attached. • The EMPr, EIA and Specialist Studies are still in the process of being completed. I will upload them to our website and send you a link as soon as they are available. Please let me know if I can be of any further assistance.
Willem Louw (SANPARKS) Letter included in Appendix G	The Namaqua National Park (NNP) was declared in 2001 (Government Notice 578 in Government Gazette 22414 dated 29 June 2001). The NNP is situated in the Namaqualand region of the Northern Cape Province of South Africa, and stretches from the Groen and Spoeg Rivers on the Atlantic Ocean to just west of the town Kamieskroon, which is 495 km north of Cape Town. The park is still in the process of development, with the coastal contractual area between the Groen and Spoeg rivers incorporated recently to expand the park to include more succulent habitats and a coastal section. WWF-SA, the National Parks Trust and De Beers Consolidated Mines are	Noted, thank you for providing this information

I&AP	Comment	Response
	contractual partners in the park. In total, contractual land contributes 83,799.6 ha to the park. Although not yet declared, the park also manages the Admiralty Zone between the Groen and Spoeg Rivers. The current area of the park totals 145,892.35 ha of which 110,964.2390 ha has been declared, with the rest in the process to be declared.	
Willem Louw (SANPARKS)	Please note the following: a) SANParks' legal mandate is to protect, control and manage National Parks and other defined protected areas and their biological diversity, (NEM:PAA 57 of 2003); b) SANParks manages Namaqua National Park in accordance of a management plan, approved by the National Minister of Environment and Water Affairs on 05-09-2013 in terms of sections 39 and 41 of NEM:PAA (Act 57 of 2003, including buffer zone of NNP). c) The proposed mining development falls within NNP core expansion and buffer Zone areas; Biodiversity Policy and Strategy for South Africa: A Strategy on Buffer Zones for National Parks, (Government Gazette, 08 Feb 2012, No. 35020, (Notice no. 106 of 2012) : As mentioned earlier in this letter, the proposed mining area falls within the expansion footprint and buffer zone of the Namaqua National Park. The purpose of a National Park buffer Zone is to: i) Protect the purpose and values of a national park, which is explicitly defined in the management plan, submitted in terms of sec 39(2) of the NEM:PAA; ii) The proposed mining development triggers the following provisions of the Buffer Zone Guidelines for National Parks: Goal 3, which reads as follow: "Discourage development in areas in which biodiversity and ecological function would be adversely affected". Mining is listed as an activity, which has to be discouraged. However, it is not prohibited to mine in the buffer areas, but any development / mining activities	CES met with SANParks in the initial round of public participation in July 2013. SANParks was asked to provide information on the Park's expansion strategy and to indicate if the proposed mining area falls within such. SANParks indicated that they intended to expand in a southerly direction and did not raise any concerns at that time regarding this application. SANBI's BGIS site was also perused to determine the location of the site in relation to protected areas and expansion areas. Information on this portal indicates that the proposed site is not within any of these areas. During the Scoping Phase, it was brought to our attention by the specialist botanist that the site falls within the park's buffer area. CES contacted Bernard van Lente of SANParks to confirm this information and received maps on the 2nd of April 2013. It should be noted that this information was provided the same day the Final Scoping Report had been approved by DENC (i.e. the report was approved on 3rd of April 2014 and information was received on the 3rd of April – please refer to e-mail included below). **From:** Bradshaw, Peter (Dr) (Summerstrand Campus South) [mailto:Peter.Bradshaw@nmmu.ac.za] **Sent:** 03 April 2014 08:39 AM **To:** Lara Crous **Cc:** Bernard van Lente **Subject:** RE: Namakwa expansion kmz Hi Lara Please find attached a map indicating the potential mining areas, as well as the SANPArks managed land, parks buffer zones and expansion

I&AP	Comment	Response
	in the buffer zone of a national park needs to be controlled by all three spheres of government. It seems that this development occurs within a natural priority and catchment protected area of the buffer zone of NNP. "All developments in the buffer zone of a national park requiring an environmental authorisation ito NEMA, will be subject to an environmental impact assessment process on a national level", according to the Buffer Zone Policy. SANParks would like to suggest that the EAP informs DEA: Sensitive Environment section, about the proposed mining application in the buffer zone of NNP, in order for DEA to decide on the extent of their involvement in this matter. Please note that national park buffer zones, defined in the park management plans, will be considered special areas in terms of section 24(2)(b) of the National Environmental Management Act, 1998, (Act No.107 if 1998). Mining and Biodiversity Guideline, 2013 The Mining and Biodiversity guidelines rate the proposed mining area as Category B, – highest risk for mining; extreme caution should therefore be exercised in all proposed mining activities - due to the very sensitive nature of the area, which: Falls in a critical biodiversity areas(CBA); Is adjacent to a national park, (in buffer zone of NNP); The presence of very sensitive aquifers in the proposed mining area The guidelines further states that environmental authorisation may or may not be granted and that biodiversity offsets should be considered; however, strict limitation should be set and must be written into authorisations. SANParks fully supports the provisions and guidelines of the 2013 Mining and Biodiversity guidelines. SANParks would like to urge the EAP and Competent Authority to take cognisance of this categorisation and the	footprint (which indicates areas where the park might potentially expand, if an opportunity presented itself). I will clip this expansion footprint to your area of interest, and send you the KMZ. Kind regards Peter Further to the above, it is our interpretation that while the site falls within the buffer zone which is a declared area in terms of Section 24(2)b, the area is not protected by an international environmental instrument as confirmed in Section 2.8 of the Namaqua National Park Management Plan (International Listings – None), and as such, this section is not applicable to this application. Notwithstanding SANParks' plans to expand the NNP there is nothing in the Listing Notices to the NEMA EIA Regulations (2010, as corrected) as they currently stand to suggest that the proposed mining project falls within the competence of the Department of Environmental Affairs, and the application has therefore been directed to and accepted by the Nothern Cape Department of Environment and Nature Conservation, Nevertheless, we will as you suggest include DEA, particularly the Sensitive Environment section, as an interested and affected party on the distribution list to offer comments on the Draft EIA Report., We take note of the relevance of the Mining and Biodiversity Guidelines, and impacts associated with such have been addressed in the Draft EIA.

I&AP	Comment	Response
	biodiversity significance of the mining site - if authorisation is granted, to set limits on the allowed activities and impacts.	
Willem Louw (SANPARKS)	Furthermore, SANParks fully supports that the standard focus on the ecological aspects, values, principles and socio-economic and cultural values be adhered too; that the ecological mitigation hierarchy: avoidance, minimisation, rehabilitation and ecological offsets be followed. Biodiversity offsets are measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and or rehabilitated or restored, in order not to achieve no net loss or a net gain of biodiversity. We strongly recommend that this process be followed during the EIA phase. The Mining and Biodiversity Guidelines, Western Cape Offset Guidelines and SANBI Offset Guidelines provided clear guidance on this process. If it became clear that biodiversity offsets should be considered, then SANParks would like to be consulted in the appointment of an experience Biodiversity Offset Facilitator. Biodiversity and Ecology.	Noted, SANParks will be consulted in this regard.
Willem Louw (SANPARKS)	The area contains very special rare and endangered vegetation types – the site is also listed by SKEP and Namaqualand District Municipality' SDF as priority and Critical Biodiversity Area or (CBA).	This has been taken into account in the vegetation assessment, please refer to Figures 5.2 and 5.5.
Willem Louw (SANPARKS)	The Site is therefore of very high biodiversity value, and includes very important aquifers. SANParks is therefore rightly very concerned about possible groundwater contamination. The impact of dust, noise generation, spread of alien species, loss of threatened species and habitats, possible decrease in natural beauty and aesthetics of the area should also be investigated.	This has been taken into account in the surface and groundwater assessment. Please refer to impacts 1, 3 and 4. These issues are addressed in the air quality assessment, noise assessment, vegetation assessment and visual assessment respectively.
Willem Louw (SANPARKS)	SANParks request the following specialist studies to be undertaken:	No ecological baseline studies were undertaken specifically for the Groen and Spoeg Rivers. However, the Groen and Bitter rivers were included in

I&AP	Comment	Response
	1. Ecological baseline studies in the Groen- and Spoeg Rivers; 2. A full scale vegetation survey considering plant species of special concern. 3. SANParks encourage the applicant to do a full scale hydrological impact assessment including assessment of possible impacts of polluted water on the Namaqua National Park, local communities, farmers and tourism. 4. An socio-economic cost benefit assessment; 5. The impact of the desalination plant and its possible impact on natural surrounding areas.	the Surface and Groundwater report and impacts on surface water features related to these rivers (e.g. the estuaries) where assessed. The Spoeg River has not been incorporated as it occurs approximately 27 km north of the project site and will not be impacted on in any way by the proposed development. A full scale vegetation assessment has been completed for the project. This included both dry and wet season survey. Furthermore, an additional survey was undertaken outside of the project affected area, to locate all identified SCC in the NNP as well as on privately owned land outside the project boundary. The following reports have been prepared by Schlumberger Water Services (SWS): A hydrogeological scoping assessment of the Kamiesberg project area (SWS 2012), the results of which were used to establish a hydrogeological baseline for the site prior to the commencement of mining activities, and to make recommendations for project implementation to ensure water resource protection. A full hydrological and hydrogeological prefeasibility study (PFS) for the Kamiesberg project area (SWS 2013), which provides a pre-feasibility assessment of the surface water, groundwater and hydro-geochemistry issues related to mining, and provides an assessment of the potential impacts to these systems, based on the current preliminary mine plan for the Kamiesberg project. The PFS comprised the following studies: • A hydrological study to determine the flood risks to infrastructure intended to be built close to the ephemeral rivers in the mining area. • A hydrogeological study, including drilling new boreholes, to better characterise the site lithology, aquifer units and groundwater regime. • Numerical modelling of the site to assess the potential risks associated with the use of seawater in mineral processing, especially storing tailings and backfilling with material saturated with seawater, and the associated impacts on water resources in the area. • A hydro-geochemical study to characterise the physico-chemical quality of the water resources on site, including the presence of radioactive isotopes, and to assess the potential for the use of seawater to leach elements from the mineral sands. Additional hydrogeological studies, including further numerical modelling, for the project area (SWS 2014), to further refine the hydrogeological

I&AP	Comment	Response
		assessment of the site and to identify potential risks and impacts related to specific facilities and operations on the site, and to support future water resource, environmental and mine planning decisions. The findings of these reports were synthesized into the Surface and Groundwater report. A socio-economic assessment has been completed for the project as well as a social and labour plan. Impacts related to the desalination plant have been incorporated into the waste assessment as well as in the surface and groundwater report.
Willem Louw (SANPARKS)	As the responsible person dealing with development applications in buffer zones of national parks, I would like to request to be registered as I&AP on behalf of SANParks. Due to the fact that SANParks Planning & Development Division became so late aware of this mining right application, I would kindly request additional time in order to enable SANParks Scientific team to thoroughly comment on this application and in particular on the specialists reports.	Please note that you have been included on the I&AP database. Please note that SANParks where contacted on the 23rd of July 2013, in regards to this application and site notices were erected on this date at the Park offices (please refer to Plate 6.2D for photographic evidence). In addition to this, correspondence with Mr Bernard van Lente has been ongoing since the submission of the application form in the final quarter of 2013. The reports will be made available to all I&APs on the 21st of October and the review period will conclude on the 1st of December. Please be so kind as to let me know if you would require an extension to these timeframes.
Willem Louw (SANPARKS)	I would like to request that all correspondence and reports regarding this mining application, including EIA specialist reports, which requires official SANParks commenting, should (in addition to the Park Manager, Mr Bernard van Lente), be addressed to: Willem Louw PO Box 440 SANLAMHOF 7532 SANParks reserves the right to revise initial comments based on additional information that may be received, additionally, to oppose the mining right application if these comments are ignored.	Noted

6.5.3 Draft EIA Report Public Review

The EIR Phase was initiated using the stakeholders listed in Tables 6.1-6.4 above as a starting point. Public participation during the Draft EIR review period focused on providing information on the project and gathering stakeholders' views on the Draft EIR, Draft EMP and Specialist Assessments, to identify additional or new I&APs, and to gather perceptions and comments on the reports.

An advertisement was placed in Die Burger on Saterday 1 November 2014 (Figure 6.4) announcing the availability of the draft EIR for public review as well as details regarding the public meetings on the 19th and 20th of November 2014.

Notification emails, letters as well as cellphone messages (sms) were sent to registered I&APs as well as key stakeholders on the 30th of October 2014 (Appendix F-5). These letters informed I&APs that the draft EIR was available for review, that it could be found on the CES website, at Sophia's Guesthouse in Garies or at the Groenriviermond Accommodation in close proximity to the site; and that two public meetings would be held on 19 November 2014 (at Sophia's Guesthouse in Garies) and on 20 November 2014 (at Groenriviermond Accommodation in close proximity to the site). The notification letters also stipulated that the review period for comment was from 31 October until 9 December 2014. Attendance registers for these meetings are available in Appendix F-6 of this report. The comments received at these meetings have been included in a comments and response table (Table 6.9). No additional comments were received via emails, SMS's or as written correspondence.

Consultations were held with a diversity of I&APs at national, provincial, district and local level. All efforts were made to follow a broad and inclusive consultation process to ensure that any new I&APs are identified and included in the EIA process.

Kennisgewing

MUNISIPALITEIT VAN PRINCE ALBERT

MUNICIPALITY OF PRINCE ALBERT

Geklassifiseerd

RED 'N LEWE! Dankie dat jy my lewe gered het!

Westelike Provinsie Bloedoortappingsdiens

W.P.B.T.S. 021 507 6300

Figure 6.4: Copy of advertisement placed in Die Burger

Table 6.9: Comment and reponse trail during the Draft EIR Phase

I&AP	ISSUE/CONCERN	RESPONSE
SANParks	NEMA Section 2 (4) (a) requires inter alia that “Sustainable development requires the consideration of all relevant factors including the following: • That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; • That the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimized and remedied; • That the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; • That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and • That negative impacts on the environment and on people's environmental rights are anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied. These provisions place an onus on development applicants and the responsible Environmental Assessment Practitioner to ensure that all impacts, including cumulative impacts, in an area	Noted. The EIA process is an important mechanism that is used to assist the development process to achieve these sustainability goals. The impact chapters have carefully assessed impacts, considered all aspects of the impacts, and where applicable or available considered thresholds.

I&AP	ISSUE/CONCERN	RESPONSE
	do not exceed established thresholds, and that residual impacts are remedied. Additionally, EIA regulations also place an obligation on the EAP and or person compiling specialist report to ensure that all aspects of impacts be taken into account, (see Section 17 of the EIA Regulation No. R .543, Government Gazette No.33306, dated 18 June 2010, for requirements and criteria for EAP's / specialists undertaking a specialised EIA process).	
SANParks	The Namaqua National Park (NNP) was declared in 2001 (Government Notice 578 in Government Gazette 22414 dated 29 June 2001). The NNP is situated in the Namaqualand region of the Northern Cape Province of South Africa, and stretches from the Groen and Spoeg Rivers on the Atlantic Ocean to just west of the town Kamieskroon, which is 495 km north of Cape Town. The park is still in the process of development, with the coastal contractual area between the Groen and Spoeg rivers, incorporated recently to expand the park to include more succulent habitats and a coastal section. The current area of the park totals 145,892.35 ha of which 110,964.2390 ha has been declared, with the rest in the process to be declared. Please note the following: • SANParks' legal mandate is to protect, control and manage National Parks and other defined protected areas and their biological diversity, (NEM:PAA 57 of 2003);	• EOH CES acknowledge the mandate of SANParks, and the important role played by SANParks in conserving the biodiversity of South Africa. • The NNP management plan has been carefully considered and discussed in the EIA report. • We recognise and acknowledge the importance of protected areas and the role they play in protecting biophysical and cultural heritage, safeguarding ecosystem services through protection of key ecological processes, and contributing to regional stability and resilience. It is for this reason that buffer areas between the mine and NNP were recommended.

I&AP	ISSUE/CONCERN	RESPONSE
	• SANParks manages Namaqua National Park in accordance of a management plan, approved by the National Minister of Environment and Water Affairs on 05-09-2013 in terms of sections 39 and 41 of NEM:PAA (Act 57 of 2003, including buffer zone of NNP). • Furthermore – please note that protected areas are becoming our last remaining biophysical support systems, protecting key ecological infrastructure that serve as environmental ‘lungs’ and ‘kidneys’ and provide functions core to the future of life on the planet. Protected areas are increasingly expected to fulfil multiple objectives, e.g. protecting our biophysical and cultural heritage, safeguarding ecosystem services through protection of key ecological infrastructure, buffering societies against the impacts of climate change, and contributing to regional stability and resilience. However, the protected area estate can only live up to these expected ideals if such areas are indeed protected.	
SANParks	SANParks strongly opposes the mine in its proposed form and considers the project to be fatally flawed for the reasons listed below.	Noted. More detailed responses are provided below.
SANParks	Project alternatives – no fundamental project alternatives were considered which constitutes a fatal flaw for this project. It is standard practice to consider	The no-go alternative was incorporated into the Draft EIR as well as this Final EIR. It is discussed in Section 7.3 of the Alternatives Chapter (Chapter 7) in the EIR. In addition to this, the impacts related to the no-go alternative were discussed and assessed for each set of identified impacts (i.e. biophysical, social and waste and infrastructure). The impacts are

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<tr><td></td><td>the following project alternatives, (close proximity of Namaqua National Park, the fact that the minerals to be exploited are not classified as strategic minerals and the sensitivity of the area, make this requirement even more urgent):
• Land use alternatives;
• The No-Go option</td><td>referred to as existing impacts in the text and are available in the following sections of the report:
• Biophysical Impacts Section 9.1.2
• Social Impacts Section 9.2.2
• Waste and Infrastructure related impacts Section 9.4.1
In terms of land use alternatives there are potentially two alternatives, (1) Agriculture (which is the current zoning of properties within the region), and (2) Conservation purposes.
<u>Agriculture</u>
Based on the ecological assessment undertaken for the proposed project the region has a low carrying capacity. In Namaqualand the carrying capacity is generally given as 1 small stock unit per 10 to 12 hectares. The official carrying capacity for farms in the Leliefontein area was set at 12 ha per small stock unit, although this changed to 10 ha per small stock unit (SSU) by November of the same year (2002). Current recommended stocking levels in Namaqualand are based on a survey undertaken in the late 1980s by the Department of Agriculture (DoA) to identify carrying capacities for various veld types in the area. It resulted in a map of Namaqualand being developed, which is divided into different units with corresponding carrying capacities. The map produced from this survey is today used by the DoA as a general guide to what the Namaqualand veld can tolerate in terms of grazing pressure. The study area falls into the range of 0 – 48 ha per Large Stock Unit, or 0 – 16 ha per SSU (Lebert 2004). Certain farms, especially those with Sand Fynbos, also have fallow cereal fields. It seems that very few farmers still plant cereals, in spite of currently higher than average grain prices, and this is due to consistently lower rainfall than decades ago, when most of these fields were developed; however, the old lands are still clearly visible, as heavy livestock grazing has resulted in limited natural rehabilitation in these areas. The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing is unlikely to have resulted in total loss of any plant SCC in the area. However, land use has undoubtedly impacted on the isolated populations of SCC, and reduced the total population numbers of about 5-10 SCC. Overall no species or habitats are likely to have been lost, although degradation in certain areas (around stock kraals) has been intense. As a result current land use practices are having a moderate negative impact on biodiversity in general as well as on SCC. Based on the above information it is safe to assume that degradation of the SCC and vegetation communities will continue in the long term and thus agriculture as an alternative land use is not preferred.
<u>Conservation Purposes</u>
It is uncertain when/if this area will be incorporated into the NNP as per their expansion strategy. Without active management of the area (which is unlikely to occur due to the difficulties of managing land owned by private land owners), the current land use (i.e.</td></tr>
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I&AP	ISSUE/CONCERN	RESPONSE
		agriculture) will continue and thus the degradation described above will continue over the long term, which will result in an increase in loss of SCC. No timeframes are available for the NNP expansion strategy and thus it is difficult to ascertain the conservation value of the area in question. It can however be said that if the current land use in the area persist for an extended period of time the conservation value of the properties will be reduced in the long term. Mining As stated in the EIR, the proponent will be responsible for the rehabilitation of the area post-mining to its natural state. The EIR also recommends that the area referred to as Rhoode Heuvel is donated to the park for incorporation as per their expansion strategy once fully rehabilitated. Thus the option of mining could assist in the NNP meeting it expansion targets post-closure. Mining will also exclude stock grazing from the areas identified as having sensitive vegetation within the proposed corridors (on land owned by the mine) which will allow the vegetation in this area to recover from degradation. Stock farming will also be precluded from rehabilitated areas. In addition to this, the social and economic benefits provided by the project, such as employment, skills development and local economic development will not accrue from the alternative land uses discussed above. The Section included above on land use alternatives was not included in the EIR as it is an expansion on the no-go alternative.
SANParks	The proposed mining development falls within NNP core expansion and buffer zone areas, and also within the default 10km buffer area as provided for in Listing Notice 3 of the 2010 NEMA EIA Regulations.	Noted. We are aware of the fact that the mining area falls within the NNP core expansion and buffer zone areas. A section on the Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks has been added as Section 3.1.11 in the EIR. In addition to this a section on the Namaqua National Park Management Plan and its Buffer zones has been added as Section 4.3.3 in the EIR. In terms of the 10km buffer area as provided for in Listing Notice 3 of the 2010 NEMA EIA Regulations, please refer to the listed activities included in Table 1.1 of this EIR. A number of listed activities were included under GNR 546 (Listing Notice 3), including activities 4, 8, 12, 13, 14 and 16.
SANParks	The Biodiversity Policy and Strategy for South Africa: A Strategy on Buffer Zones for National Parks, (Government Gazette, 08 Feb 2012, No. 35020, (Notice no. 106 of 2012), provides that mining applications in buffer areas of national parks should be discourage because of its adverse effect on biodiversity and ecological functioning of these areas.	Noted. Also please note that this policy states that these developments will be strictly controlled and does not state that they may not take place in these areas. The current land boundary of the NNP is in excess of 100 km in extent and covers an area of 140 300 ha. Exclusion of all development from a 10km buffer over this length would sterilize some 337 016 ha of Namakwaland from many forms of land use and development, except for agriculture, which is a dwindling enterprise in the area, and the possibility of tourism development within the park. It is, with respect, an unrealistic and unreasonable expectation of SANParks that can restrict or prevent most forms of development in 10km wide areas adjacent to National Parks. This would conflict significantly with many other pieces of legislation, and numerous other

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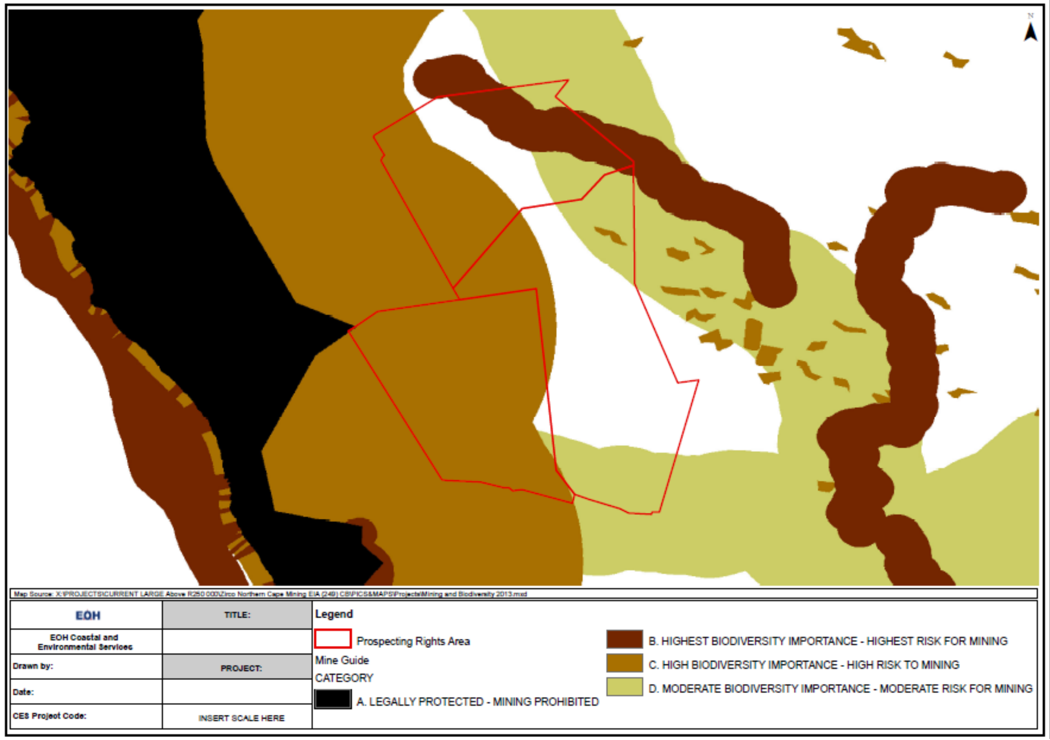
<tr><td></td><td></td><td>Government Policies, and is highly unlikely to be enforceable. Like most of the deposits in the area, the Kamiesberg deposit has been undergoing exploration and development since 2007 (and many much earlier than this), but the nearby coastal portion of the NNP was only established in 2008.</td></tr>
<tr><td>SANParks</td><td>Additionally, the Mining and Biodiversity Guideline, 2013 guidelines rate the proposed mining area as Category B – highest risk for mining and biodiversity importance, due to the very sensitive nature of the area proposed as mining site, which:
• Falls within a critical biodiversity area (CBA). The area contains very special rare and endangered vegetation types. The site is listed by SKEP and Namaqualand District Municipality' SDF as a priority and Critical Biodiversity Area;
• Includes the presence of very sensitive aquifers in the proposed mining area – which mining activities could severely impact on the purpose and values of NNP.</td><td>As discussed in the meeting held at the SANParks offices in Port Elizabeth, the proposed project falls into a Category B in terms of calculating the financial quantum of the project as provided for by the DMR. This is very different from the Categories proposed in the Mining and Biodiversity Guidelines of 2013. In terms of the latter, the majority of the project area falls within a Category C: High biodiversity importance, high risk for mining (please refer to Map 1 provided below). Please note that enlarged, readable maps are available in Appendix I of this document.


Map 1: Categories proposed in the Mining and Biodiversity Guidelines of 2013</td></tr>
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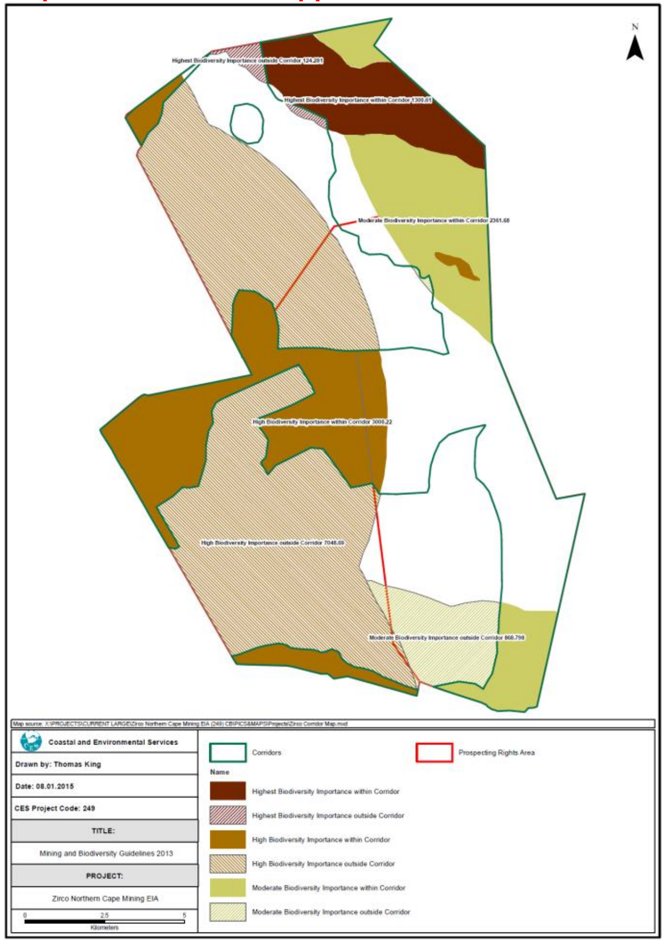
Only a small portion of the Leeuvlei property is considered to be Category B, however it should be noted that 91% of this area has been incorporated into the proposed ecological corridors. (For calculations of areas covered both in and outside the proposed corridors for each individual category, please refer to Map 2 below). **Please note that enlarged, readable maps are available in Appendix I of this document.**



Map 2: Areas covered by each of the Categories proposed in the Mining and Biodiversity Guidelines of 2013
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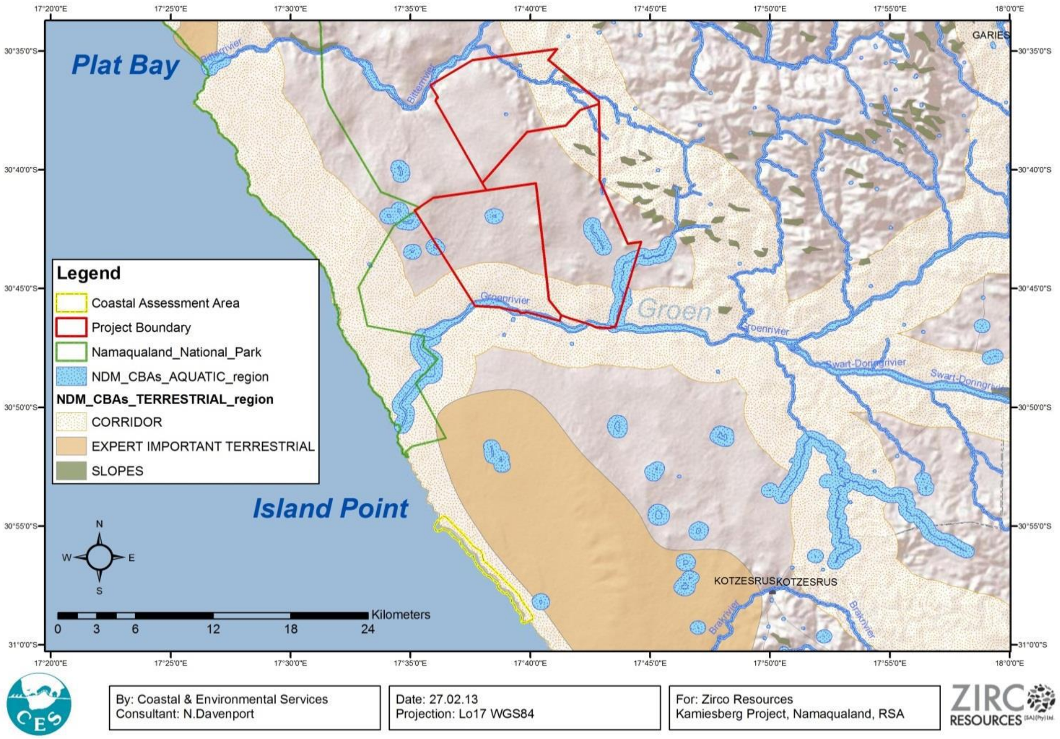
It should be noted that the Mining and Biodiversity Guideline does not state that mining may not proceed within this area but that mining may be strictly controlled. It also states that authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.
In terms of the status of the site as a CBA, please note the following:
The site does not fall within a CBA according to the Namaqua District Municipality SDF (please refer to Map 3 included below. Please note that enlarged, readable maps are available in Appendix I of this document). It does fall within a corridor establish around the Groen River, however it should be noted that a portion of this area has been included in the ecological corridors proposed by the EIR and thus will not be developed.



Map 3: CBAs according to the Namaqua District Municipality SDF
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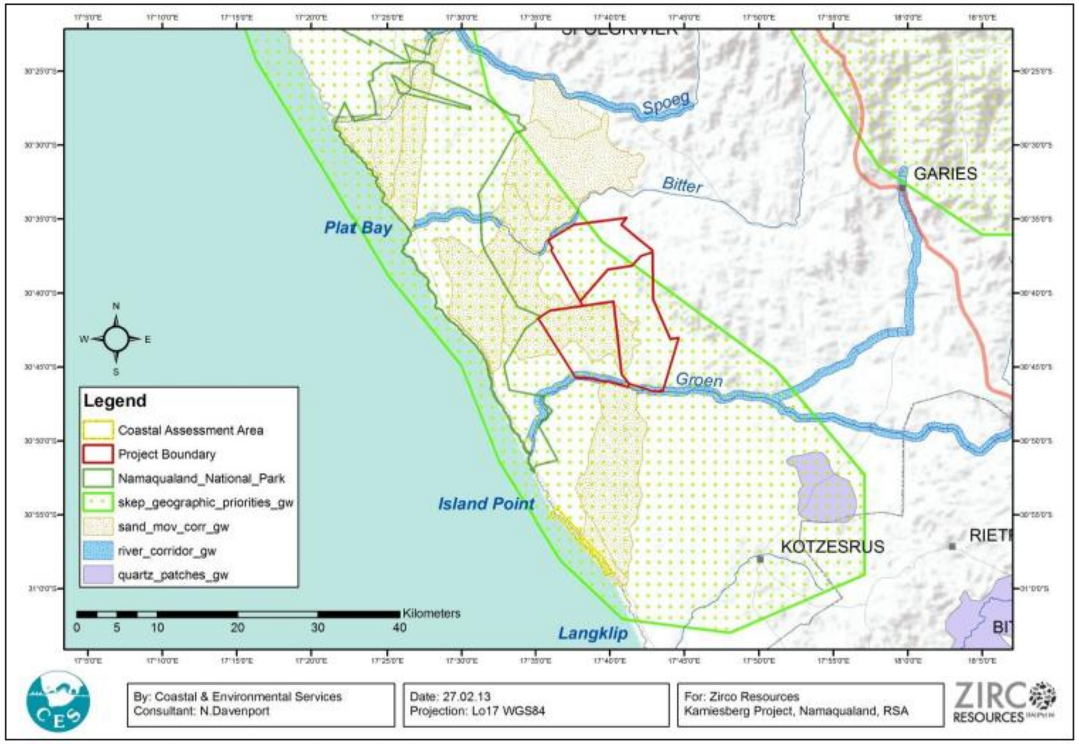
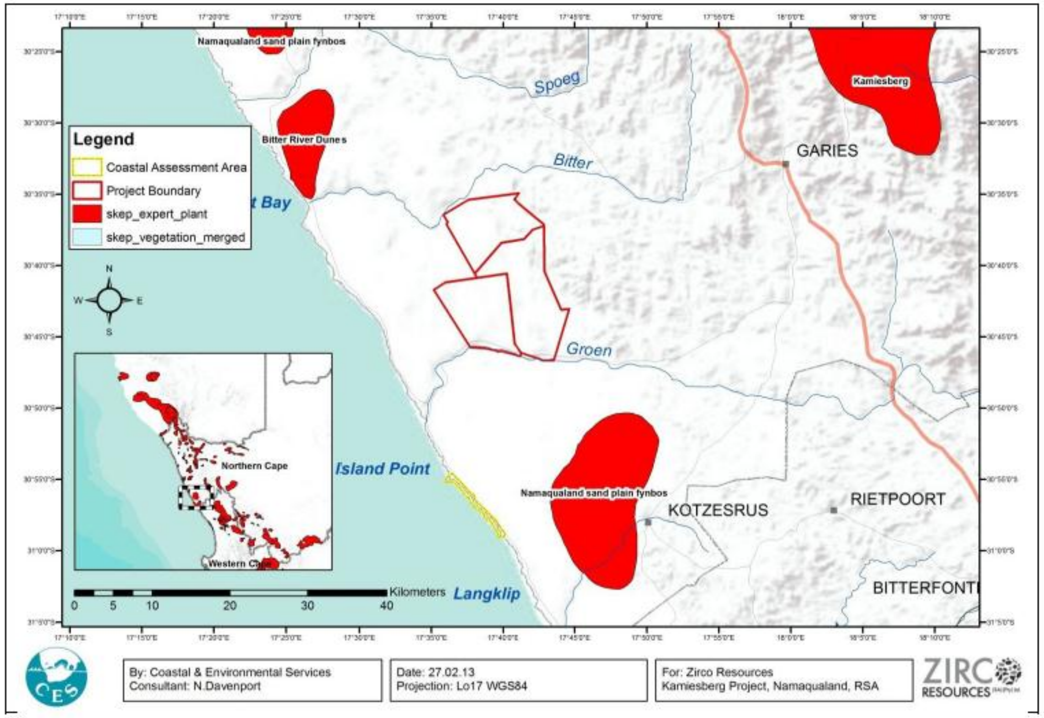
I&AP	ISSUE/CONCERN	RESPONSE
		The project site does fall within a SKEP Geographical Priority Areas (please refer to Map 4 below. **Please note that enlarged, readable maps are available in Appendix I of this document**). It should be noted that the Biodiversity Geographical Information System (BGIS) website states the following in this regard. “SKEP recommends giving priority to conserving those habitats within geographic priority areas that have conservation value and are most vulnerable to increasing land use pressures. Ideally, all <u>untransformed</u> land in these habitats, irrespective of size should enjoy some form of conservation action in order to achieve conservation targets and link reserves by means of natural corridors.” As stated above the area is currently utilised for agriculture and has been significantly overgrazed in some areas. It is likely that this land use will persist over time which may result in the loss of conservation value of the properties.



Map 4: SKEP Geographical Priority Areas

I&AP	ISSUE/CONCERN	RESPONSE
		The area does not fall within any botanical priority areas as identified by SKEP (refer to Map 5 included below. **Please note that enlarged, readable maps are available in Appendix I of this document**).  **Map 5: SKEP Botanical Priority Areas** According to the hydrologist there is no evidence of sensitive aquifers on the mine site. In addition to this there is no evidence of connectivity between the groundwater on site and the surface water of the estuary. (More information is provided in the sections below).
SANParks	Sabies area is mentioned / included in this draft EIA, while this specific area is still subject to provisions of the M&PRDA, (Mineral and Petroleum Resources Development Act, 28 of 2002), for purposes of prospecting licence application.	The Sabies area has been incorporated into the NEMA EIR to be submitted to DENC. It should be noted that this project is being completed under the 2010 regulations, which means that 2 parallel processes are required. This includes an application to NEMA for the construction of all infrastructure that triggers a listed activity in terms of GNR 544, 545 and 546. The application for mining constitutes a separate application for a mining right in terms of the MPRDA. The inclusion of the Sabies area in the NEMA application is for all associated infrastructure. The mining right application submitted to the DMR was for the areas known as

I&AP	ISSUE/CONCERN	RESPONSE
		Rhoode Heuvel and Leeuvlei. Thus should the proponent wish to mine the area known as Sabies, a separate application for a mining right will have to be submitted to the DMR for approval as per the MPRDA.
SANParks	The EIA does not discuss the value of the heavy minerals, in terms of its national importance for the country, or whether it is classified as Strategic Minerals and in national interest. In fact, the minerals proposed to be exploited, is not classified as Strategic Minerals, which further make this mining right application, even more problematic.	The EAP requested a list of strategic minerals from the DMR. Please note the response below: From: Martin Kohler [mailto:Martin.Kohler@dmr.gov.za] Sent: 08 January 2015 15:14 To: Kim Brent Subject: RE: National Strategic Minerals Dear Kim, At present there is no approved list of strategic minerals, at this stage there are only proposed provisions for the determination and publication of strategic minerals in the MPRDA Bill (which is still before the President for approval). The regulations for the necessary process are still under development. Thus, it would be premature for the department to compile a list of such minerals prior to the promulgation of the Mineral and Petroleum Resources Development Amendment Act. Kind regards, Martin Kohler Deputy Director: Statistics Tel: (+27 12) 444 3734 Fax 2 e-mail: 086 710 1471 Cell (Mobile): (+27 82) 446 6061 Based on the above e-mail, it should be noted that there is currently no list of strategic minerals for South Africa, thus it cannot be stated that heavy minerals are not strategic minerals. It is noted that the Mining and Biodiversity Guidelines (2013) states that: "*This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the* ***potential strategic importance of the minerals to the country****, and whether or not the minerals could be extracted from deposits outside of these biodiversity priority areas."* However, due to the absence of identified strategic minerals this simply cannot be considered to be applicable to any mining project until such time as the list becomes available.

I&AP	ISSUE/CONCERN	RESPONSE
		In addition to the above, it should be noted that mining in general is of national importance. A section on this was indeed included in the Draft EIR in Section 5.1. This has been included below for your convenience: The mining industry is the third largest sector in the South African economy after the agriculture and industrial manufacturing sectors. It accounts for approximately 8% of Gross Domestic Product (GDP) and creates approximately one million jobs (500 000 direct and 500 000 indirect) (The Mining Sector Innovation Strategies Implementation Plan 2012/13 – 2016.17). In addition to this, exported minerals and metals account for as much as 60% of all export revenue and is a critical earner for foreign exchange. The project will also contribute to the South African economy through the payment of taxes and royalties.
SANParks	Cumulative impacts has not been taken into account or properly mitigated. Cumulative impacts are those impacts from the project combined with the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity or natural resources collectively. In this instance, cumulative impacts would include infrastructures to be constructed in addition to the mining and associated infrastructure (mineral separation plant, primary concentrator plant, tailings dam, offices, workshops and stores etc. Furthermore, it would also include the construction of various ancillary infrastructure such as: • Seawater intake, desalination plant, pumping station and pipeline • Waste water treatment works • Product transfer stations • Airstrip • Upgrade of the provincial road to and junction with the N7 road • Fuel Depot • Construction and operation accommodation	Cumulative impacts have indeed been taken into account in the EIR. Please refer to Section 9.5 of the EIR. <u>Seawater intake, desalination plant, pumping station and pipeline</u>: The cumulative impact for the intake and pumping station is included in Section 9.5.1 Issue ii and is included below for your convenience: *It is likely that there are some cumulative impacts on the marine environment associated with this project as this is not the only mining project situated on the Namaqualand coast (to the knowledge of the marine specialist there are at least four other seawater intakes for mines in the general area and a further 4 seawater intakes for mariculture operations). However, given that these are spread out over approximately 600 km of coast these impacts can almost certainly be considered as negligible.* In terms of the desalination plant, no cumulative impacts are expected as no brine will be discharged into the coastal environment. As stated in the report, brine from the desalination plant will be discharged back into the process water stream. In addition to this the pipeline is also not anticipated to result in any cumulative impacts as it will consist of an above ground pipeline. <u>Waste water treatment works</u>: There will be no anticipated cumulative impacts from the WWTW as the treated effluent will be recycled as process water and thus will not result in any discharge of effluent. <u>Product transfer stations:</u> Product transfer would have been required for the road rail option, however due to the fact that the road only option is the preferred option these will not be required for the project as the product is loaded onto trucks at the mine site and then transported directly to Saldana. <u>Airstrip</u> There are no anticipated cumulative impacts from the airstrip. It should be noted that the airstrip falls outside all areas demarcated as high sensitivity. In addition to this, the area occupied by the airstrip is relatively small in comparison to the mining development (i.e 1.3 km long and 75 m wide). The only possible cumulative impact could be noise related.

I&AP	ISSUE/CONCERN	RESPONSE
		However, due to the infrequency of use and the utilization of small aircraft the impact would be considered to be negligible. Upgrade of the district road There are no anticipated cumulative impacts related to the upgrading of the existing road as the road reserve along the district road is mostly 25 m wide and will require only minor adjustments. Fuel Depot As stated in the EIR, the fuel depot does not form part of the scope of works. The fuel depot will be constructed by a fuel supply company who will sell fuel on site to the mine, this will be subject to a separate EIA undertaken by the service provider. Construction and operation accommodation Please note that no workers will be housed on site during the operation phase of the proposed development. During the construction phase workers will stay on site, however due to the fact that this is relatively short term, it occurs within the footprint identified for all other infrastructure (thus no additional clearing) and since residential areas within the overall project area are limited to sporadic farm structures no cumulative impacts are anticipated.
SANParks	• The surface water assessment conducted by the Coastal & Environmental Services (October, 2014) provides a useful collation of the relatively sparse information on the rivers and estuaries of the study area. Their respective assessments of potential impacts on surface water related to (a) the tailings storage facility, (b) groundwater abstraction, and (c) river crossing infrastructure are particularly informative. As is common for arid areas, surface water quantity and quality in the study area are largely moderated through a groundwater contribution. The uncertainty related to, and risk associated with groundwater contamination, as a result of the Kamiesberg project is significant. The overall risk is further increased due to the long time-frame at which	• While the concern expressed by Sanparks regarding the potential implications of the Kamiesberg Project for groundwater quality within the area of project influence is entirely legitimate, ‘industry best practise’ tools for the assessment of such risks have been applied. Numerical models which represent the physical mass transport of groundwater from potential contaminant ‘source-terms (including the tailings storage facility (TSF) and pit backfill areas) and which simulate the chemical evolution of water along transport flow paths, as applied for the Kamiesberg Project, are accepted by environmental regulators worldwide. In the absence of any specific evidence to suggest that the groundwater flow and contaminant transport modelling approach adopted for Kamiesberg is fundamentally flawed, it is therefore reasonable to assert that long-term impacts have been characterized with a high level of certainty. The risk of groundwater impact in the area of influence of the Kamiesberg project must be viewed within the context of the natural baseline quality of the groundwater system. Detailed monitoring of groundwater quality has been undertaken, as reported within the project EIA, to confirm that groundwater is naturally brackish with a TDS level averaging approximately 8 g/l. This reduces the inherent risk of degradation arising from any seepage of saline water from the Kamiesberg TSF or opencast backfill in any manner liable to significantly modify the beneficial use status of water. Long-term (100 year) projections of groundwater chemistry down-gradient of the Kamiesberg site suggest that TDS will increase temporarily to in excess of 20 g/l. This impact is, however, localized and is confirmed from groundwater elevation simulations to be confined to the aquifer system rather than to any surface water resource. The length of time over which saline water from the Kamiesberg

I&AP	ISSUE/CONCERN	RESPONSE
	groundwater contamination plays out. • The saline plume from the Tailings and storage facility will result in an increase in salinity at the top of the Groen estuary. The Groen estuary is a B rated estuary and is considered an endangered environment (National Biodiversity Assessment 2011, SANBI). This naturally saline system is fed by groundwater of lower salinity which ensures the functionality of the estuary; once this source increases in salinity the estuary will lose ecological viability. This impact is unacceptable for an endangered environment within a National Park. A full estuarine impact study is required to determine these impacts.	site may migrate to the Groen River (of the order of 100 years) is, contrary to Sanparks assertion, advantageous in that monitoring will be possible throughout the period of mine operations to validate the long-term impact projections presented in the EIA. This will afford opportunity for the implementation of any appropriate remedial action ahead of the migration of any plume to the latitude of the Groen River. Pump-back well curtains are widely applied in the mining and landfill disposal sectors for plume migration control and in the unlikely eventuality that such interventions are considered necessary at Kamiesberg these could be applied within the Zirco property limit. • The assertion that a saline plume from the Kamiesberg TSF will result in an increase in salinity at the top of the Groen Estuary is unsupported by empirical observations relating to the hydrology of the riverine and estuarine system. While recent survey work performed by SWS and other consultants has confirmed that 'brackish' water does indeed emanate from a wetland zone at the head of the Groen estuary, this is not sourced from perennial flow within the Groen River. Furthermore, this emanation is chemically distinctive from groundwater in the area of influence of the Kamiesberg Project. The current interpretation of the source of brackish-water entails discharge from a structurally controlled spring, through which water is conveyed along a NW-trending fault structure. Detailed spring and seep surveys performed in support of the Kamiesberg EIA, along with historical evidence regarding recharge/discharge mechanisms in the Groen river catchment , strongly indicate that inflow to the Groen River itself is effectively zero for most of any average year and that perennial flow does not occur. Excavations in the river bed along a section extending between 4 and 10 km upstream of the estuary confirm that no baseflow occurs in the channel substrate. It is unlikely that groundwater discharge, other than that encountered within the wetland at the head of the estuary, is of significance to the hydrology, hydrochemistry or ecology of the estuary. **It requires reiteration that the spring emanation within this wetland is not in any hydraulic connection with the groundwater system within or around the Kamiesberg mine property area.** All existing evidence supports the contention that major recharge events influencing the estuarine system occurs in association with rare flash flood events in the Groen River. This results in temporary 'freshening' of the estuarine system to TDS levels of only a few grams per litre or lower. During periods between such recharge events, evapo-concentration of the largely 'closed' estuarine water body occurs to a magnitude which produces TDS levels in the hyper-saline range (>100 g/l). The TDS of the lower basin of the estuary is such that virtually no aquatic life is observable. While a detailed analysis of the ecological response of the estuarine system to the profound fluctuations of salinity which naturally occur following flash flooding events has not been performed, it is intuitively reasonable to assume that the system can accommodate a very large salinity range. It is thus likely to be insensitive to any modest changes of groundwater salinity

I&AP	ISSUE/CONCERN	RESPONSE
		which could theoretically be associated with increasingly saline spring or seep emanations into the Groen River.
	• Approximately 33 000 cumecs per day of sea water will be piped to the site. As far as we can tell only a trivial amount of this is desalinated, and the vast bulk is used directly in the mining process, and is essentially disposed of with the backfill or in the unlined tailings/slimes dam. Assuming that the normal 35g/litre salt concentration, SANParks calculated 1155 tons of salt a day, being moved on site. • The density effects of saline water, which will cause the sea water to move downwards at a faster rate, was not modelled in the groundwater study. Furthermore, the groundwater study does not have sufficient climate/ rainfall data, making it impossible to model the hydrology of the area. • The groundwater study does not take in evaporative losses, which must surely increase the salt concentrations in the soil and groundwater. • A concern for SANParks is that, why in such an arid area, the modelled salinity of the groundwater would be less saline than the sea water being introduced to the site in large quantities. The groundwater study indicates that water with raised salinity reaches a number of boreholes on the Groenrivier, and it	• While the 'mass balance' presented by Sanparks is technically correct, this cannot be applied to infer the mass of NaCl which will be introduced to the groundwater system following implementation of the Kamiesberg project. Detailed modelling of the hydrodynamics of the TSF and backfill has been performed to simulate the rate of flux of saline water through the vadose zone and into the aquifer system. This rate of flux is a function of the hydraulic properties of both the backfill and the underlying stratigraphy. Results indicate that the rate of introduction of salt to the groundwater system, if expressed on a daily basis, is approximately 1% of the rate at which NaCl is physically transported to the site. This inevitably results in the accumulation of a substantial inventory of salt within the backfill matrix, most of which will remain permanently immobilized following the termination of mining and the drain-down of solution from the backfill to a condition which equates to 'specific retention' or field capacity. • The influence of salinity and associated density effects on groundwater flow was considered in detail during the conceptualization stage of the groundwater modelling process. While in principle the injection of a high salinity solution into a fresh column of groundwater can influence flow rates and migration paths, this was concluded to exert virtually no control on groundwater flow or plume dynamics within the Kamiesberg setting. This is supported by the fact that the flux of saline water entering the groundwater system must pass through a low hydraulic conductivity weathered rock sequence before reaching the phreatic surface. Within this sequence, matrix flow is essentially controlled by the hydraulic conductivity of the material assemblage irrespective of solution density. The result of this constraint is the slow introduction of a high salinity solution into a receiving groundwater body which itself has a relatively high 'baseline' salinity and density. This will induce a progressive increase in overall groundwater density from around 1.02 to 1.07 over a time period of decades. The lack of site-specific climatic data was recognized in a scoping level hydrological assessment performed by Schlumberger in 2013, in response to which a weather station was established at the Kamiesberg site. Hydrological and hydrogeological modelling has been founded on the use of Agricultural Research Council (ARC) meteorological records for two automated weather stations within 60 km of the Kamiesberg site. Daily and hourly climatic data for the period 2003 to date are available from these stations. The datasets have been correlated against limited site-specific data compiled during Schlumberger's scoping investigations in 2013 and appear highly representative of the site. Consequently, it is considered that the annual precipitation and evaporation data applied in all hydrological and hydrogeological modelling are of sufficiently high confidence level

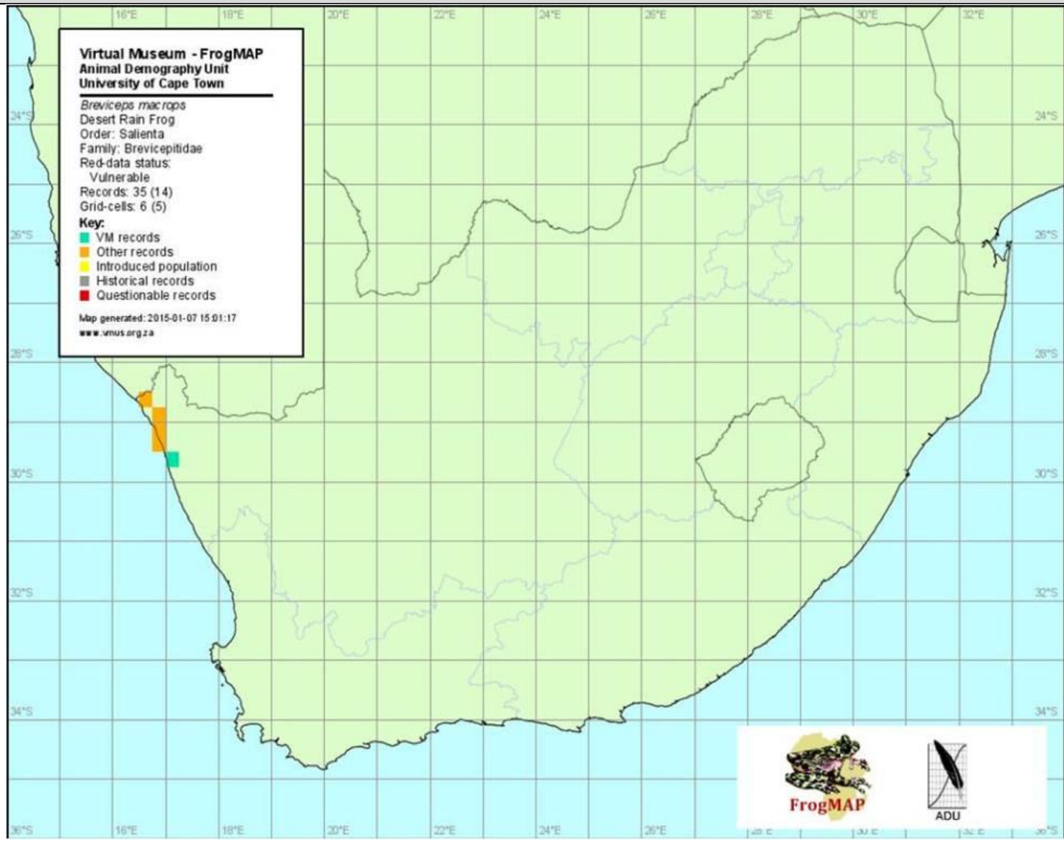
I&AP	ISSUE/CONCERN	RESPONSE
	seems reasonable to assume that any extra saline water entering the estuary will increase estuary salinity overall, even if it does enter via the Groenrivier. The logic of the study cannot be followed, saying that the saline groundwater impacts the top end of the Groenrivier, but not the Groenrivier outside the mine site. This appears to be hydrologically not sensible. Furthermore, the groundwater modelling scenarios are insufficient as the most important variables are omitted from the model. Omitting these variables from the groundwater model essentially renders the analysis as useless. The simulated salts concentrations from seawater and processed mine water seepage from backfill voids into the groundwater will pollute the system with hyper saline water for the next > 100yrs. • In the absence of comprehensive integrated monitoring or long –term rehabilitation plan for essentially the next > 100yrs, apart from the environmental impacts. SANParks is concerned that that the local population's socio-economic and cultural (livestock farming) aspects will be complete destroyed as a result of the groundwater contamination and abstraction. • Furthermore, the estuary seems to receive "fresher" groundwater, which should prevent the system from	to meet the objectives of the work performed. A further consideration with regard to the climatic datasets used for hydrological and hydrogeological impact assessment relates to the extremely low precipitation levels prevailing at Kamiesberg. A fundamental conclusion of the seepage flux simulations performed for the Kamiesberg backfill is that, following the initial drain-down of pore-solution, recharge via rainfall will be insufficient to induce long-term seepage and ongoing mobilization of salts into the groundwater system. Sensitivity analyses performed at 2 x estimated annual rainfall suggest that this conclusion would be unaffected by an increase of rainfall input of this magnitude. In effect, imprecision in the estimated rainfall depth over the backfilled opencast areas of a magnitude as great as 100% would not materially influence the key conclusions drawn from the modelling exercise with respect to long-term groundwater impact. • This assertion is incorrect. The groundwater impact model does account for evaporation in calculating the water balance of the backfill. This results in a tendency for any rainfall over the backfilled mine footprint to evaporate from the surface, or from the zone of infiltration above the elevation of the capillary fringe. Long-term post-closure seepage is consequently reduced and the mobilization of salt inventory from the backfill into the groundwater system is inhibited. • Groundwater model simulations performed using a calibrated 3D model show that salinity within the groundwater system to the south of the Kamiesberg operation will increase from a baseline of approximately 8 g/l to a post-mining level of >20 g/l. This higher level will prevail for a finite period, although it is conceded that this will extend for more than a century. Model simulations designed to assess groundwater quality impacts over a 100 year period confirm that the zone of salinization will propagate southward to reach the latitude of the Groen River by around year 80. Due to the confinement of much of the groundwater flow to the fractured bedrock aquifer, discharge or daylighting of water as spring emanations into the Groen River will not occur. While water quality in boreholes along the Groen River may indeed be impacted, neither flow nor water quality within the surface water system will change. The Groen River will continue to flow largely in response to rare flash flood events and no mechanism for salinization of the Groen Estuary is foreseen. The assertion that the 'most important variables' of the model have been omitted is without foundation. This also applies to the assertion that the Groen system will be polluted with 'hyper-saline water'. • The aforementioned responses deal with this concern. • There is currently no evidence that the Groen Estuary is sustained by, or in receipt of, any significant inflow of groundwater from any source in hydraulic connection with the Kamiesberg site or area of influence. Fresh water inputs to the system are on the basis of existing evidence assumed to be associated with a brackish spring controlled by a NW

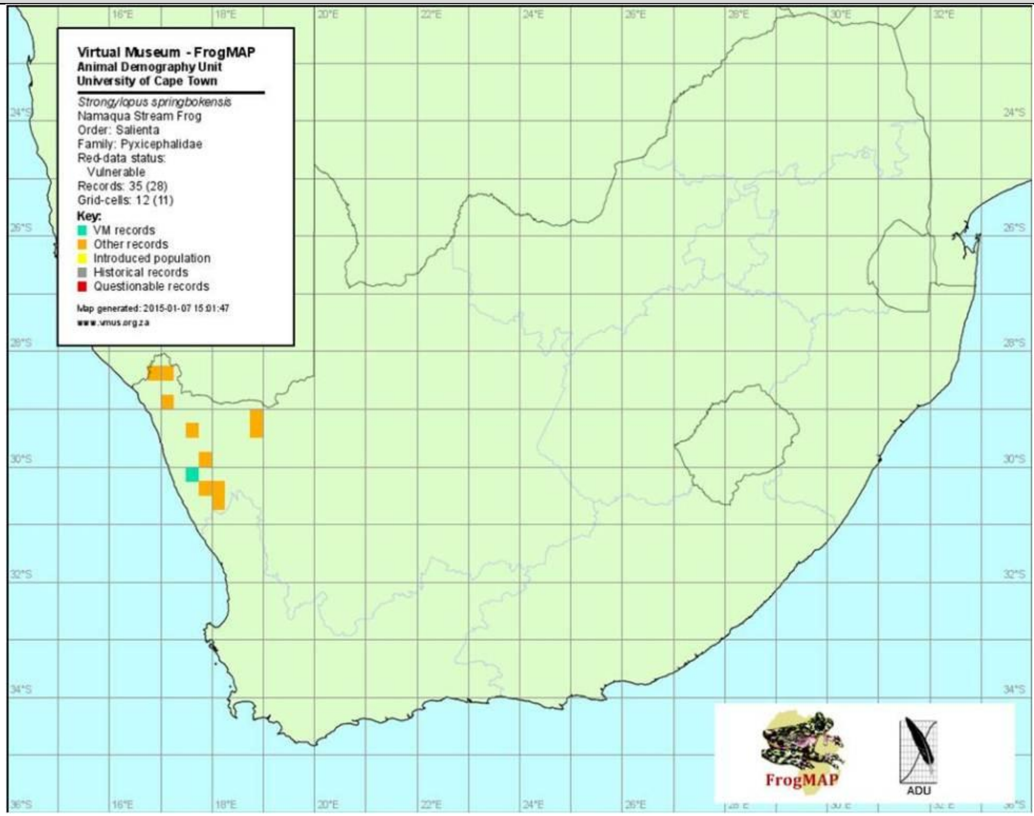
I&AP	ISSUE/CONCERN	RESPONSE
	becoming totally hypersaline. It appears that this source of fresher water is at risk. • It appears unreasonable for the groundwater study to write–off impacts of the saline water on the estuary, as the timelines for the impacts are such that the concentrations at the certain sites are still rising 100 years after mining. A concern for SANParks is the plan to properly rehabilitate the area, given the extremely high concentration of salt added to it. It seems that we are starting to look at a long term toxic desert, with risk to broader areas through salt being blown off exposed landscapes. Certainly, the tailings dam is going to be highly saline. Recommendations for groundwater impacts • Lining the back fill voids with impervious material and considering modern treatment processes, to mitigate the groundwater impacts. • A full estuarine study on the impacts of loss of dilution and increased salt inputs into the system needs to be conducted – this is a very rare estuarine type and risks cannot be taken when considering its protection.	trending fault which causes water to daylight at a rate of <1 l/s in the wetland at the head of the estuary, plus occasional flash flood events in the Groen River itself. During all interim periods the estuary is subject to intense evapo-concentration with salinities of in excess of 100 g/l TDS produced. This is essentially inconsistent with any more substantial or frequent input of fresh groundwater. • Please note that the groundwater assessment does not “write off” impacts related to saline water on the estuary. As stated above there is **no** hydraulic connectivity of the groundwater on site with the surface water of the estuary. Without this connection any salt introduced at the mine site simply cannot have an effect on the estuary. Also please note that the concentration of the salts **will not** still be increasing after 100 years. Please refer to Figure 1.4 and 1.5 in the Surface and Groundwater Assessment that shows that salinity values either start to decrease or tapper off towards the end of the modelling period (i.e. 100 years after mining). In terms of rehabilitation, there is proven success of rehabilitation at Namakwa Sands using the same methodology. (More information on rehabilitation is provided in the sections below). Thus it is highly unlikely that the site will become a “toxic desert” as stated. • Please note that the initial mining area 6 145 ha in size. It is simply not economically feasible to line an area of this size nor is it reasonable or practical. • As stated above, recent survey work performed by SWS and other consultants has confirmed that ‘brackish’ water does indeed emanate from a wetland zone at the head of the Groen estuary, this is not sourced from perennial flow within the Groen River. Furthermore, this emanation is chemically distinctive from groundwater in the area of influence of the Kamiesberg Project. The current interpretation of the source of brackish-water entails discharge from a structurally controlled spring, through which water is conveyed along a NW-trending fault structure. Detailed spring and seep surveys performed in support of the Kamiesberg EIA, along with historical evidence regarding recharge/discharge mechanisms in the Groen river catchment , strongly indicate that inflow to the Groen River itself is effectively zero for most of any average year and that perennial flow does not occur. Excavations in the river bed along a section extending between 4 and 10 km upstream of the estuary confirm that no baseflow occurs in the channel substrate. It is unlikely that groundwater discharge, other than that encountered within the wetland at the head of the estuary, is of significance to the hydrology, hydrochemistry or ecology of the estuary. It requires reiteration that the spring emanation within this wetland is not in any hydraulic connection with the groundwater system within or around the Kamiesberg mine property area. From this section it is entirely clear that there is no connectivity between the groundwater from site and the estuary itself. Thus any salinization of the estuary as a result of mining 10 km upstream is highly unlikely. For

I&AP	ISSUE/CONCERN	RESPONSE
		this reason a full estuarine assessment is deemed unnecessary. However, in good faith an estuarine assessment has been commissioned by the proponent. The scope of services include: o Habitat mapping The estuarine functional zone (estuarine habitat area) will be digitized using the most recent (2013) Spot 5 imagery combined with 2014 Google Earth images. Earliest aerial photographs that can be obtained will also be digitised and estuarine open water areas mapped. Macrophyte habitats will be described for past conditions using additional available information i.e. vegetation reports, species lists or oblique photographs. By comparing earlier vegetation maps with more recent maps, changes over time can be documented and the extent of change determined. All maps will be digitised in ArcGISTM Version 10.2. o Species data Vegetation will be analysed along transects. Vegetation cover will be measured as average percentage cover in duplicate quadrats (1 m2) placed at 5 m intervals along each transects. Transects will be placed where there was a transition from salt marsh to terrestrial vegetation and where there is as little disturbance as possible. Taxon names follow Germishuizen and Meyer (2003), and Mucina and Rutherford (2006). Voucher specimens will be housed in the Ria Oliver Herbarium (PEU) of the Nelson Mandela Metropolitan University. o Groundwater and sediment analysis Along each transect, depth to groundwater will be determined by manually auguring down to the water table. Water table readings will be taken at the same sites from where the sediment samples are collected. In each of the vegetation zones, sediment samples will be collected for analyses in the laboratory. Analyses included sediment moisture and organic content as well as sediment electrical conductivity, following the methods of Black (1965 – sediment moisture content), Briggs (1977 – sediment organic matter) and The Non-Affiliated Sediment analyses Working Committee (Barnard 1990 – sediment electrical conductivity). In situ measurements of the groundwater salinity and electrical conductivity will be conducted using an YSI handheld multiprobe. o Fauna Fauna (invertebrates) of the Groen Estuary will be sampled at three different sites. Hyperbenthos, benthos and zooplankton will be sampled using standard techniques. o Hyperbenthic sampling will be conducted at three (3) sites. Two (2) replicates will be sampled at each site, allowing for six (6) samples. This includes samples of organisms living just above the bottom of the estuary such as fish larvae, shrimps and so forth.

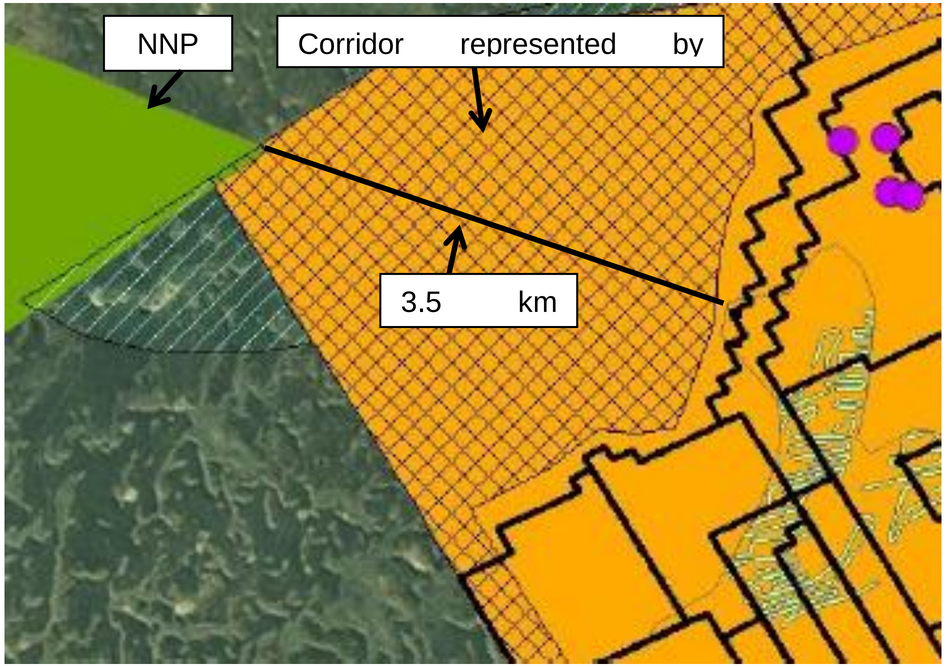
I&AP	ISSUE/CONCERN	RESPONSE
		○ Benthic sampling will be conducted at three (3) sites. Three (3) replicates will be sampled at each site, allowing for nine (9) samples. Organisms in the sediment will be sampled such as polychaete worms. ○ Zooplankton sampling will be conducted at three (3) sites. Two (2) replicates will be sampled at each site, allowing for six (6) samples. A multitude of organisms that move in to the water column at night will be sampled. ○ An Intertidal survey will also be conducted to establish presence/absence of mudprawns, sandprawns etc. Density estimates will be done at numerous sites. Technique: ○ Hyperbenthic sampling will be conducted using a rectangular net mounted on skids that is pulled across the bottom. ○ Benthic samples will be collected with a grab that bites into the substrate – the sample is then sieved through a mesh bag ○ Zooplankton samples will be collected using the benthic sled at night ○ At each site a sediment sample will be collected ○ At three (3) sites environmental parameters will be measured namely temperature, salinity, etc. Samples will be analysed in a laboratory. The information from the site visit, as well as the information provided by Schlumberger (specifically and information relating to a possible increase in salinity in the estuary) will be utilised to compile a report that describes both the structure and function of the Groen River estuary. The report will discuss the implications of an increase in salinity on the ecosystem functioning of the Groen River estuary. Information from Schlumberger will be used to identify and assess anticipated impacts (including any changes to the ecosystem functioning of the estuary) due to indirect impacts on the salinity content as a result of the proposed project, should these in fact be determined as potentially occurring.
SANParks	The specialist study found that all air quality matters were within legal requirements in the short-term. We question what the long-term impact of the sulphur dioxide and nitrogen dioxide deposition will be, as this is what SANParks and the surrounding communities are going to have to deal with.	The proposed Kamiesberg location will be an isolated industrial source of sulphur and nitrogen emitted predominately via the dryers. At present the life of the mine and plant is estimated to be 20 years. The transformation of the emitted gases into sulphate and nitrate salts will occur but is unlikely to result in substantial quantities of sulphur and nitrogen deposition (such as is observed over the Highveld). The sandy soils of the west-coast are likely to already be salt-laden, especially sulphur, as a result of input from sea-spray. Additional sulphate from the proposed Kamiesberg will likely represent a small proportion of the sea-spray sulphate inputs. The impact of nitrogen deposition on the west-coast ecosystems - usually considered to be nitrogen limited – in the long term is unlikely to have any lasting effects, simply because the quantities released from this relatively small mining operation (there are no smelters or other facilities emitting large volumes of nitrogen) are very small in the context of the overall area, and will be very widely dispersed by the strong and

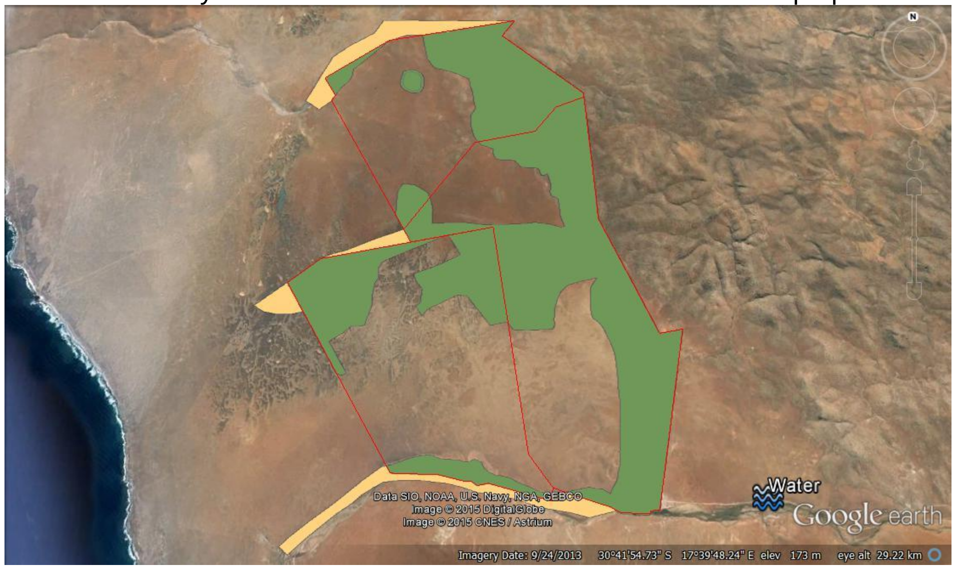
I&AP	ISSUE/CONCERN	RESPONSE
		frequent onshore winds.
SANParks	• The faunal assessment states that there are no threatened or endemic amphibians in this area. This is incorrect as, *Stongylopus springbokensis* and *Breviceps macrops*, are both listed as Vulnerable along the coast, the latter occurring in the coastal dunes on the Namaqualand coast. Researchers are currently conducting a survey to locate populations of both these species in Namaqua National Park - preliminary results indicate that the habitats are suitable and these species should be present. • Commercial exploitation of all reptile species does occur in this area and the establishment of the mine, with the influx of people may result in more illegal poaching of reptiles for trade. To state that NNP protects these species so no measures need to be put in place at the mine is ludicrous (Point 9.2 number 5, pg. 80)! • According to SKEP, a number of amphibian, reptile, bird and mammals species of conservation concern, occur within the mining area and will all be negatively affected by the operations of the mine. • There are no recommendations that mining staff be prohibited from killing or trapping animals for meat. This should be included in the report. • The suggested 2km buffer/ecological	• This is incorrect as can be seen from the maps included below (up-to-date distribution of both species). Both species have specific habitat requirements that are not present in the current project site. *Breviceps macrops* - Channing and Wahlberg 2011 clearly state that this species only occur as far south as Koiingaas and that no suitable habitat occurs further south. They also only occur on the coastal white dunes and don't occur inland to the red sand dunes. *Strongylopus springbokensis* – only occur inland above 200 -1600 m above sea level, in Upland Succulent Karoo vegetation in the Succulent Karoo Biome. They prefer springs, seeps, small permanent and non-permanent streams and artificial impoundments. Thus it is highly unlikely that either species will occur in the current project site footprint.

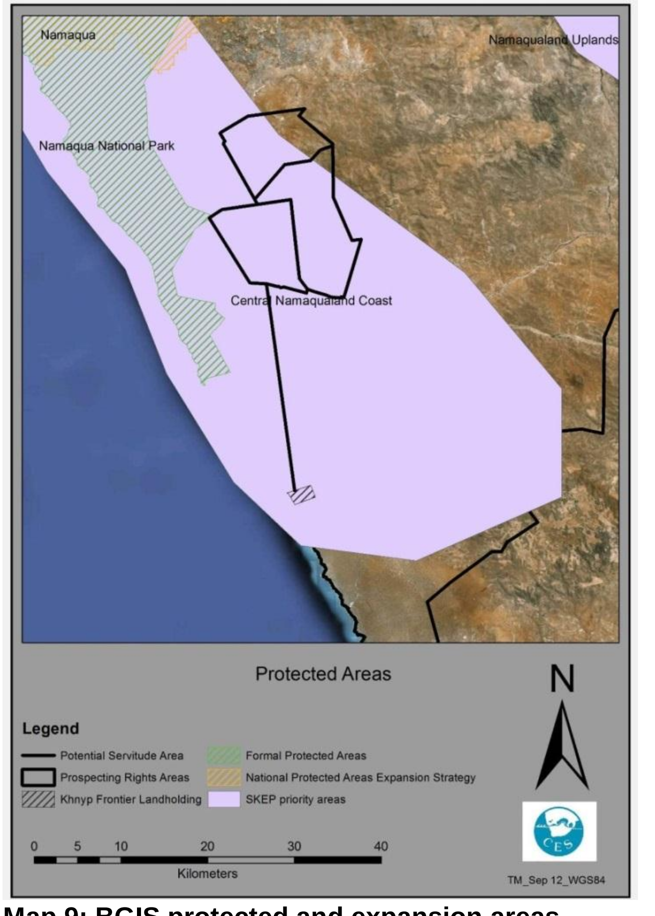
I&AP	ISSUE/CONCERN	RESPONSE
	corridor is insufficient given the edge effects of the mine will in all likelihood be 50% of this area already (1km), the mining and biodiversity guidelines recommend 5km. Under pollution and contamination, the report does not note the effects of salt on the water systems, and the impact this will have on the amphibian and bird species living in the riverine and wetland areas. • Due to the occurrence of a threatened bat species at the mining site, night operations and excessive lights should be added to the list of recommendations. • The protected area expansion strategy is mentioned as not relevant to this project in the faunal survey as the mine is 5km from the expansion footprint. This is incorrect, as the mine borders on the park within the future expansion area of NNP.	 **Map 6: Distribution of *Breviceps macrops***

I&AP	ISSUE/CONCERN	RESPONSE
		 **Map 7: Distribution of *Strongylopus springbokensis*** • Please refer to Section 8.4.1, Impact 2: Loss of reptile diversity. The mitigation measures include the following: o Avoid clearing or damaging areas of high faunal value as defined in the Faunal Assessment. o Protect abiotic habitats, such as rock outcrops, which shelter many reptile species. o Basic Search and Rescue of SCC need to be conducted before each plots get stripped from vegetation and erecting low drift fences around these plots (or at least on the border of the adjacent plot) will limit the movement of

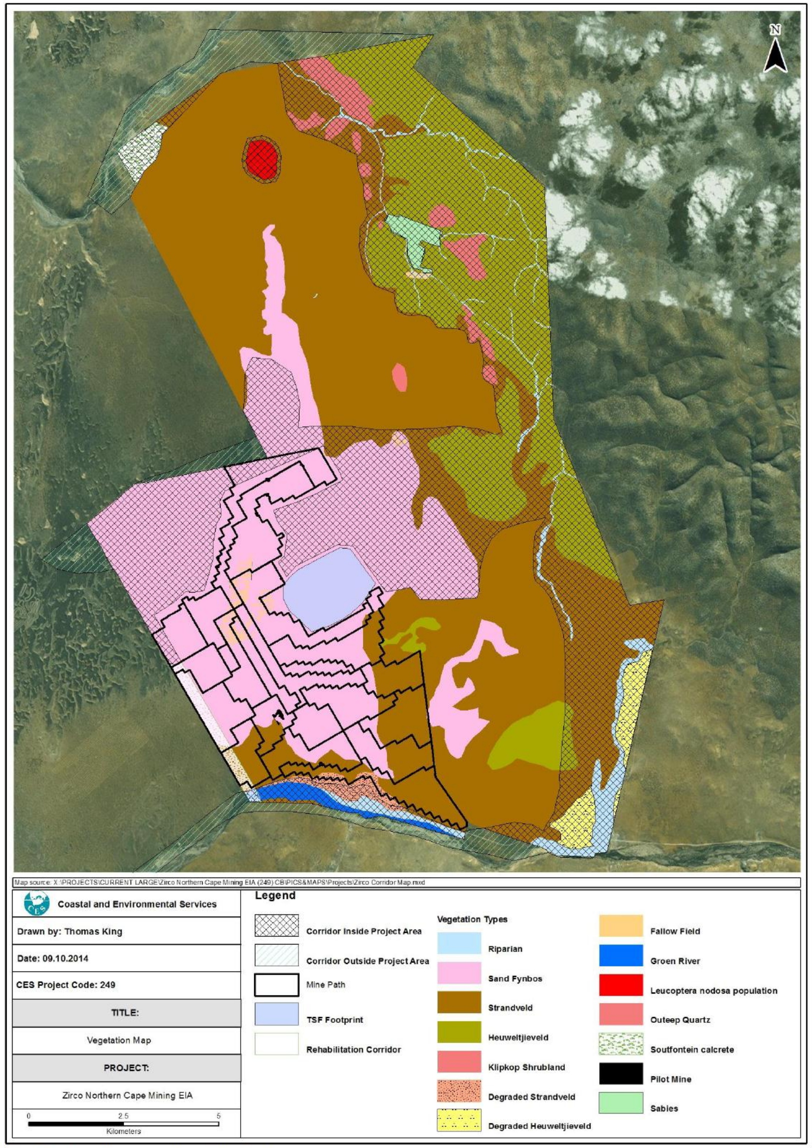
I&AP	ISSUE/CONCERN	RESPONSE
		reptiles (especially tortoises) back onto site. o Curtail unnecessary night driving onsite roads as far as possible. o Prohibit exploitation of SCC, e.g. tortoises and chameleons, by employee's onsite. o Educate mine staff about the necessity of protecting snakes and other reptiles. In addition to this please refer to Section 9.2 Point 13 which states: o Prohibit exploitation of SCC, e.g. tortoises and chameleons, by mine employees Based on the above it is clear that poaching was considered in the faunal assessment and mitigation measures have been provided. • This is true, however you also need to take into consideration the nature of heavy minerals mining (i.e. the entire area is not mined at once, but rather in smaller sections), in addition to this rehabilitation is undertaken progressively. Thus habitat is still continuously available. Furthermore, animals are mobile and tend to move away from increased activity and noise. It also should be noted that the species identified on site are well protected in other areas within the region. Thus it is unlikely that that the proposed project will have a high impact on the survival of the species in the long-term. • As stated above, the following mitigation measure has been incorporated into the faunal assessment as well as the EIR: o Prohibit exploitation of SCC, e.g. tortoises and chameleons, by mine employees Exploitation is defined as "the action of making use of and benefiting from resources" and thus includes the mitigation recommended. However, the following mitigation has been incorporated into the EIR in Section 8.4: "Prohibit the trapping and killing of animals for the production of bush meat by mine employees". 9 Please note that the faunal assessment states the following: "A significant buffer (at least 1-2000m wide) needs to be maintained along the part of the study area that borders the existing edge of the Namaqua National Park." This recommendation that refers specifically to the area bordering the NNP. Please note that a corridor has been established in this area, where no mining or construction will take place, essentially providing a buffer of 3.5 km between this area and the Park itself (refer to map included below). Even if the edge effects pertain to 50% of the vegetation (which is highly unlikely) this still leaves a buffer of 1.75 km. As it is difficult to establish the true distance of edge effects a buffer of more than 1 km is deemed sufficient to deal with environmental perturbations. Please note that the Mining and Biodiversity Guidelines states the following: "…5km buffers around other protected areas, excluding Gauteng where there are no buffers around protected areas. In these areas

I&AP	ISSUE/CONCERN	RESPONSE
		environmental impact assessments should be required for a range of activities that impact on biodiversity value, sense of place, visual sensitivity of the natural landscape; and cultural value of Nature Reserves." Thus based on the above the 5 km buffer is not mandatory. It simply states that should development occur within this area an impact assessment would be required that takes into consideration biodiversity value (vegetation assessment and faunal assessment), sense of place (social assessment), visual sensitivity (visual assessment) of the natural landscape; and cultural value (heritage assessment). This requirement has therefore been met.  **Map 8: Corridor in the area of the project site that borders the NNP** • In terms of amphibians, please note that according to the faunal assessment only 3 species of frogs where recorded in both the wet and dry seasons. Of these three, two species namely the Common Platanna (*Xenopus laevis*), and the Cape River Frog

I&AP	ISSUE/CONCERN	RESPONSE
		(*Amietia fuscigula*) have tadpoles that take at least 6-12 months to complete metamorphosis. Their distribution is thus dependent on the presence of permanent water, and the only suitable sites in the region are permanent pools in the Groen River valley (e.g. (30°46’43.3”S, 017°45’54.9”E; 112m asl), which is upstream from the proposed development (please refer to Map 9 included below). Thus even if there was an increase in salinity at the border of the site or alternatively downstream of the site (which has been refuted by the hydrologists as per the responses above), there will be no anticipated impacts upstream of the development, and thus no anticipated impacts on these frog species. In addition to this, please note that based on discussions with the estuarine specialist the estuary is anoxic and thus faunal habitation other than birds are limited (estuarine assessment currently being compiled). It is unlikely that birds will be impacted on by the proposed development, as there is no foreseeable increase in salinity in the estuarine system downstream from the proposed project.  **Map 9: Location of permanent pools in the Groen River in proximity to the study site** • Only 8 species of bats may occur in the area and 4 are listed as Near Threatened. Only one bat (not threatened) species has been recorded. Due to the lack of suitable roosting place on the project site, it is unlikely that there will be any significant impact on bats within the area.

I&AP	ISSUE/CONCERN	RESPONSE
		• Please note that the updated information on the protected area expansion strategy based on the NNP Management Plan is included in both the EIR and the vegetation assessment. The reason why it is shown as not relevant in the faunal assessment is because the specialist utilised the SANBI's BGIS site to determine the location of the site in relation to protected areas and expansion areas. Information on this portal indicates that the proposed site is not within any of these areas (please refer to map included below).  **Map 9: BGIS protected and expansion areas**

I&AP	ISSUE/CONCERN	RESPONSE
SANParks	• The mining site cuts directly through a large north-south portion of Namaqua Sand Fynbos. This vegetation type is highly dependent on acid pH levels and will be severely impacted by the mine operations, as well as the resultant increase in salinity from the use of sea water. Rehabilitation of this vegetation type back to Sand Fynbos will not be possible as suggested by the report. This vegetation type will be lost as the more saline tolerant Strandveld vegetation will take the place of the Sand Fynbos. Sand Fynbos is the richest of the vegetation types found in the mining area, and particularly on the ecotone between the Strandveld and Sand Fynbos. The impact to these will be severe and no amount of translocation or restoration will ensure their survival. • Although all the vegetation types within the mining area are listed as 'Least Concern' none of them have met the national conservation target of between 26-28% conserved. • To reply merely on NNP to conserve these vegetation types is unrealistic, as ecosystems function on a landscape scale, and this mine will severely impact the conservation of large intact portions of vegetation types (point 4.1, pg 19). This is the second largest intact portion of Sand Fynbos remaining in Namaqua National Park, (pg 25).	• Mining will remove a section of sand fynbos, as stated in the EIR. However it should be noted that the majority (54%) of this vegetation type has been incorporated into ecological corridors that will not be mined or utilised for construction purposes (refer to Map 11 included below). Sand fynbos prefers acidic soils and hence a high salt load in the sediment may result in challenges with the rehabilitation of sand fynbos as soil alkalinity might increase. As strandveld is more adapted to saline soils, this may result in a shift in community composition towards strandveld. However, it is very important to note that the section referred to in the rehabilitation report, seems to have been taken out of context. The rehabilitation report states the following: "This is important as seawater will lead to a significant increase in the salinity of the soil returned to the areas. This will compromise the rehabilitation potential of Namaqualand Sand Fynbos (Desmet & Helme 2003), which prefers acidic soils. Studies at Namakwa Sands have found that high soil salinity poses a challenge during rehabilitation (reducing species diversity), especially if rainfall is below average (and natural leaching is thus reduced)." If read in conjunction with the entire section it would become clear that this refers to the case where no topsoil is spread above the backfilled area in which case it may very well pose a problem for rehabilitation. It is however stated in the next section (Section 4.2 point no. vi) that "topsoil of at least 300mm depth (0.3m) must be set aside for rehabilitation purposes, as this will then retain its original pH, and will also include the bulk of the soil stored seed bank (including most of the bulbs, which are more deeply buried than most of the seeds). Furthermore, the top 2 metres of tailings returned to the surface after mining must be sand tailings only, as any clay will assist in the retention of salt." Thus, based on the above there are three important points to consider (a) for the first two meters the sediment will consist of sand and thus would have a lower salt retention capacity, (b) the topsoil will have NO increased salt levels as it will be sourced directly from site and stockpiled for use in rehabilitation and (c) topsoil will be spread to approximately rooting depth (i.e. 0.3 m) thus simulating the same conditions as pre-mining. Based on this information it is clear that the statements made by SANParks in regards to "Rehabilitation of this vegetation type back to Sand Fynbos will not be possible as suggested by the report" and "the impact to these will be severe and no amount of translocation or restoration will ensure their survival" is simply untrue. • Noted and correct. In this regard, the project may result in an increase of the area of the vegetation type that is currently conserved through the provision of biodiversity offsets that could be incorporated in the NNP as recommended in the EIR.

I&AP	ISSUE/CONCERN	RESPONSE
	• The heuweljieveld in this area is also particularly rich in species and 2 new species were found in this assessment. The potential loss of known and unknown species, should the mine go ahead, is a serious concern (pg 21). • The coastal dune areas are poorly botanised, however historic records indicate that these are fragile systems and that rare and threatened species occur in small clumped populations. The building of the desalination plant here could potentially result in the loss of these populations. • SANParks experience in the translocation of plants to other areas in the arid environment has found that they do not transplant well and up to 100% died in the first year. This recommendation should be re-written and the plants should be kept ex situ in a nursery (preferably a Botanic Garden), and used as 'mother stock' to propagate new plants to be used in the rehabilitation of post-mined areas (given that they soils are not overly saline). SANParks strongly recommends the following: • The recommended 300m ecological corridor through the mine site should be made larger (500m) should the mine proceed. (pg76). • Identified habitat corridors and other sensitive areas need to be secured for conservation in perpetuity through	

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	an appropriate stewardship mechanism. An environmental management plan needs to be prepared for these areas, and appropriate resources allocated to ensure that they are well managed. This should include sufficient fencing (or other control of these areas) to ensure they are appropriately demarcated and managed.	**Map 11: Proposed ecological corridors** • Please note that the vegetation assessment does not solely place the responsibility of the conservation of these vegetation types on the NNP. It simply states that these vegetation types do indeed occur in the NNP and what % of the conservation target it incorporates. In regards to the SSC, the report also simply states that the SCC populations found on site are also present and protected within the NNP as well as areas sampled outside the NNP and the proposed mining area. Please note that the sand fynbos is considered to be relatively intact. As stated in the vegetation assessment, fallow cereal (oats, rye and wheat) fields (308 ha) occur scattered throughout large sections of the Sand Fynbos communities, especially in the north western sections of Roode Heuvel. The EAP does not understand the comment: "This is the second largest intact portion of Sand Fynbos remaining in Namaqua National Park, (pg 25)" for the following reasons: (1) The page number referred to in the vegetation report (pg 25) consists solely of Figure 4.2: Vegetation map of the project area. (2) the study site does not fall within the NNP. (3) The only place the term "second largest" is utilised in the vegetation report is in regards to the following: "Sand Fynbos (6072 ha) is the second largest vegetation unit in the area. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei (Figure 4.2)." Please note the following point in regards to the above sentence (1) the word intact is not used and (2) this refers to the area covered by the relevant vegetation type **<u>on site</u>** not in the NNP. In light of the EAPs confusion please be so kind as to clarify what was meant by this statement. • Please note that 3,261 ha of the area delineated as heuweltjieveld has been incorporated in the ecological corridors (area that will not be touch by either mining or the construction of infrastructure). This amounts to 89% of the entire area of this vegetation type (total area = 3,654 ha) and includes all areas where SCC were identified, including the new species. Thus these species will **<u>not</u>** be lost as a result of mining. • Please note that the desalination plant will **<u>not</u>** be constructed within the coastal environment. The desalination plant will be constructed on the mine site within the same 400 x 400 m footprint for all other mine related infrastructure. Thus this comment is not applicable. • Three points need to be made in answer to this comment. (1) Plants will not be propagated on salinized soils, as discussed above topsoil will be spread to a depth of 0.3 m prior to rehabilitation taking place. (2) The vegetation report should be read in conjunction with the rehabilitation report. The rehabilitation report clearly states in Section 4.3.1, Step 1: "*Geophytes, succulents, and suitable plants must be harvested and relocated to rehabilitation sites. If conditions are un-favourable, they will need to be established in a holding nursery for later use."* This is reiterated in Step 7: "*The nursery is*

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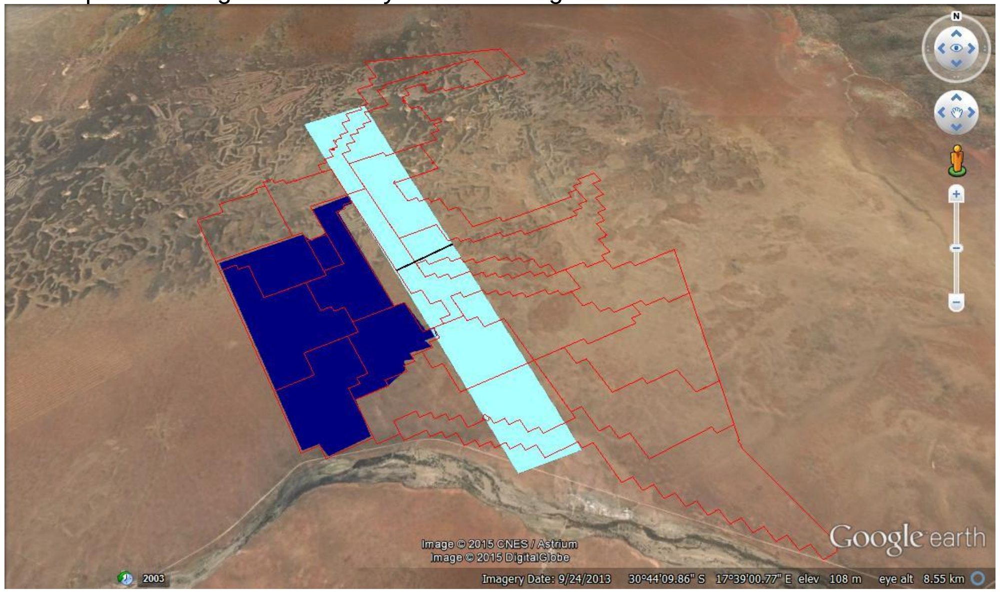
		primarily required for the propagation of species of special concern and the management of seed harvesting etc. The nursery must be established at the start of construction, prior to any clearing in order for harvested seeds to be stored, and any SCC collected and translocated to the nursery, or planted directly into the ecological corridors (preferably, as the success rate will be higher)." Thus it is clear that a nursery will indeed be established on site. (3) Lastly, rehabilitation has been done for Namakwa Sands. The results showed no significant difference in vegetation cover in the medium to long term (after eight to nine years). Thus rehabilitation has been **proven** to be effective in this environment. • This is not deemed necessary and once again needs to be put in perspective. The reason for the recommendation of a north south corridor is because sand fynbos has a north – south regional distribution. Thus the report recommends that there is a north-south corridor at all times. The Figure below depicts the corridor for the first five years of mining. The dark blue polygon shows the area to be mined in the first 5 years. The light blue area shows the area that remains untouched by infrastructure and mining during that period, thus providing a north-south corridor of in excess of 900 m. Thus no additional corridor is required during the first five years of mining.



Map 12: Corridors during the first 5 years of mining

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		During the latter part of mining (years 6-20), the eastern side of this area will be mined (red outline not shaded in dark blue). Thus the initial natural corridor will be mined. Thus we now will require a north-south corridor on the western end of the mine site. It should be noted that rehabilitation would have been in progress for 4 years in some of the areas mined in years 1-5. In addition to this, a natural north-south corridor of sand fynbos runs through the property adjacent to the western side of the property referred to as Roode Heuvel and connects with the NNP (refer to Map 13 below). This corridor is approximately 4.7 km wide. Thus based on the above information there will be continuity within the sand fynbos throughout the entire mining period. The reason that a 300 m corridor on the western boundary of the Roode Heuvel Property was proposed, is that should the property on the western side of the proposed project site be developed, there will still be continuity with the sand-fynbos habitat. The idea would be that Zirco Resources provide 300 m on their land and the landowner on the adjacent property provides 300 m on their land thus establishing a corridor of 600 m.

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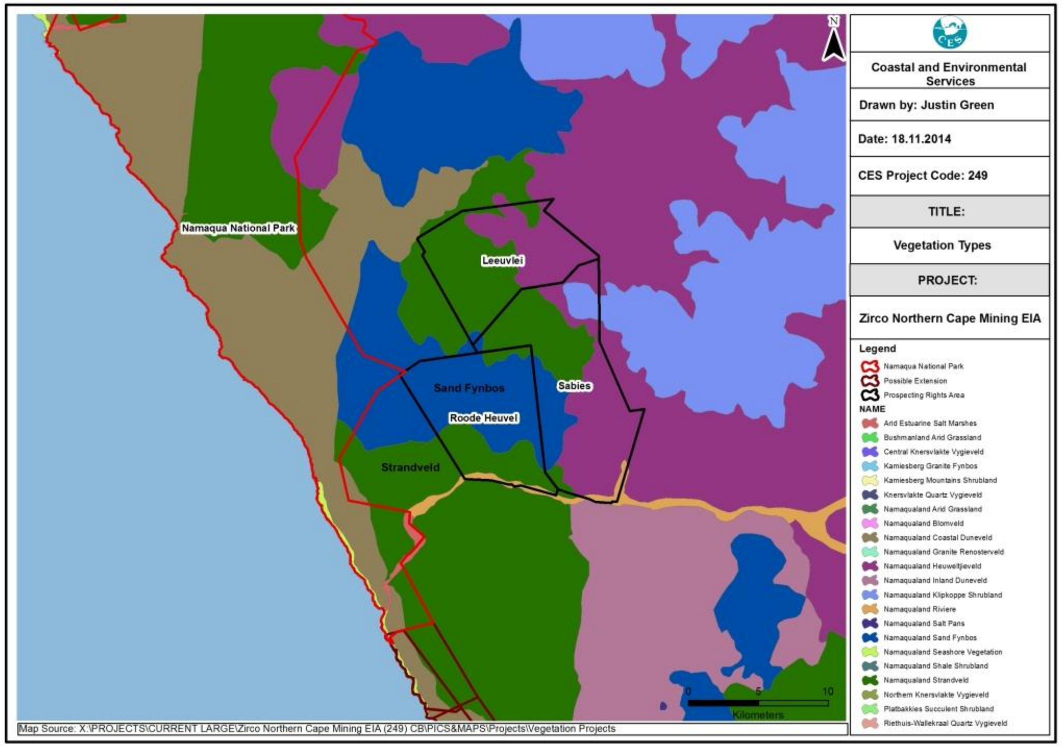

Map 13: Vegetation map showing the vegetation type occurring on adjacent properties

- The area referred to will not be mined and will be managed as a conservation area for the life of the mine. The conservation of these areas after this period will depend on the land use. It can either revert back to agriculture in which case the onus will be on the farmer or it can as stated in the EIR be donated to the NNP for incorporation into the park in which case the management of the land will revert to the park. The only way that these areas can be effectively protected in perpetuity would be incorporation into the NNP.
</td></tr>
<tr><td>SANParks</td><td>

- The report states that the high salinity of the soils from the mining plant is leached after 25 months and able to be rehabilitated. I question what the salt content of this soil was and the
</td><td>

- This information is based on an MSc undertaken by H.P. Prinsloo entitled: “*Alteration of the soil mantle by strip mining in the Namaqualand Strandveld”. This study stated the following: “Cumulative rainfall of 46 mm over a four month period resulted in a more than threefold decrease in salinity from 1 500 mS.cm-1 in fresh tailings to levels below 500 mS.cm-1. Cumulative rainfall of 490 mm over a period of 28 months decreased salinity at*
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	rainfall in the area that was tested, and then how this compares to the Khamiesberg mine project site (pg 13). • The rehab of the mined areas will lag 2 years behind the mining operations (pg 19); however seeds in topsoil do not last longer than 12 months. Thus, the plan needs to consider collecting seed and sowing this onto the first sites to be rehabilitated post-mining. Thereafter, topsoil should not be stored longer than 12 months, it should preferably be moved directly onto an old mine site from a newly opened cut.	*3 soil depth to mean levels below 200 mS.cm-1"* As the mining methodology used by Namakwa Sands is similar to that to be used by the proponent (use of seawater for processing purposes), within the same climate range (i.e. 70 km south of the site) it is fair to assume that the salinity changes in the soil will correspond to those found at Namakwa Sands. In term of rainfall, the weather station erected by the proponent has recorded rainfall data over a period of 16 months from October 2013 to January 2015. The cumulative rainfall for this period amounts to 145.3 mm and thus corresponds to the rainfall data included in the above mentioned MSc. It is therefore safe to assume that the decreases in salinity of the topsoil due to leaching as a result of rainfall (even low rainfall), found for the above mentioned study will apply to this project as well. • Please refer to Section 4.3.2 point no. 2. This only relates to the year 1 mining area. As a void needs to be created the topsoil from the year 1 area needs to be stockpiled. The year two area will be covered by topsoil from year three, the year three area will be covered by topsoil from year 4 etc. Thus this recommendation is already incorporated into the rehabilitation report.
SANParks	The recommended buffer around quartz outcrops of 5m should be increased as these areas are also rich in flora and 5m will not protect the outcrop.	Please note that the quartz outcrops referred to here are of cultural heritage concern only they occur within the vegetation type identified as strandveld and of low sensitivity (please refer to the Map 14 included below). The quartz areas identified to have a high species diversity in the vegetation report are referred to as Klippekop Shrubland and Outeep quartz (indicated on map below) and have been incorporated into the ecological corridor and thus will not be impacted on.

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		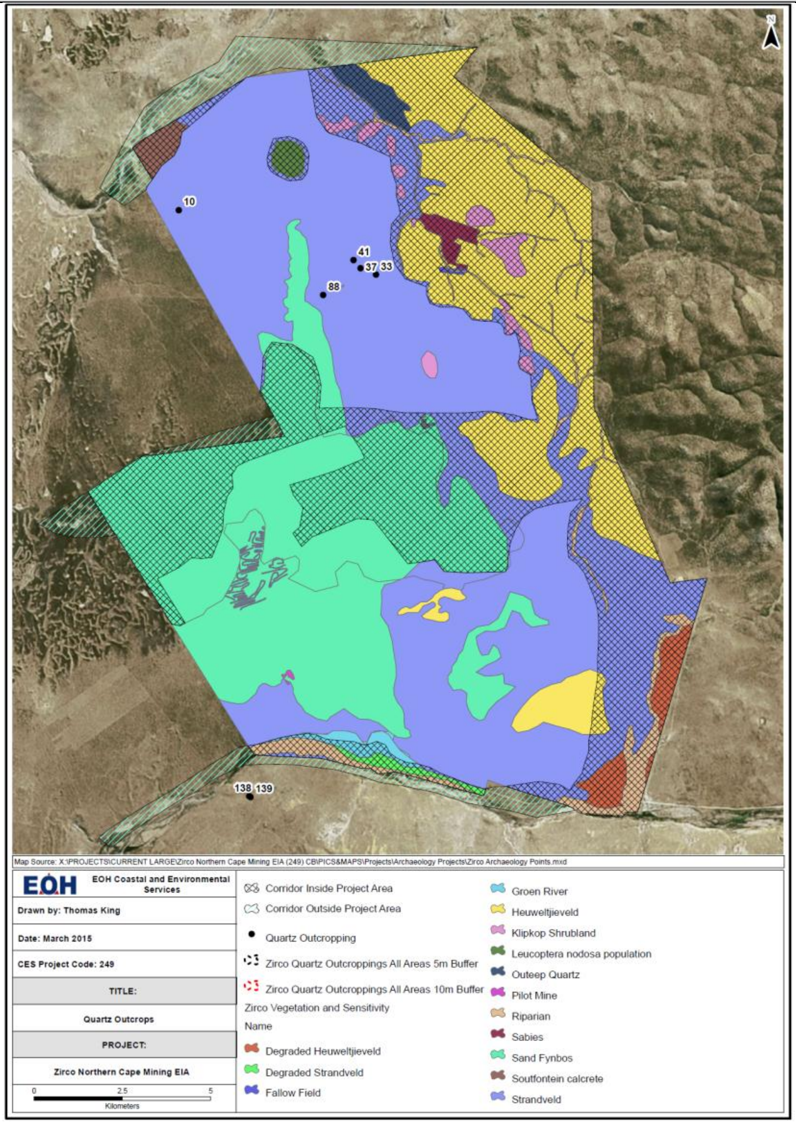 **Map 14: Quartz outcrops of heritage value**

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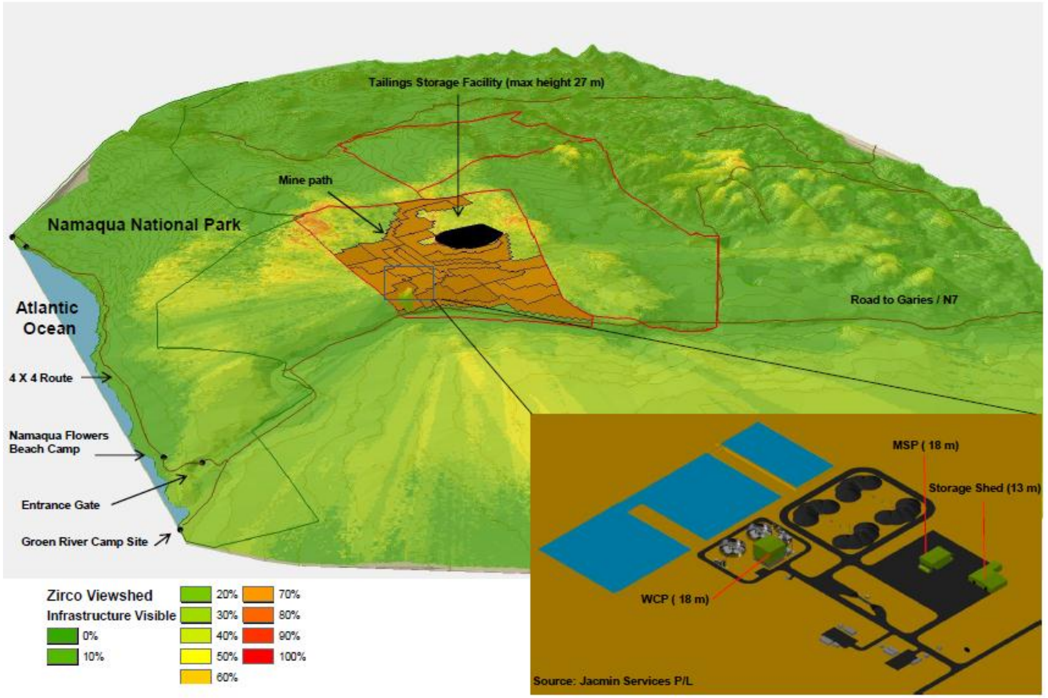
	The location for the proposed landfill site has yet to be determined, this must be informed by the ground water and vegetation assessments and provided to stakeholders for comment. The report states that liquid waste produces of the desalination process will be discharged into the ocean. We have not seen an impact assessment of what this discharge may do.	The location of the landfill site is yet to be determined. The landfill site selection will follow the criteria set out in the Minimum Requirements for Waste Disposal by Landfill, 3rd ed. (DWAF 2005). The landfill site selection criteria include consultation with IAPs and the elimination of sites with fatal flaws such as proximity to ground and surface water. The landfill site will also be subject to the approval of a waste license application which can only be submitted once more information becomes available from detailed design. The liquid waste produced from the desalination plant will **NOT** be discharged into the ocean. Section 5.3.2 and Table 5.3 of the waste assessment clearly states that the brine and other liquid wastes from desalination plants will be recycled as process water.
SANParks	The visual impact of the 27m high tailings dump in this flat landscape will be an eyesore. The visual assessment is implying it's not important to SANParks because it will not be seen from the coastal camps. It will however, be seen from almost anywhere else in the park once you move away from the coast. The apparent assumption that these areas are not used by people/ visitors is also incorrect - we could very well have horse trails, 4x4 trails etc. there in future.	The VIA reports the following in terms of SANParks' views: "*The most sensitive visual receptors identified, have been those associated with the Namaqua National Park: the accommodation camps and the 4x4 route. The Coastal Section of the Namaqua National Park, acquired in 2008, is located to the west of the mining license area, and actually borders it at one point. The location of the camp sites next to the ocean in all cases, and the 4x4 route which tends to run quite close to the coast, are all at lower elevation. The location of the mining area on higher ground that is inland (approximately 150 masl) means that none of the camp sites (excluding Groen River camp site which is about 13 kilometres from the processing area) will have any views of the mine. It is possible that a very small section of the 4x4 route will have views of a small amount of mine infrastructure, and this is only likely to be the Tailings Storage Facility when it reaches it's maximum height of 27 meters. Some uninhabited areas on the western border of the park will have views of up to 20% of mine infrastructure."* Based on the above it is clear that the VIA acknowledges that there will be views of the mine from the park. It does, however, state that these areas are currently uninhabited. It is noted that SANParks may in the future wish to develop uninhabited areas within the park, however according to the NNP Management Plan the only infrastructure planned for the current planning cycle is an entrance control point and a new rest camp near the Hondeklip Bay road (far north from site). Thus without any knowledge of where or what infrastructure may be constructed in the future the impact of the mine on these simply cannot be assessed. In addition to this, according to the NNP Management Plan the area is zoned as "Primitive" (refer to figure included below). The Management Plan states that: "Primitive areas were designated around remote zones to buffer them from higher use tourist areas and external impacts from outside the park. Primitive areas were also designated in relatively low sensitivity valleys to allow management and controlled tourist 4x4 access on planned routes along **existing** tracks through the eastern mountains." According to the visual specialist the majority of existing tracks run from the 4x4 track (from which there is no identified visual impact; refer to map below) in a westerly direction towards the coast. Thus it is highly unlikely

I&AP	ISSUE/CONCERN	RESPONSE
		that these will be impacted on by the proposed development. If there are indeed any existing tracks running in an easterly direction (overlooked by the specialists) please be so kind as to provide us with the location of these so that they may be included in the viewshed analysis. In terms of the visual impact of the TSF on the NNP, please note that the TSF will be built up slowly over the life of the mine i.e. it will not be 27 metres high from inception of mining, but will reach this height only towards the end of the mine life. At which time the proposed development will only be between 30 and 40% visible to the park.



Map 15: Viewshed Analysis

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		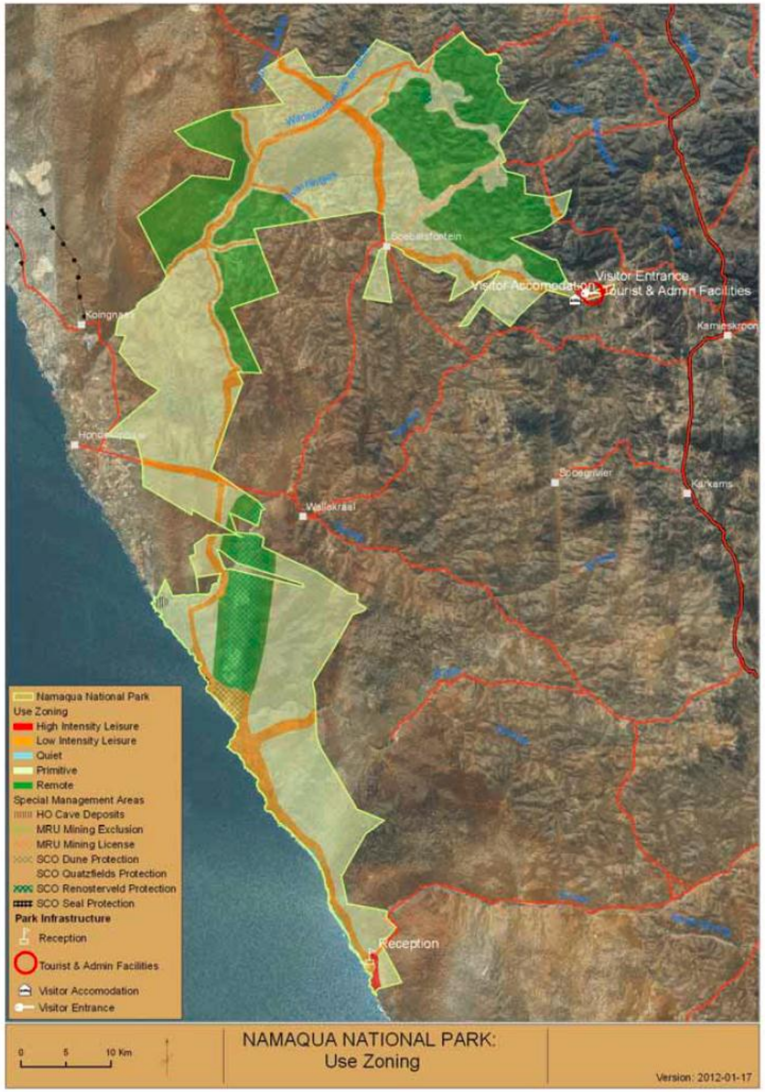 **Map 16: Namaqua National Park Zoning**

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<tr><td></td><td>The Social and Labour Plan seems to be meeting all the legal requirements and is within the format required by the DMR. However, one cannot really get a sense of the anticipated turnover and /or projected profitability of the Mine, except in the SLP and ESP an indication that 270 Million tons of sand will be mined from 3,500ha over the 20 year life-span of the Mine. The Mine has committed R 15 M to the SLP over the first 5-years of the life-span of the Mine. Unfortunately one cannot assess how reasonable an offer this is given the lack of information.
In terms of the current LED projects identified:
The projects are only infrastructure focused – DMR also encourages skills development and income generation projects. The municipality is a small rural municipality and probably rightfully places emphasis on basic service delivery and bulk infrastructure and water is a priority concern. However, whilst the Mine will cover the capital costs the municipality will have to cover the operations and maintenance costs and this must be factored into the socio-economic impact and “off-set” calculations;
Whether these LED projects are sufficient to mitigate the socio-economic and environmental impact on the Mine is, however, questionable. The anticipated socio-economic impact of the Mine is</td><td>The aim of the SLP is to address LED and as legislation requires the SLP has been developed in extensive consultation with the Kamiesberg Local Municipality and accepted by them.
Please note that a section on skills development was indeed included in the SLP under Chapter 3: Human Resources Development Programme (HRDP). This Chapter also provides a budget for the HRDP which has been included below for your convenience.<table><tr><th>Human Resources Development Programme</th><th>Total 5-Year Budget</th></tr><tr><td>Adult Basic Educational Training</td><td>ZAR 1,643,933</td></tr><tr><td>Core Business Training</td><td>ZAR 2,933,300</td></tr><tr><td>Learnerships</td><td>ZAR 540,733</td></tr><tr><td>Portable Skills Training</td><td>ZAR 225,306</td></tr><tr><td>Skills Development Budget (Sub-total)</td><td>ZAR 5,343,273</td></tr><tr><td>Bursaries</td><td>ZAR 1,539,395</td></tr><tr><td>Internships</td><td>ZAR 117,332</td></tr><tr><td>TOTAL HUMAN RESOURCES DEVELOPMENT PLAN BUDGET</td><td>ZAR 7,000,000</td></tr></table>* Also refer to Table 6.1 for the Social and Labour Plan financial breakdown
Based on the above it is clear that the proponent is committed to skills development within the region.
In terms of income generation projects, the SLP states the following: “As Zirco will be developing a new mining operation, the local Procurement and Supplier Development Programme will assist, where feasible, in identifying small business development opportunities and suppliers at the local level. The focus would be on procuring services such as garden, security, food, and other services from the local community. During mine development, the largest expenditures are generally directed at capital goods and specialised services that are normally procured from large urban businesses as well as international suppliers. In the long-term, the Company will aim to shift the balance of its expenditures where feasible from these large businesses to smaller, developing businesses located near or in the mine community. The objective will be to maximise both job creation and the economic benefit of the mining operation at the mine community</td></tr>
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I&AP	ISSUE/CONCERN	RESPONSE
	significant, e.g. newcomers, especially job-seekers, will be attracted into the area, The municipality will need to deliver services and housing to these newcomers. A significant number of jobs to be created will be short-term and construction related in the first few years of the Mine's operations. These workers will be sourced through construction companies that will probably source unskilled and semi-skilled workers locally. There future is uncertain and may contribute to growing unemployment and associated social problems within the community. • The long-term production jobs in the Mine will last 20 years. Economic activity within the community is limited so chances of employment within other sectors are scarce unless alternative forms of economic activity are stimulated during the life of the Mine. • The local municipality has no budget (Namakwa IDP 2012 – 2016) to finance LED projects (its focus is necessarily basic service provision) so requires private sector partners to come on board in that regard. • Conservation has not been specifically identified either by the municipality in its IDP or the Mine's SLP as a specific economic sector or an area of sustainable job creation. The sectors identified for growth are	level." The following LED projects has been identified for the project, (1) supporting KLM with constructing a desalination plant in Garies to alleviate growing water pressure on the municipal area and supply good quality water to the communities of and surrounding Garies (2) Assist the Joe Slovo Community Clinic in Garies with restoring its own small desalination plant and equipment that is needed by the clinic (3) Assist Lepelsfontein with the provision of household water tanks. Please note that of these 3 projects only the first will require ongoing maintenance. It is true that the cost of this will need to be covered by the municipality, however it should be noted that the municipality is responsible for providing residents within their area with potable water and thus funds should already be available for water maintenance costs. In addition to this please note that the proponent will be providing people from the surrounding communities with skills training, through the relevant SETA, to enable them to gain new skills to find decent work after the construction and implementation phases of this plant. For each of the infrastructural components provided to the KLM by the proponent, The proponent consulted the municipality with the design of the Local-Economic Development (LED) projects, as the proponent is required to do under legislation. The proponent will be supporting primarily infrastructure projects based upon intensive discussions with the municipality which requires these services. The Social and Labour Plan (SLP) should support the local municipalities with required services. • The socio-economic impacts of the mine have been addressed in much detail in the project's Social Impact Assessment (SIA). Measures to address many of these impacts are not necessarily covered by the SLP, but also by mitigation measures in the SIA and other specialist studies. The aim of the SLP is to address LED, and a central objective is to provide sufficient skills amongst the local population to ensure that they have long-term employment. The socio-economic impacts of the LED projects can only be quantified with a post-monitoring survey, and speculation as to its effectiveness at this stage is premature without any supporting quantitative data. It should be born in mind that the LED projects were also developed through consultation with the local communities, who identified these needs in their communities. The mine is well-aware of the strong possibility of an influx of job-seekers, for which the proponent will be drafting a Recruitment and Influx Management Plan in order to mitigate these impacts effectively in the long term. • The Life of Mine (LoM) will in all probability exceed 20 years (if Leeuvlei and Sabies are mined as well. It should be noted that the SLP is only a five-year commitment document, which should be reviewed annually and updated after the first five years. The need for alternative economic sectors is well-noted. Subsequent to the implementation of the first

I&AP	ISSUE/CONCERN	RESPONSE
	Tourism, Renewable Energy and Mariculture. However, they could be regarded as relatively compatible with conservation and could be linked to biodiversity and heritage protection. It is interesting to note that: Both the Namakwa and Kamiesberg Municipalities note the biodiversity significance of their vegetation and their coastlines and the degradation thereof. Alien invasive vegetation and mining activities are causal factors identified for this degradation; • The Mine's proposed LED contribution does not correlate with the potential negative socio-economic impact of the Mine; • The SLP does not address broader environmental and biodiversity concerns within the community as its plans are focused on the Mine's operations and rehabilitation objectives. We propose that the first 5-year projects are focused on basic service delivery, but we strongly argue that the Mine also has a social and corporate responsibility to promote alternative economic activity, and opportunities within their area of operation, in order to address the future opportunities of their workforce. In the case of the Kamiesberg Project, this is urgent, given the fact that the construction jobs to be created will be relatively short term. The Mine also has a responsibility to contribute to biodiversity conservation	three LED projects, the proponent will discuss with the municipality and local communities the need to amend its projects accordingly. • Noted • It should be stressed that legislation requires the proponent to develop its LED projects through the municipality, which should approve the LED projects. We therefore propose for SANParks to discuss this issue with the municipality directly. Renewable energy project may or may not be compatible with conservation. For example, renewable energy in the Northern Cape is best suited for the generation of solar energy. Solar energy requires a large area of land for the generation of relatively low volumes of power (e.g. 20 ha for the production of 10 MW of photovoltaic energy). Eventhough these panels are raised above ground level, shading effects will result in the die-back of any vegetation within the construction footprint and subsequently may lead to a reduction in biodiversity. In addition to this, solar farms are also visually intrusive. Mariculture may result in genetic as well as biological pollution which may reduce natural stocks if not managed appropriately. Once again the argument can be made that mariculture leads to a reduction in biodiversity rather than protecting it. SANParks could, however discuss the potential of including some eco-tourism projects into the SLP upon its revision for the next 5 year period with the KLM. • Legislation requires the proposed LED projects to be developed based upon a needs analysis of the local municipality. The rationale for SLPs is for mining developments to support local municipalities through LED. It should be noted that the only negative impacts identified from a social perspective are those related to inmigration. This can be effectively mitigated in the long term through a recruitment and influx management programme and thus does not outweigh the positive impacts associated with the project such as job creation, skills development, provision of infrastructure, etc. This issue is addressed in the SIA which states: "There is a general concern that, should the mine not support local businesses, insufficient opportunities would be created for the communities to become self-sustainable after mine closure". This is further addressed in the SLP which states: "As Zirco will be developing a new mining operation, the local Procurement and Supplier Development Programme will assist, where feasible, in identifying small business development opportunities and suppliers at the local level. The focus would be on procuring services such as garden, security, food, and other services from the local community. During mine development, the largest expenditures are generally directed at capital goods and specialised services that are normally procured from large urban businesses as well as international suppliers. In the long-term, the Company will aim to shift the balance of its expenditures where feasible from these large businesses to smaller, developing businesses located near or in the mine community.

I&AP	ISSUE/CONCERN	RESPONSE
	within its broader environment. • We propose that to meet these imperatives, an additional project in the SLP could be on "Green Job Creation". These projects would be aligned to the Namakwa District's IDP where a number of these projects are already listed as indicated. We propose the supporting of a "National Green Trust" that would operate within National Park Buffer Zones and Protected Areas that focus on: ○ Building capabilities required for monitoring of mining activities through research and bursary opportunities; ○ Promoting conservation as a key sector for rural economic development and job creation through building capabilities to: ○ Undertake socio-economic analyses of Buffer Zones, their broader regional economies, and conservation-linked economic opportunity; ○ Facilitate stakeholder engagement processes within the Buffer Zone ○ Facilitate the extension of protected areas through private and public led initiatives and partnerships; ○ Input into Mining ○ Input into Municipality Spatial development Frameworks, Integrated Development Plans and LED Strategies;	The objective will be to maximise both job creation and the economic benefit of the mining operation at the mine community level." In addition to this, it is stated in the SIA that the proponent will be developing a Corporate Social Responsibility (CSR) Programme aimed at identifying and developing particular projects that could alleviate possible future conflicts and strengthen community values. In terms of biodiversity conservation, please note that the proponent has set aside corridors which will not be developed to protect SCCs. In addition to this, the proponent has offered to donate the area known as Roode Heuvel to the park once rehabilitated or to provide a suitable biodiversity offset to be incorporated into the park. This is included in both the vegetation assessment and the EIR. • The SLP has been approved by the local municipality and as stated before legislation requires the proponent to develop its LED projects through the municipality, which should approve the LED projects. Thus SANParks needs to discuss the incorporation of such a project with the KLM for incorporation into the next revision of the SLP.

I&AP	ISSUE/CONCERN	RESPONSE
	and ○ Promote Green Job Creation.	
10 SANParks	SANParks REQUIRES THE FOLLOWING STUDIES TO BE DONE A Full Economic evaluation study Given the very high biodiversity importance of the proposed mining area, SANParks request that a full economic evaluation study be done. A full economic valuation of the proposed Kamiesberg mining operation compared with other reasonable/feasible alternative land uses, undertaken as a necessary component of the EIA, would determine whether mining would be the optimum sustainable land use in the proposed mining area. The economic valuation should ideally addresses the values of biodiversity and ecosystem services that conventional economic analysis excludes, since their value is not traded or priced in the marketplace. A full economic valuation may show that the value of the intact ecosystem to local communities and society exceeds the value of mining as the new proposed land use. Furthermore, this will reflect both the economic loss that results when biodiversity is degraded or lost, as well as the value gained from conserving the resource. The economic evaluation needs to clearly show whether it would in the national interest to exploit these minerals. Furthermore, the study would also assess whether other alternative deposits or reserves exist, which could be exploited in areas, which are not biodiversity priority areas or less environmentally sensitive	• In terms of the request for an economic assessment, please note that it is highly unlikely that the income generated by tourism and/or conservation in the area would be equivalent to the income generated by the mine in terms of foreign exchange earnings, royalties, taxes, salaries, increased business opportunities, skills development, infrastructure development, etc. In terms of alternative deposits please note that this is dependent on the grade of the deposit, since this will have a direct impact on the costs associated with mining the ore. Thus even if other deposits exist within the area, the grade may make it unsuitable for mining. With this said, please note that an economic assessment has been commissioned for the project. The scope of work is as follows: ○ Provide a profile/baseline of the existing economic context within which the project would be established. ○ Identify significant economic impacts for assessment. ○ Assess significant economic impacts without mitigation. ○ Recommend appropriate management and mitigation measures. ○ Re-assess impacts assuming mitigation measures are implemented. In order to establish the existing economic environment affected by the project, information would be gathered from the following sources in order to investigate the existing economic situation that would be affected by the project: ○ Information generated during consultations with the public and authorities ○ Statistical databases such as Census information ○ Local economic development and planning documents The study would assess the impacts of the project focusing on the local, regional and national scales where relevant. Adverse, positive, direct and indirect impacts would be identified for the establishment and operational phases. Impacts would be assessed in accordance with the provincial guidelines for economic specialist inputs into EIAs (van Zyl, et al., 2005) that use a cost benefit analysis framework. The study must specifically deal with the issues raised by SANParks in their correspondence to the EAP (EOH CES), from Mr Willem Louw, and dated 6 December 2014. Specifically, the points raise in Section 6.2 of this correspondence must be dealt with.

I&AP	ISSUE/CONCERN	RESPONSE
	areas.	
SANParks	A full estuarine study A full estuarine study on the impacts of loss of dilution and increased salt inputs into the system needs to be conducted – this is a very rare estuarine type and risks cannot be taken when considering its protection.	• An estuarine assessment has been commissioned by the proponent. The scope of services include: ○ Habitat mapping The estuarine functional zone (estuarine habitat area) will be digitized using the most recent (2013) Spot 5 imagery combined with 2014 Google Earth images. Earliest aerial photographs that can be obtained will also be digitised and estuarine open water areas mapped. Macrophyte habitats will be described for past conditions using additional available information i.e. vegetation reports, species lists or oblique photographs. By comparing earlier vegetation maps with more recent maps, changes over time can be documented and the extent of change determined. All maps will be digitised in ArcGISTM Version 10.2. ○ Species data Vegetation will be analysed along transects. Vegetation cover will be measured as average percentage cover in duplicate quadrats (1 m2) placed at 5 m intervals along each transects. Transects will be placed where there was a transition from salt marsh to terrestrial vegetation and where there is as little disturbance as possible. Taxon names follow Germishuizen and Meyer (2003), and Mucina and Rutherford (2006). Voucher specimens will be housed in the Ria Oliver Herbarium (PEU) of the Nelson Mandela Metropolitan University. ○ Groundwater and sediment analysis Along each transect, depth to groundwater will be determined by manually auguring down to the water table. Water table readings will be taken at the same sites from where the sediment samples are collected. In each of the vegetation zones, sediment samples will be collected for analyses in the laboratory. Analyses included sediment moisture and organic content as well as sediment electrical conductivity, following the methods of Black (1965 – sediment moisture content), Briggs (1977 – sediment organic matter) and The Non-Affiliated Sediment analyses Working Committee (Barnard 1990 – sediment electrical conductivity). In situ measurements of the groundwater salinity and electrical conductivity will be conducted using an YSI handheld multiprobe. ○ Fauna Fauna (invertebrates) of the Groen Estuary will be sampled at three different sites. Hyperbenthos, benthos and zooplankton will be sampled using standard techniques. ○ Hyperbenthic sampling will be conducted at three (3) sites. Two (2) replicates will be sampled at each site, allowing for six (6) samples. This includes samples of organisms living just above the bottom of the estuary such as fish larvae, shrimps and so forth.

I&AP	ISSUE/CONCERN	RESPONSE
		○ Benthic sampling will be conducted at three (3) sites. Three (3) replicates will be sampled at each site, allowing for nine (9) samples. Organisms in the sediment will be sampled such as polychaete worms. ○ Zooplankton sampling will be conducted at three (3) sites. Two (2) replicates will be sampled at each site, allowing for six (6) samples. A multitude of organisms that move in to the water column at night will be sampled. ○ An Intertidal survey will also be conducted to establish presence/absence of mudprawns, sandprawns etc. Density estimates will be done at numerous sites. Technique: ○ Hyperbenthic sampling will be conducted using a rectangular net mounted on skids that is pulled across the bottom. ○ Benthic samples will be collected with a grab that bites into the substrate – the sample is then sieved through a mesh bag ○ Zooplankton samples will be collected using the benthic sled at night ○ At each site a sediment sample will be collected ○ At three (3) sites environmental parameters will be measured namely temperature, salinity, etc. Samples will be analysed in a laboratory. The information from the site visit, as well as the information provided by Schlumburger (specifically and information relating to a possible increase in salinity in the estuary) will be utilised to compile a report that describes both the structure and function of the Groen River estuary. The report will discuss the implications of an increase in salinity on the ecosystem functioning of the Groen River estuary. Information from Schlumburger will be used to identify and assess anticipated impacts (including any changes to the ecosystem functioning of the estuary) due to indirect impacts on the salinity content as a result of the proposed project, should these in fact be determined as potentially occurring.
SANParks	A full tourism impact study Given the importance of tourism for NNP, SANParks request that a full tourism impact study, in terms of the potential impacts on tourism opportunities in the park, be undertaken. The park is heavily dependent on its sense of place, and it appears that the tailings facility will be visible across much of the park. Furthermore, the increased traffic and other mining activities on the road to the Groen River mouth, could significantly	Please note that the visual impact assessment acknowledges that there will be views of the mine from the park. It does, however, state that these areas are currently uninhabited. It is noted that SANParks may in the future wish to develop uninhabited areas within the park, however according to the NNP Management Plan the only infrastructure planned for the current planning cycle is an entrance control point and a new rest camp near the Hondeklip Bay road (far north from site). Thus any new planned development will not be impacted on by the mine (including the TSF). It should also be noted that the TSF will not be 27 m in height from the start but will be built up over the period of mining. Thus the visual impact on the NNP is considered to be low. In regards to traffic, the traffic and transport assessment acknowledges that there will be a significant increase in traffic on the district road. However, please not that a number of mitigation measures have been recommended that will decrease the impact to that of moderate significance. Furthermore, the road will be upgraded and will

I&AP	ISSUE/CONCERN	RESPONSE
	impact on tourism in this area.	thus provide improved access to not only mining vehicles but also local residents and tourists which may be considered to be a positive impact in this regards. In addition to this, the social specialist interviewed a number of people in this regard and states the following: "*For purposes of this SIA and in the context of this project, tourism can be divided into eco- and business tourism. Ecotourism can be defined as an influx of people to the area specifically drawn to the area for its natural beauty and flower season. It is one form of tourism that usually attracts people to the area's fragile, yet pristine and relatively undisturbed natural areas. This is in stark contrast to mass tourism (related to leisure tourism, site of cultural significance or holiday destinations), which this area does not experience significantly. A business tourist, alternatively, can be defined as someone who is drawn to a specific place for business or professional reasons. From an ecotourism perspective, some expressed concern that the mine would change the area's landscape and would fail to attract tourists in the future. However, from discussions with the KLM, as well as the communities and some of the affected farm-owners, some agree that the mine should not really affect the area's tourism industry significantly. As claimed by many, people are not attracted to the farming areas, but prefer to visit the Namakwa NP and areas known for their flower displays around the town of Garies. According to Mr van Lente (SANParks), the development of the mining industry could in fact stimulate and increase the area's tourism potential. It is believed that more guesthouses might mushroom to cater for the mine's needs. The same guesthouses might also be able to cater for more tourists. However, the latter could only be achieved if resources are allocated to promoting the area's biodiversity and conservation importance.* *Lastly, considering business tourism, it is anticipated that the mining development will increase business tourism, as more opportunities will be created for accommodation in the area. This, in return, will have a positive add-on (or spill-over) effect on other sectors as well (such as the food industry)."* For the reasons listed above a tourism assessment is not deemed necessary, however in the spirit of co-operation a section on tourism will be incorporated into the economic assessment.
SANParks	A full peer review Given the very high biodiversity importance of the proposed 3,500 ha mining footprint, rated as Category B (highest risk for mining and biodiversity importance), within the buffer zone of NNP. SANParks are of the opinion that a full review of the Environmental Impact Assessment (EIA) is justified and that this review be performed by suitably qualified professional.	Please note that the project area <u>does not</u> fall within a category B project. It falls within a category C as explained above. In terms of the Environmental Impact Assessment (EIA) Regulations (GNR 543) as promulgated under the National Environmental Management Act (No. 107 of 1998) (NEMA) and the National Environmental Management Second Amendment Act (No. 30 of 2013), it is not a regulatory requirement for the EAP to submit any reports to an independent specialist for peer review. The EIA regulations also clearly states in Chapter 3, Section 18 (Disqualification of EAPs or a person compiling a specialist reports or undertaking a specialist process), subsection (5) – "If, after considering the matter, the competent authority is unconvinced of compliance with regulation 17 by the EAP or or person compiling a specialist report or undertaking a specialised process, the competent

I&AP	ISSUE/CONCERN	RESPONSE
		authority must in writing, inform the EAP or person compiling a specialist report or undertaking a specialised process and the applicant accordingly and may—(b) request the applicant to – (i) commission, at own cost, an external review by an independent person or persons of any reports prepared or process conducted by the EAP or person compiling a specialist report or undertaking a specialised process in connection with the application". The Regulations also indicates in Chapter 3, Part 3, Section 34 (Consideration of Environmental Impact Assessment Reports) that "(2) the competent authority must, within 60 days of acknowledging receipt of an environmental impact assessment report, in writing— (b) reject the report if it does not substantially comply with regulation 31(2) and (i) notify the applicant that the report has been referred for specialist review in terms of section 24 of the Act". Therefore based on the above, peer review of Environmental Impact Assessment reports or Specialist reports are not a regulatory requirement and should the actioned by the Competent Authority should they deem it necessary.
SANParks	SANParks strongly request the involvement of the DEA on a national level in this project. Goal 3 of the Biodiversity Policy and strategy for South Africa: Strategy on Buffer Zones for National Parks, p.15, stated as follow: "All developments in the buffer zone of a national park requiring an environmental authorisation ito NEMA, will be subject to an environmental impact assessment process on a national level". SANParks would like to suggest that the EAP informs DEA: Sensitive Environment section, about the proposed mining application in the buffer zone of NNP, in order for DEA to decide on the extent of their involvement in this matter.	CES met with SANParks in the initial round of public participation in July 2013. SANParks was asked to provide information on the Park's expansion strategy and to indicate if the proposed mining area falls within this area. SANParks indicated that they intended to expand in a southerly direction and did not raise any concerns at that time regarding this application. SANBI's BGIS site was also perused to determine the location of the site in relation to protected areas and expansion areas. Information on this portal indicates that the proposed site is not within any of these areas. During the Scoping Phase, it was brought to our attention by the specialist botanist that the site falls within the park's buffer area. CES contacted Bernard van Lente of SANParks to confirm this information and received maps on the 2nd of April 2014. It should be noted that this information was provided the same day the Final Scoping Report had been approved by DENC (i.e. the report was approved on 3rd of April 2014 and information was received on the 3rd of April – please refer to e-mail included below). From: Bradshaw, Peter (Dr) (Summerstrand Campus South) [mailto:Peter.Bradshaw@nmmu.ac.za] Sent: 03 April 2014 08:39 AM To: Lara Crous Cc: Bernard van Lente Subject: RE: Namakwa expansion kmz Hi Lara Please find attached a map indicating the potential mining areas, as well as the SANPArks

I&AP	ISSUE/CONCERN	RESPONSE
		managed land, parks buffer zones and expansion footprint (which indicates areas where the park might potentially expand, if an opportunity presented itself). I will clip this expansion footprint to your area of interest, and send you the KMZ. Kind regards Peter Furthermore, whilst we understand that the site falls within the buffer zone which can be promulgated in terms of Section 24(2)b, the area is not formally protected through such promulgation. Furthermore, it is not protected by an international environmental instrument as confirmed in Section 2.8 of the Namaqua National Park Management Plan (International Listings – None), and as such, this section is not applicable to this application. In addition, as far as we are aware, the NNP buffer zone has not been declared in a Governemnt Gazette. Notwithstanding SANParks' plans to expand the NNP there is nothing in the Listing Notices to the NEMA EIA Regulations (2010, as corrected) as they currently stand to suggest that the proposed mining project falls within the competence of the Department of Environmental Affairs, and the application has therefore been directed to and accepted by the Nothern Cape Department of Environment and Nature Conservation. Nevertheless, the DEA Biodiversity and Conservation Department was notified of the project on the 31st of October 2014 as suggested by SANParks regarding the availability of the Draft EIR (proof included below and in Appendix F of the Final EIR). To date no comments have been received.  REGISTERED LETTER GEREGISTREERDE BRIEF Post Office (with an insurance option/met 'n versekeringsopsie) Full tracking and tracing/Volledige volg en spoor Addressed to/Geadresseer aan DEA : BIODIVERSITY & CONSERVATION PRIVATE BAG X447 PRETORIA 0001 Postcode Postkode Postage paid R c Service fee/Diensgeld R c Insurance/Versekering R c Total/Totaal R c Insured value of contents Versekerde waarde van inhoud R c Enquiries/Navrae Toll-free number Tolvry nommer 0800 111 502 Initial of accepting officer Paraaf van aaneem-beampte Date stamp 31 OCT 2014 SA POST OFFICE Datumstempel REGISTERED LETTER CUSTOMER COPY 301028R 701281
SANParks	Biodiversity offsets With regards to the EAP's	Please note that this comment is contradictory and needs to be clarified for the following reasons. It states that: "If it became clear that a biodiversity offsets should be considered and

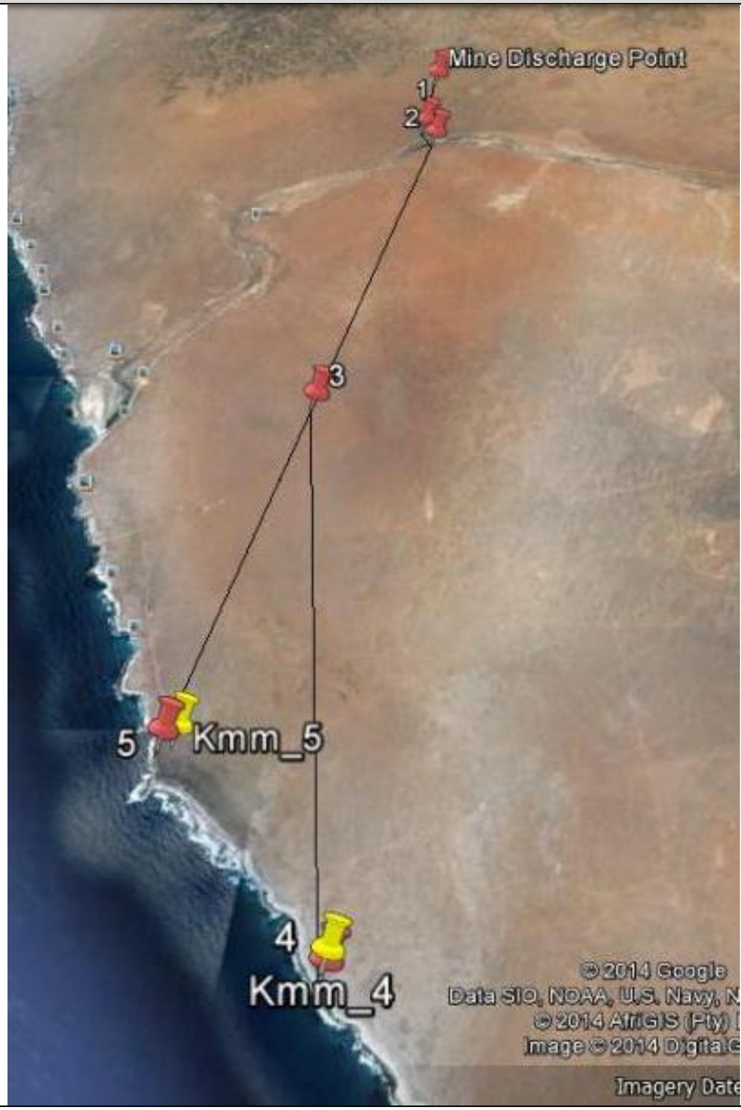
I&AP	ISSUE/CONCERN	RESPONSE
	recommendation that discussions with SANParks will be held in respect of biodiversity offsets, the following: Biodiversity offsets are measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised or rehabilitated or restored, in order not to achieve no net loss or a net gain of biodiversity. The Mining and Biodiversity Guidelines, Western Cape Offset Guidelines and SANBI Draft Biodiversity Offset Guidelines provide clear guidance on the process to be followed concerning a Biodiversity offset process. If it became clear that a biodiversity offsets should be considered and should an environmental authorisation be granted then SANParks Strongly recommends that an experience Biodiversity Offset Facilitator in consultation with SANParks, be appointed, to scientifically calculate and design the biodiversity offset in terms of the Western Cape and SANBI Offset guidelines. Furthermore, the Biodiversity Offset Report should form part of the Environmental Impact Assessment Report (EIAR) and its recommendations should be included as conditions of the Environmental Authorisation.	should an environmental authorisation be granted then SANParks Strongly recommends that an experience Biodiversity Offset Facilitator in consultation with SANParks, be appointed, to scientifically calculate and design the biodiversity offset in terms of the Western Cape and SANBI Offset guidelines.” This implies this should be done once the project is authorised. The latter half of the comment states: “The Biodiversity Offset Report should form part of the Environmental Impact Assessment Report (EIAR) and its recommendations should be included as conditions of the Environmental Authorisation.” Which implies it should be done as part of the EIR. According to the EAP the former approach should be adopted. The EIR states the following in Section 7.2 (vi): “It is thus recommended that the prospecting area referred to as Roode Heuvel, which has been identified by the ecologists as an area of high sensitivity is continuously rehabilitated back to its natural state throughout the life of mine as the mine path progresses, and at post closure the land is offered to Namaqua National Park (NNP) for incorporation. This will tie in with the expansion strategy for the NNP as depicted in Figure 7.4 below, the intention of which is to include the western portion of Roode Heuvel into the NNP footprint. Should the NNP decline the offer of incorporating this area, a biodiversity offset in close proximity to the proposed development will need to be established. Under this scenario the land post-closure would be rehabilitated back to agricultural land.” Thus a biodiversity offset has been recommended by the EAP and could be incorporated in the environmental authorisation as a condition if the competent authority deems it necessary. In which case the proponent will be obligated to comply as the EA is a legally binding document. Based on the above it is recommended by the EAP that a biodiversity facilitator is appointed once the authorisation is received as it is premature to complete this work prior to authorisation being granted.
SANParks	SANParks reserves the right to revise these comments based on additional information that may be received, additionally, to oppose the mining right application if these comments are ignored.	Noted
ISSUES RAISED IN REGARDS TO THE EMP (PLEASE NOTE THAT THE MAJORITY OF THE COMMENTS RAISED IN THIS DOCUMENT RECEIVED FROM SANPARKS ARE EXACT DUPLICATES OF THE COMMENTS RECEIVED ON THE EIR AND THUS ONLY COMMENTS THAT ARE DIFFERENT		

I&AP	ISSUE/CONCERN	RESPONSE
FROM THE PREVIOUS COMMENTS WILL BE ADDRESS AS THE DUPLICATES HAVE BEEN RESPONDED TO IN THE SECTIONS ABOVE).		
SANParks	Would you kindly indicate in terms of which provisions of the MPRDA this draft ESMPr has been issued? Section 39(5) of the MPRDA requires all applicants for a mining right to submit an EMP (environmental management plan) and an EMPr, strictly in accordance with the subject headings and guidelines published on the DMR website. This ESMPr has been standardised and adapted to the requirements stipulated in the Equator Principles (EP III 2013), the International Finance Corporations (IFC) Performance Standards on Environmental and Social Sustainability (2012) and associated Environmental, Health and Safety (EHS) Guidelines. Kindly indicate whether DMR approval has been granted for this departure from DMR guidelines and legislative requirements. Furthermore, it is 11 standard practice that the Minister / Regional Manager, (DMR office), is responsible to request comments from state departments with regard to the application and compilation for EMP/EMPr, not the EAP – please confirm whether approval for this departure of provisions of Section 39 of MPRDA was granted by the Regional Manager, (DMR).	There seems to be a misunderstanding in regards to the documents reviewed by SANParks. The EMPr reviewed is the one drafted in accordance with NEMA as per regulation 33 of GNR 543. The EMPr drafted in accordance with the MPRDA was submitted directly to DMR as per Section 39 of the MPRDA as pointed out by SANParks. 12 Thus to clarify, two EMPr's were drafted for this project, one which complies with NEMA and which is subject to public participation as per regulation 56 of NEMA (reviewed by SANParks) and one which complies with the MPRDA submitted directly to DMR.
SANParks	Project alternatives – no project alternatives were considered which constitutes a fatal flaw. It is standard practice to consider (some) of the following project alternatives, the close proximity of Namaqua National Park, make this requirement even more urgent:	As stated above the EMPr reviewed by SANParks was the one compiled in compliance with NEMA. According to regulation 33 of GNR 543, there is no requirement for assessing alternatives within the EMPr and thus this is not a fatal flaw.

I&AP	ISSUE/CONCERN	RESPONSE
	I) Land use alternatives; II) Mining method alternatives III) Product handling and transport alternatives IV) Access alternatives V) Mine power alternatives VI) Location of RDP's VII) The No-Go option	
13 SANParks	The ESMPr does not provide an indication or proof of financial provision for remediation of environmental damage. To state that, "the proponent will be responsible for ensuring that sufficient financial resources are made available for the effective implementation of the requirements of this ESMP.", is inadequate and constitutes non-compliance of Section 41(1) of MPRDA. I&AP are supposed to comment on the financial provision for this mining application.	As stated above please note that the EMPr reviewed by SANParks was the one compiled in compliance with NEMA. The financial provisions in terms of the MPRDA were incorporated into the EMPr submitted to DMR and are included below for your convenience. "The financial provision calculated DMR EMPr was undertaken in terms of the Guidelines for Calculating the Quantum of Financial Provision as published by the DMR. It is important to note that at any one time only a small part, around 30-300 ha of the deposit will be exposed. Vegetation and topsoil removal, mining, concentration and tailings disposal will occur as a continuous process. The composition of the tailings from the PCP, which amount to > 90% of the mined material, will be unchanged by the process and will be immediately returned to the mining void as backfill material. Once the mine void has been backfilled (with a combination of tailings and slimes) the surface will be contoured and the topsoil that was previously removed and stockpiled as part of the clearing and stripping process will be returned and spread by bulldozers and replanted. As far as practical, the natural seed bank within the topsoil will be encouraged to germinate. This will involve developing the operational processes in a manner that minimises the length of time that topsoil is stockpiled. In addition to this, the rehabilitation report recommends that broadcast seeding of primarily pioneer vegetation that will rapidly germinate and stabilise areas are conducted. Due to progressive rehabilitation throughout the life of mine, the area calculated for the rehabilitation of the open cast mine was determined by providing an average size of the pit exposed at any one time during the mining process. In addition to the above, please note that only the components considered to be relevant to this mining project have been included in the tables and costed for. The financial provision required for the first year of operation using the DMR costing spreadsheet is R 30,957,989 while the financial provision required for the life of mine operation is R 79,877,699. It is recommended that the provision be reviewed after the first year of mining and that updated rates are used to give an accurate costing of rehabilitation activities."
COMMENTS RECEIVED DURING TWO PUBLIC MEETING HELD ON THE 19TH AND 20TH OF NOVEMBER 2014		
B. van Lente (SANParks)	Is there a going to be a desalination plant?	Yes, it will be located on the mine site.
B. van Lente	What is going to happen to the brine? Is it	The brine and other liquid wastes from desalination plants will be recycled as process water.

I&AP	ISSUE/CONCERN	RESPONSE
(SANParks)	possible to return the brine to the sea?	This is preferable to the discharge of brine into the coastal environment.
B. van Lente (SANParks)	Why is the tailings dam so high (27m)?	This is in preparation for the worst case scenario (in the event that all the tailings need to be deposited into the tailings dam). It is also for rehabilitation purposes. It will allow the side walls to have a gentle angle, making rehabilitation easier as well as allowing the structure to blend into the environment.
B. van Lente (SANParks)	I appreciated the transparency regarding new species and the sea water intake.	Thank you. Noted.
B. van Lente (SANParks)	Who owns the property where the seawater will be taken from?	The municipality.
B. van Lente (SANParks)	I am concerned about social negative impacts (theft, prostitution etc.)	These impacts are mainly related to in-migration of job seekers. The proponent will compile a Recruitment and Influx Management Plan which will mitigate these issues.
B. van Lente (SANParks)	What about potential salt penetrating the groundwater	Detailed monitoring of groundwater quality has been undertaken, as reported within the project EIA, to confirm that groundwater is naturally brackish with a TDS level averaging approximately 8 g/l. This reduces the inherent risk of degradation arising from any seepage of saline water from the Kamiesberg TSF or opencast backfill in any manner liable to significantly modify the beneficial use status of water. Long-term (100 year) projections of groundwater chemistry down-gradient of the Kamiesberg site suggest that TDS will increase temporarily to in excess of 20 g/l. This impact is, however, localized and is confirmed from groundwater elevation simulations to be confined to the aquifer system rather than to any surface water resource. The length of time over which saline water from the Kamiesberg site may migrate to the Groen River (of the order of 100 years) is, advantageous in that monitoring will be possible throughout the period of mine operations to validate the long-term impact projections presented in the EIA. This will afford opportunity for the implementation of any appropriate remedial action ahead of the migration of any plume to the latitude of the Groen River.
B. van Lente (SANParks)	Is the land going to be bought from the farmers?	Negotiations are still in progress.
Adriaan	Plants may not necessarily grow now but appeared 20 / 30 years ago and may only appear in 20 years' time. Not all plants grow at the same time on all of the farms.	Noted.
MacDonald	When will the mine be in operation if everything goes well?	If everything goes according to plan the mine will be in operation in 2017.
Mr Niewoud	Mr Niewoud crosses his sheep on the groenrivier road and is worried about safety	A number of mitigation measures has been recommended in the traffic and transport assessment to minimize the risk of increased traffic on the DR2938 on road users, these include the following: • The road must be upgraded to ensure that it is wide enough to allow two heavy vehicles

I&AP	ISSUE/CONCERN	RESPONSE
		to pass safely. The carriageway may need to be widened in places, and realigned at sharp bends. Construction work on the road upgrade must be done in such a way as to minimise disruption to local traffic. • A speed limit appropriate to the design and construction factors and characteristics of the road (such as width, horizontal and vertical alignment, grade, sightlines and surfacing material) must be specified for all construction vehicles, and strictly enforced. Signage must be erected at frequent intervals along the road. • Warning signage must be erected at all intersections, including at the intersections with farm access roads. • Operational trips must be minimised during the hours of darkness. Trips by heavy vehicles must, as far as possible, be avoided during the hours of darkness. • Deliveries by heavy vehicles must, as far as possible, be scheduled to avoid the formation of convoys. Sufficient distance must be maintained between heavy vehicles to allow light vehicles to overtake safely. • An Operational Construction Traffic Management Plan must be developed and implemented. • The Operational Emergency Preparedness and Response Plan must include provisions to deal with traffic accidents, and particularly accidents involving personal injuries, and all drivers must be made aware of the procedures to be followed. • Communication with the local community and individuals must provide regular information on the volumes of traffic particularly heavy vehicles, anticipated on the road during the operation of the mine.
Mr Niewoud	Mr Niewoud's farm is the third farm along the groenriviermond road and is concerned about dust from trucks transporting material along that road, even more concerned should the trucks be speeding.	Please note that the road will be tarred which will reduce any dust related impacts. In addition to this a speed limit appropriate to the design and construction factors and characteristics of the road will be specified for all construction and operation vehicles, and strictly enforced.
Dirk Van Zyl	Please clarify where the pipeline is going.	Included below is a map indicating the position of the proposed pipeline route.

I&AP	ISSUE/CONCERN	RESPONSE
		
Dirk Van Zyl	Is the pipeline going above or below the ground? It may result in cutting off the	The pipeline is above ground. A berth will be placed at regular intervals to make sure the animals can cross. There will be no fencing of the pipeline servitude.

I&AP	ISSUE/CONCERN	RESPONSE
	sheep from water troughs etc., it should run along the fence line	
Dirk Van Zyl	Will you negotiate with landowners prior to registering the servitude and get advice?	Yes.
ADDITIONAL COMMENTS RECEIVED		
Cornelia Klak	The Succulent Karoo has been identified as one of the 25 biodiversity hotspots in the world. The area, proposed for mining falls into this biodiversity hotspot. The Aizoaceae, where I am a leading expert, are one of the most diverse plant families found in the succulent Karoo (Snijman, 2013), with many being endemic to this area. Many Aizoaceae have very narrow distributions. Therefore, even the destruction of a fairly small area, could drive one or more species to extinction! A recent EIA study in the Garies area brought to light several new species, including two new species of Aizoaceae. One of them has been described so far, the other is in the process of being described. Two further new species were described from the Kamiesberg area in 2012, highlighting the incredible diversity of this area, which is still in the process of being described. It is tragic that such a biodiversity hotspot should be subject to mining at all. The Red Data book, for which I was major contributor, focused on areas which are currently under high threat due to extensive agriculture and urban expansion in the south western Cape. However, many species of Aizoaceae in the Succulent Karoo are naturally rare	We are very aware of the importance of the area from a botanical perspective, which is why we appointed Nick Helme to undertake the specialist work (have you seen his report?). Having discovered some new species, and some with very restricted distributions, we motivated to our client that Nick does further, surveys north and west of the site. As anticipated, he found additional specimens of all the new species, and identified suitable sites for possible biodiversity offsets. The fieldwork was undertaken from 1-12 August 2014, and the main focus species were Lachenalia sp. nov., Elegia sp. nov, Agathosma elata, Lampranthus procumbens and Leucoptera nodosa. During this survey all locations of these species were recorded, population sizes were recorded, and the areas were subsequently mapped. The EIA report and vegetation specialist study also makes sound recommendations for ecological corridors and other strategies to mitigate impacts. Unfortunately we cannot conserve areas without the financial resources to do so. And this has to come from the development process. In poor economies one sees almost no protected area, as the country simply cannot afford them. I have seen this in most Africa counties I have travelled to. How wish is therefore to find a balance between economic growth and resultant employment benefits, and environmental protection. The elusive goal of sustainable development. Please let us know if we can send you the reports, although they are available on our web page.

I&AP	ISSUE/CONCERN	RESPONSE
	and were unfortunately never assessed, since this region has so far been fairly little impacted by human destruction. Thus, the Red Data book is incomplete and does not give the status of rarity for many species of Aizoaceae which occur in the Succulent Karoo. In this country, I believe that I am the only person, who can identify these plants correctly and determine how rare they are. For a proper EIA, I would expect that I should be involved in the identification of the specimen of Aizoaceae from the area earmarked for mining.	
Vic Fitzmaurice	I wish to register as an IAP for this project.	Mr Fitzmaurice has been registered as requested.
Matthew Law	Please could you register me as an IAP for the Zirco Kamiesberg Project? My interest in the project relates to my involvement in environmental management of other mining operations in the region.	Mr Law has been registered as requested.

7. ALTERNATIVES

In terms of section 31 (2) of the EIA Regulations (2010), *an environmental impact assessment report must include:-*

(g) A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity.

(i) A description and comparative assessment of all alternatives identified during the environmental impact assessment process.

In addition, the definition of alternatives in section 1 of the EIA Regulations is *"different means of meeting the general purpose and requirements of the activity",* and s27€(iii) says that alternatives must be feasible and reasonable.

One of the objectives of an EIA is to investigate alternatives to the proposed project. There are two types of alternatives - Fundamental Alternatives and Incremental Alternatives.

7.1 FUNDAMENTAL ALTERNATIVES

Fundamental alternatives are developments that are totally different from the proposed project and usually involve a different type of development on the proposed site, or a different location for the proposed development. Since the core business of the project proponent is heavy mineral mining, the fundamental alternative of a development other than the proposed mine and associated infrastructure does not meet the general purpose and requirements of the proposed activity. Zirco holds the prospecting rights to the Roode Heuvel and Leeuvlei deposits, and is in the process of acquiring prospecting rights for the Sabies deposit immediately east of and adjacent to Roode Heuvel. Considerable effort has been expended in quantifying the size of the mineral resource in these areas, and no alternative locations for mining have been considered.

Accordingly no fundamental alternatives have been considered in this EIA, apart from maintaining the status quo (the No-Go option). Alternative locations for infrastructural components of the project that are not locality bound are, however, considered in section 7.2. The mine path is, of course, locality bound, as it is entirely dependent on the location of the resource being mined.

7.2 INCREMENTAL ALTERNATIVES

Incremental alternatives are modifications or variations to the design of a project that provide different options to reduce or minimise environmental impacts. There are several incremental alternatives that can be considered, including:

- The design or layout of the activity;
- The technology to be used in the activity;
- The operational aspects of the activity.

Various incremental alternatives have been considered throughout the EIA process. These include the following:

i. <u>Open Water vs Gully Seawater Intake</u>

Two types of sea water intake works have been proposed as a source of water for the mine, these include:

- Open water intake in Khnyp Bay or elsewhere as a stand-alone installation;
- Gully Intakes.

Open Water Intake in Khnyp Bay or elsewhere as a stand-alone installation

An open water intake would include the following components:

- **A beach crossing**: Stretching from the head works landward of the primary dune to approximately the low water line. The construction of this section would consist of an open dry excavation which would be protected by a cofferdam.
- **A surf zone crossing**: From the low water line to the limit of the breaker zone. There are two methods of construction for this section. The first consists of an open wet excavation between rock embankments in protected waters, while the second consists of a protected excavation inside a rock cofferdam with the seaward end closed off to exclude wave action inside the cofferdam.
- **An offshore zone pipeline**: From the breakwater zone to the intake structure. This section could be constructed without a cofferdam utilising times of calm sea conditions.
- **An intake structure**.

The above components are shown in the layout diagram in Figure 7.1.

The offshore environment is likely to be less sensitive than the inshore environment (lower biodiversity and lower density of fish and invertebrate larvae offshore). However, the impacts of building a pipeline that extends into the offshore environment would have a much higher impact in terms of disrupting water movement patterns (waves and currents) as well as natural sediment movement,and would also result in the loss of a much greater amount of marine habitat in the pipeline footprint. For this reason this alternative is considered to be not feasible as an option which will result in a lower impact (i.e. gully intake) is available.

Gully Intake

Due to the rocky nature of the coastline in the area of the proposed development, it is feasible to construct a gully type intake. In addition to this, according to the marine assessment, all impacts associated with the construction, operation and decommissioning of the proposed gully intake can be reduced to low significance with the implementation of appropriate mitigation measures.

Based on the analyses above the construction of a gully intake is the preferred option and thus the option of an open water intake will not be assessed further in the EIR.

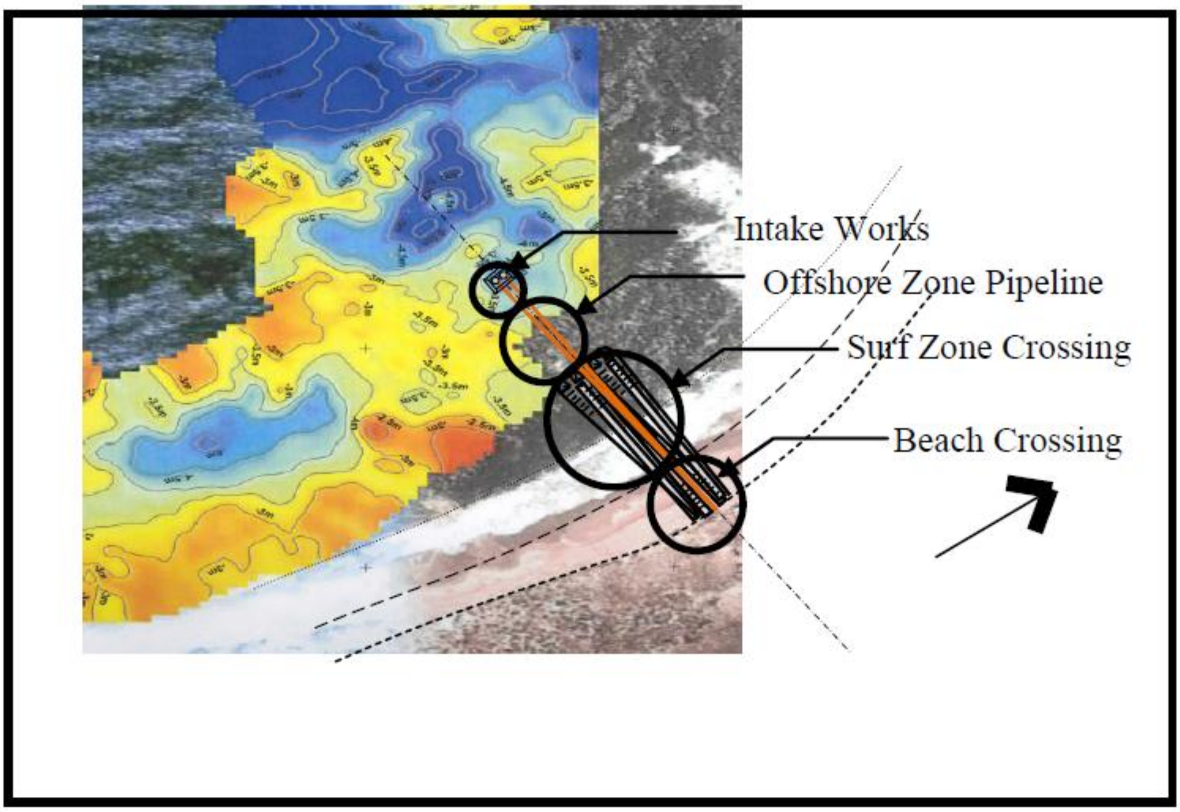


Figure 7.1: Proposed intake works at Khnyp Bay
(Source: Bergstan Africa)

ii. Alternatives Locations for a Gully Intake

Seven gullies were considered for the proposed gully intake; these are described in detail below and depicted on Figure 7.2. The proposed gully intake sites were divided into preferred sites and lesser preferred sites. This prioritisation was undertaken during the field survey in consultation with Bergstan Africa Development Engineers. The preferred sites from an engineering perspective included KMM1, KMM4 and KMM6. The lesser preferred sites included KMM2, KMM3 and KMM5. What follows is an analysis of the various options.

PARK 1

This site is located within the Namaqua National Park and the proposed Namaqua Marine Protected Area (MPA). Development at this site is in contravention of the law (the relevant sections are presented below) and thus this option was not assessed further in the EIA process.

Section 4 of the National Parks Act 57 of 1976:
"*Object of a Park*
The object of the constitution of a park is the establishment, preservation and study therein of wild animals, marine and plant life and objects of geological, archaeological, historical, ethnological, oceanographic, educational and other scientific interests and objects relating to the said life or the first-mentioned objects or to events in or the history of the park, in such a manner that the area which constitutes the park shall, as far as may be and for the benefit and enjoyment of visitors, be retained in its natural state."

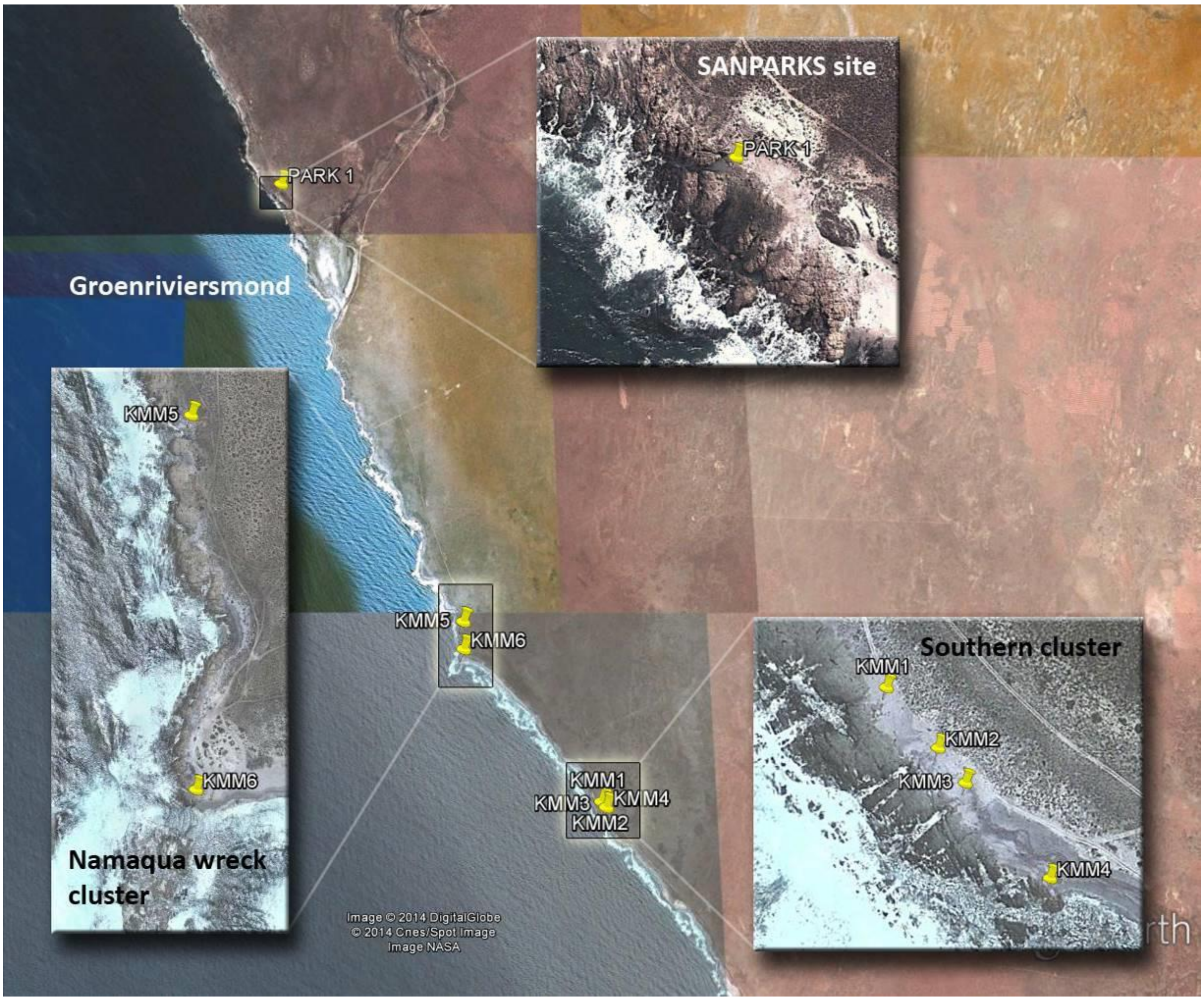


Figure 7.2: Alternative gully locations for seawater intake
(Source: Anchor Environmental)

Section 43 of the Marine Living Resources Act:
"Marine protected areas
43. (1) The Minister may, by notice published in the Gazette, declare an area to be a marine protected area—

(a) For the protection of fauna and flora or a particular species of fauna or flora and the physical features on which they depend;
(b) To facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or
(c) To diminish any conflict that may arise from competing uses in that area.

(2) No person shall in any marine protected area, without permission in terms of subsection (3)—

(a) Fish or attempt to fish;
(b) Take or destroy any fauna and flora other than fish;
(c) Dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment;
(d) Construct or erect any building or other structure on or over any land or water within such a marine protected area; or
(e) Carry on any activity which may adversely impact on the ecosystems of that area.

(3) The Minister may, after consultation with the Forum, give permission in writing that any activity prohibited in terms of this section may be undertaken, where such activity is required for the proper management of the marine protected area."

Proclamation of the Namaqualand MPA is on the Department of Environmental Affairs' workplan agenda for 2014 (pers. comm. Dr. Kerry Sink, SANBI). Furthermore the Systematic Marine Biodiversity Plan for the West Coast of South Africa (Majiedt et al. 2013) shows that the proposed MPA falls within a high priority conservation area and is regarded as a Primary Focus Area for Protection. Further findings within this publication state that Namaqualand Inshore Reef, Inshore hard Grounds and Inshore Sandy areas are critically endangered habitat types. Selection of this site for a seawater intake is likely to invoke significant resistance from South African National Parks and the Department of Environmental Affairs and is therefore strongly discouraged.

KMM1

Gully KMM1 is a preferred (potentially impacted) site because it offers good protection from wave action. However, the maximum depth recorded during low tide was measured at only 1.3 m and an extensive rock shelf closes it off to open water during spring low tide, reducing it to a shallow pool. A significant amount of blasting would be required to deepen this gully and remove the rock barriers to ensure a constant supply of seawater. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

KMM2

Gully KMM2 is a lesser preferred (control) site with maximum depth measured at 1.7 m at spring low tide. It is blocked off to the sea during spring low tide and reduced to a small puddle. Significant blasting would be required to both deepen it and to ensure a continuous flow of seawater for abstraction. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

KMM3

Gully KMM3 is a lesser preferred (control) site with maximum depth measured at 1.5 m during spring low tide. A rocky barrier closes the mouth off to the sea during spring low tide and it too is reduced to a small puddle. Significant blasting would be required to both deepen it and to ensure a continuous flow of seawater for abstraction. Given the close proximity to KMM2, it also has no adjacent sandy beach or sand dunes likely to be impacted.

KMM4

Site KMM4 is a preferred (potentially impacted) site with a maximum depth of 2.4 m during spring low tide. This site is favoured because there are no rocky barriers which cut off flow to the open sea during spring low tide and therefore a good flow of seawater is maintained throughout the gully. It is also the deepest gully out of all the proposed sites and would be well suited for seawater abstraction. However, some blasting would be required towards the beach-end of the gully as there are some large rocks between the deepest part of the gully and the beach. A steep reflective beach is adjacent to the south and is largely composed of coarse sediment and dead mussel shells, an environment largely devoid of infauna.

KMM5

Gully KMM5 is a lesser preferred site with a maximum depth of 1.7 m recorded at spring low tide. It is well protected by an outer rock shelf behind which a deep extensive pool exists with good supply of water from the open sea. Shoreward, this leads into a very shallow and well barricaded gully. The sheltered environment described above is echoed in the community structure of the intertidal biota – the open coast (exposed) survey site being more similar and clustering with the sheltered gully sites. Significant blasting would be required to run a pipeline through this gully to reach the deep outer pool. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

KMM6

Gully KMM6 is a preferred site with a maximum depth of 1.6 m recorded at spring low tide. It is a shallow channel which runs inside of the point of the Namaqua Wreck. At spring low tide the channel dries out completely with only a small trickle connecting the two sides of the point. A sandy beach adjoins this proposed site where numerous holes indicate presence of the giant isopod, *Tylos*. Many species utilise this area; eight different species of bird in the vicinity of the Namaqua wreck and Cape fur seals hauling out on the rocks.

Taking into consideration the ecological sensitivity/significance of the various sites, the suitability of each site for construction of a seawater intake was scored from 10 (most suitable) to 1 (least suitable). Table 7.1 below summarises the results. It is concluded that site KMM4 is the most preferred, followed by sites 1, 2, 3 and 5, with the Park Site least favourable.

Table 7.1: Ecological sensitivity / significance of candidate seawater intake sites

Site Number	Ecological Score (Sensitivity/Significance)	Criteria
KMM1	6	• Relatively low number of species • No adjacent sandy beach or sand dunes • Significant blasting required • Outside national park and proposed MPA
KMM2	6	• Relatively low number of species • No adjacent sandy beach or sand dunes • Significant blasting required • Outside national park and proposed MPA
KMM3	6	• Relatively low number of species • No adjacent sandy beach or sand dunes • Significant blasting required • Outside national park and proposed MPA
KMM4	8	• Average species richness • No adjacent sandy beach or sand dunes • None/small amount of blasting required • Outside national park and proposed MPA
KMM5	5	• High number of species • No adjacent sandy beach or sand dunes • Significant blasting required • Outside national park and proposed MPA
KMM6	3	• Relatively high species richness • Eight different bird species utilising intertidal zone • Cape fur seals hauling out on the rock • Legal implications (wreck site) • Outside national park and proposed MPA

Site Number	Ecological Score (Sensitivity/Significance)	Criteria
PARK1	1	• Legal implications (South African National Park) • Proposed MPA • High species richness and habitat types critically endangered • Ecologically sensitive adjacent sandy beach and sand dunes • Blasting possibly required.

Based on the above PARK1 and KMM6 were excluded from any further assessment in the EIR.

According to the Marine Assessment, it is recommended that the seawater intake pipe be installed at ***gully site KMM4***, provided that the suggested mitigation procedures are followed. This gully was shown to be the deepest of all those surveyed and would therefore not require as much blasting as the other proposed sites. Furthermore, this site demonstrated good connectivity with the open sea during spring low tide, thus ensuring that seawater can be abstracted at the recommended velocity of 0.15 m/s without risk of drying the gully out. In addition to this the southern gully cluster, in which KMM4 is situated, does not have any adjacent sandy beaches or vegetated sand dunes likely to be impacted. However, based on the results of the field survey, it is apparent that the sheltered gully sites displayed significantly lower biodiversity and abundance of intertidal rocky shore biota in comparison to the open water (exposed) sites – which had significantly greater levels of biodiversity and abundance. Furthermore the benthic biota at these sites is not of great significance in terms of conservation status. This would suggest that perceived impacts of the construction and decommissioning phases of the intake point would be fairly low within any of the proposed gully sites (i.e. KMM1, KMM2, KMM3, KMM4, KMM5). The cost of the construction of the pipeline, however, varies significantly between KMM5 and the southern cluster (KMM1-4). Due to the fact that KKM5 is situated closer to the mine site, the cost of construction and operation (water pumped over shorter distance) is lower than that for KMM4, thus KMM 5 is preferred from a financial point of view. Furthermore, the construction of KKM5 will also result in a reduction in disturbance of vegetation (due to its reduced length) and thus is also preferred from a terrestrial ecology perspective. KMM5 is thus the preferred option.

iii. Transport of Product

Three options were considered for the transport of product from the mining operation to the markets:

1. A combination of rail and road haulage.
2. Road transport only.
3. Marine Transport and Port Facilities.

Rail and Road Haulage

The rail and road option will involve transporting product by road from the mine site to the rail siding at Bitterfontein, approximately 85 km to the south east of the mine site. From there product will be loaded into a silo loading facility, purpose built at the Bitterfontein siding. This will be used to load rail wagons and the product will be railed over a distance of 540 km to Saldanha Port for export to overseas markets. At Saldanha a storage facility to hold 2-3 months of production will be constructed together with loading infrastructure for shore to ship loading. The construction of these bulk handling facilities presents challenges as the general goods terminal has no gantry or crane facilities.

In addition to this, transport by rail over a distance of 500 km is a significant operational cost and the preference would be to use the Sishen rail line, which reduces the distance to 240 km. Protracted negotiations to obtain permission to use the Sishen line are anticipated, as this line is dedicated to Iron Ore shipment and also caters for Namakwa Sands products.

Due to the extreme costs involved in this option as well as the fact that an additional storage facility will be required at Bitterfontein, increasing the development footprint, it has been deemed unfeasible and therefore will not be assessed further in the EIA.

Road Transport Only

The second option is to transport product by road (N7) all the way from the mine site to Saldanha Port, using a 37 tonne pay load horse plus 2 trailers. This will result in relatively large volumes of road traffic along the N7, estimated at 20 round trips per day.

This option has been chosen as it requires the least capital expenditure and offers the most flexibility. Once trucks have been loaded they can continue to Saldanha without the additional triple handling inherent in transferring material from truck to rail in Bitterfontein and back to truck in Saldanha. Existing contractors are already operating trucks for the same material with storage and loading facilities set up in Saldanha. Thus no additional loading and storage facilities would need to be built in Bitterfontein and specialist rail rolling stock would not need to be fabricated.

Marine Transport and Port Facilities

In this last option, the heavy minerals will be transported to the coast by truck or pumped there as a slurry, andthen be pumped as a slurry directly to the ships hold, using a subsea pipeline and Single Point Mooring (SPM) buoy. Three pipes will be required for the subsea section of the piping network, although only two will be used simultaneously. The third pipe will function as a back-up in the case of a failure occurring. The return water pipe is a continuous pipeline from the ship to the mine. The pump station on the ship will be used to pump the water onshore and a booster station onshore will provide the required energy to pump the water the remaining distance to the mine. However based on cost analysis this alternative has been excluded and will not be assessed further in the EIR.

Based on the analyses above the use of road transport is the preferred option and thus the options of road/rail and marine transport were not assessed further in the EIR.

iv. Water Use

Even though a dry mining process is anticipated, the proposed operation will require large volumes of water, as a wet separation process is required to separate the HMC from the sand tails. Although water is recycled via the slimes thickener, a certain percentage of water remains tied up with the thickened slimes and sand tails in the backfill areas. Zirco estimates that up to 12 Gl (12 million m^3) of make-up water will be required per annum, translating to 33 000 m^3 per day. It is anticipated that seawater will be used for processing in the PCP (wet plant) as there is insufficient groundwater available for this purpose.

An estimated 690 000 m^3 per annum of freshwater will be required for human use, including for drinking, and also to remove salt from the HMC prior to it going into the MSP. There are currently two options for the provision of freshwater for HMC washing:

1. The use of groundwater resources. Preliminary groundwater investigations indicate that the ground water is brackish (total dissolved solids from 17 sampling points in the mining area range from 3 300 mg/l to 9 470 mg/l, with an average of 6 920 mg/l), and therefore will need to be desalinated before being used to wash the HMC prior to entering the MSP.
2. The use of seawater: Desalination of seawater to use for HMC washing is a second option, as the use of seawater has been successfully implemented at a number of heavy mineral mining operations worldwide.

To determine the availability of groundwater for the provision of freshwater required for the washing of HMC, pump tests were conducted on 3 boreholes in the concession area. Of these three boreholes the blow yield[8] of ZIRCH03 (situated within the floodplain of the Groen River) – 10.9 l/sec - was higher than expected for the region, and a constant discharge test was carried out at a maximum pump discharge rate of 10 l/sec for 39 hours. During this test the drawdown of the groundwater level stabilised after 7 hours at approximately 30% (23.38m) of the available drawdown of 772m, and remained relatively static for the remainder of the test. On cessation of pumping, the borehole recovered to within 95% of the maximum drawdown within 2 hours. It is thus anticipated that borehole ZIRCH03 is able to sustain a yield of approximately 10 l/sec. In addition to this, the geometry of the river and the results of a resistivity survey of the Roode Heuvel block (which included four transects across the Groenrivier valley) indicate that it is likely that there may be an additional two areas in the Groenrivier valley from which similar yields may be expected from boreholes.

It is therefore possible that a total of approximately 30 l/sec of groundwater (approximately 950 000 m^3/a) could be available for abstraction. This is more than the required volume of 690 000 m^3/a, but it has not yet been definitely determined if this abstraction rate will be sustainable over the long term. It is therefore recommended that this option is excluded from further analysis until such time as it can be determined if high-volume and long-term abstraction will not result in significant drawdown, which may in turn affect local farmers in the region.

Based on the analyses above the use of seawater ONLY is the preferred option and thus no groundwater will be utilised for processing. As a result this impact was not assessed further in the EIR, and the focus was on an assessment of establishing a desalination plant on the mine, with seawater abstraction as described above.

v. Location of the airstrip

There were initially three possible locations for the airstrip (Figure 7.3). One option (Option 1) was recommended by the client and two options (Options 2 and 3) were recommended by the botanist. Option 1 for the airstrip was in an area degraded by agricultural activity. However, according to the botanist this area is in a vegetation type identified as Sand Fynbos, with a sensitivity rating of HIGH due to the high number of SCC occurring within this vegetation unit. This area has subsequently been incorporated into the suggested ecological corridor system and has been identified as one of the areas that could potentially function as a nursery for transplanted SCC identified during search and rescue prior to development. The establishment of an airstrip here has thus been excluded as an option.

8 Blow yield: The volume of water per unit of time blown from the borehole during drilling – an indication of the rate at which groundwater can be abstracted from a borehole.

The two locations identified by the botanist (Options 2 and 3) were located within an area in the adjacent prospecting area referred to as Sabies. These locations are within and/or in close proximity to riverine areas and have subsequently also been incorporated into the proposed ecological corridor system. In addition it is currently uncertain as to when (or if) this area will be mined, and thus it is not ideal for any infrastructure to be located within this region.

As a result a fourth position was recommended for the location of the airstrip, just north of the Year 8 mine path, in an area of low to moderate sensitivity. This is considered to be the preferred option for the location of the airstrip.

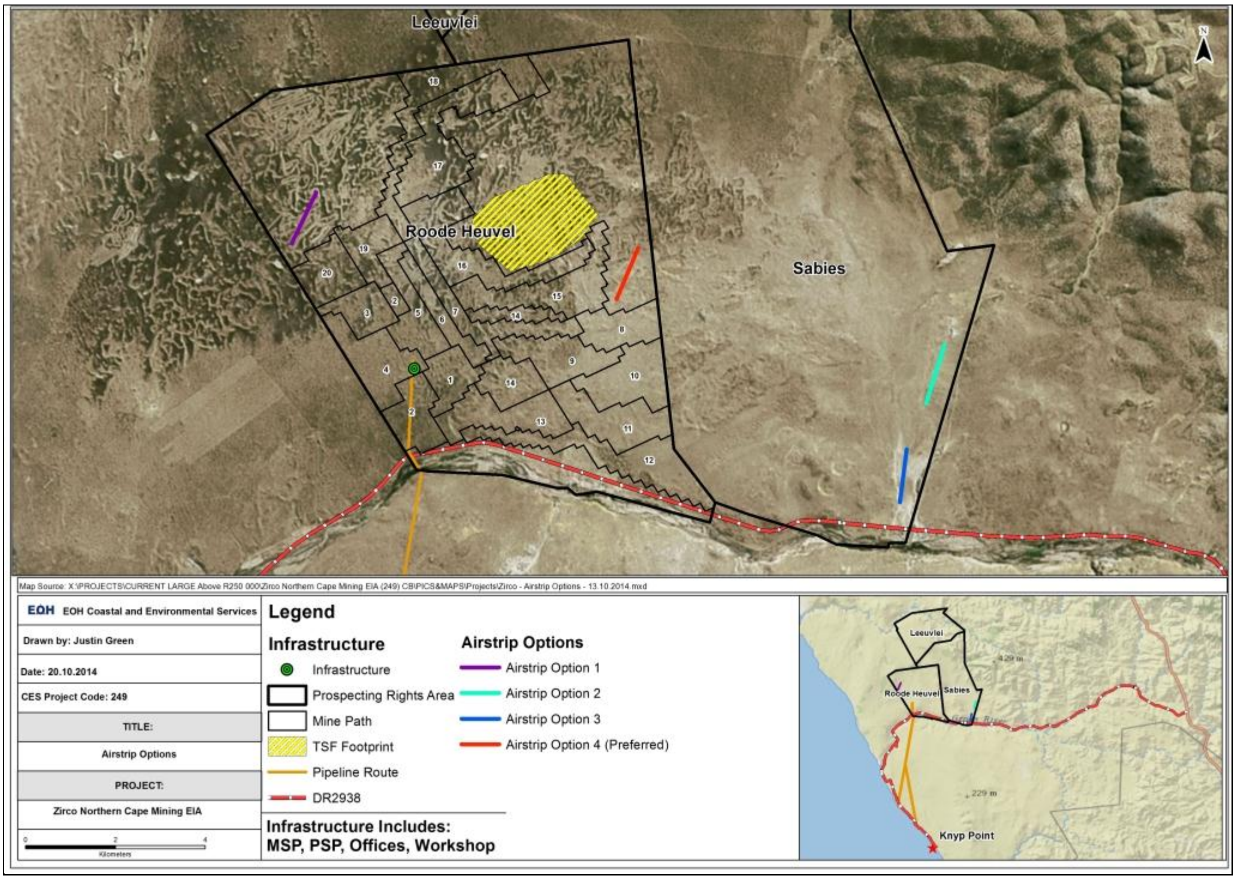


Figure 7.3: Alternative locations for the proposed airstrip

vi. ***Post-closure rehabilitation***

Various options were considered, based on the outcome of the specialist assessment for post-closure rehabilitation.

Option 1 was based on the soils and agricultural assessment, which recommended that the land should be rehabilitated back to agriculture to mitigate the impact of loss of agricultural land.

Option 2 was based on the ecological assessments (vegetation and fauna), which recommended that the area is rehabilitated back to its natural state for possible incorporation into the Namaqua National Park, which borders the proposed development in the north-west corner.

Based on the contradictory recommendations by the various specialist disciplines, it is the recommendation of the EAP that a third option is considered. Option 3 consists of a combination of the two Options above. It is thus recommended that the prospecting area referred to as Roode Heuvel, which has been identified by the ecologists as an area of high sensitivity is continuously rehabilitated back to its natural state throughout the life of mine as the mine path progresses, and at post closure the land is offered to Namaqua National Park (NNP) for incorporation. This will tie in with the expansion strategy for the NNP as depicted in Figure 7.4 below, the intention of which is to include the western portion of Roode Heuvel into the NNP footprint. Should the NNP decline the offer of incorporating this area, a biodiversity offset in close proximity to the proposed development will need to be established. Under this scenario the land post-closure would be rehabilitated back to agricultural land.

In addition it is recommended that the prospecting areas identified as Sabies and Leeuvlei are rehabilitated back to agricultural land, as the majority of the area has been identified to be of low to moderate sensitivity. Areas of conservation concern within the borders of these prospecting areas have been incorporated into the proposed ecological corridor system and will not be impacted.

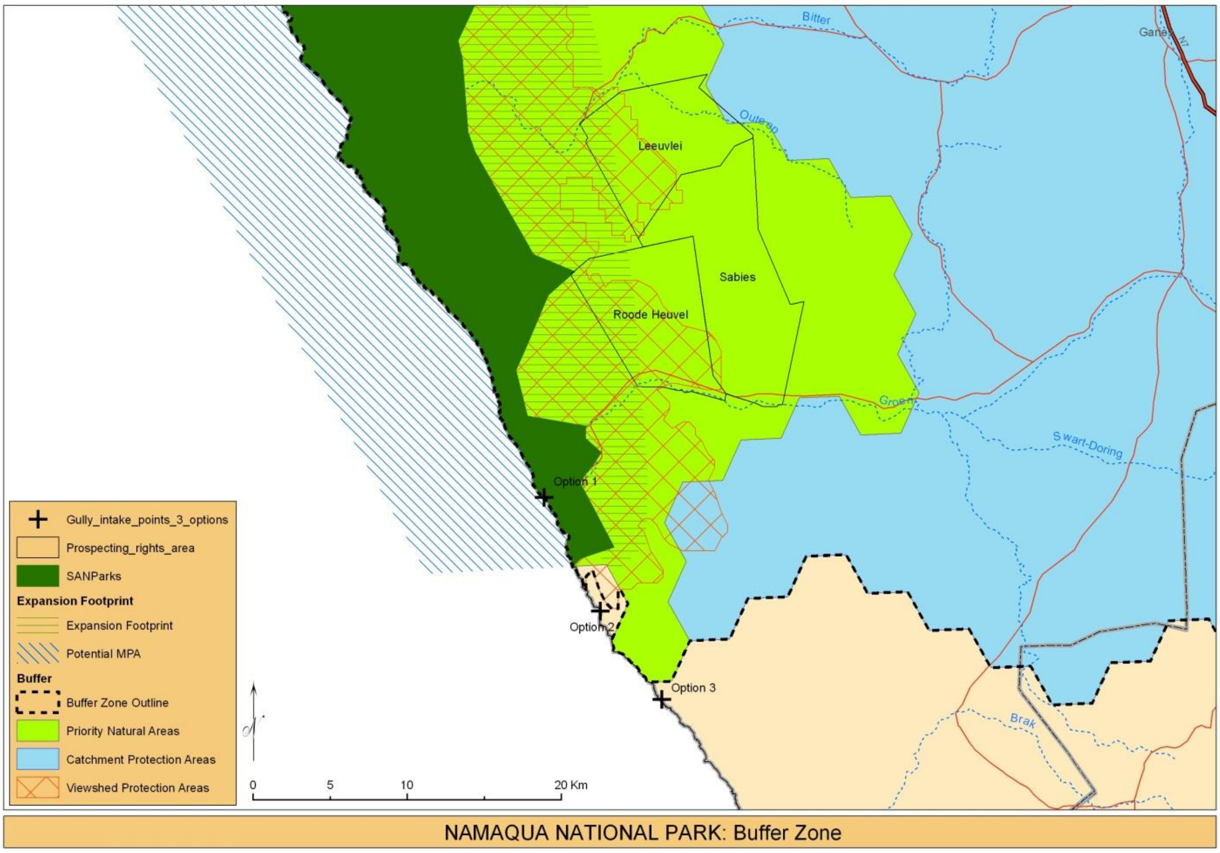


Figure 7.4: Namaqua National Park buffer zone

7.3 NO-GO ALTERNATIVE

The removal of vegetation during the mining process and the construction of associated infrastructure will cause the loss of important vegetation communities as well as habitat fragmentation. These are dynamic ecosystems that provide the habitats to support all forms of life. The study area, particularly the area referred to as Roode Heuvel and the north-eastern portion of Leeuvlei, is exceptionally rich in plant species.

However, it should be noted that the area consists of farms which focus on sheep and goat husbandry. The region has a low carrying capacity. In Namaqualand the carrying capacity is generally given as 1 small stock unit per 10 to 12 hectares. Certain farms, especially those with Sand Fynbos, also have fallow cereal fields. It seems that very few farmers still plant cereals, in spite of currently higher than average grain prices, and this is due to consistently lower rainfall than decades ago, when most of these fields were developed; however, the old lands are still clearly visible, as heavy livestock grazing has resulted in limited natural rehabilitation in these areas.

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing is unlikely to have resulted in total loss of any plant SCC in the area. However, current land use has impacted on the isolated populations of SCC, and reduced the total population numbers of about 5 to10 SCC. Overall no species or habitats are likely to have been lost, although degradation in certain areas (around stock kraals) has been intense. As a result current land use practices are having a moderate negative impact on biodiversity in general as well as on SCC.

Under the no-go option the land use of the area will remain as agriculture and based on the above information it is safe to assume that degradation of the SCC and vegetation communities will continue in the long term. In addition to this, for the no-go option, it is uncertain when/if this area will be incorporated into the NNP as per their expansion strategy. The proposed project, however, could assist in this regard upon closure of the mine.

In addition to this, the social and economic benefits provided by the project, such as, employment, skills development and local economic development will not accrue from the no-go option. The no-go option is therefore likely to have a high negative impact on social and economic development within the region.

8. KEY FINDINGS OF THE SPECIALIST STUDIES

In terms of section 31 (2) of the EIA regulations (2010), a*n environmental impact assessment report must include:*

(j) A summary of the findings and recommendations of any specialist report or report on a specialised process

8.1 SOILS AND AGRICULTURAL ASSESSMENT

An agricultural impact assessment was undertaken to identify and assess the significance of potential impacts associated with the proposed activity on the agricultural potential and the current soil conditions of the affected land.

The proposed development's primary impact on agricultural activities and soil conditions will involve the construction of the new Kamiesberg mineral sands mine site and associated infrastructure, as well as mining operations. The construction of the mine site and associated infrastructure will only influence a small area of the total local agricultural portion while mining activities will affect a large area over an extended timeframe (years).

The No-go alternative would mean abandoning the proposed development and as such there will be no negative impact on the environment as identified in Chapter 9 of this report. Furthermore it may also result in none of the positive impacts of commercial mining in terms of employment and skills development being realised from this area.

All the mitigation measures provided below are to be implemented in the Construction, Operation and Decommissioning Phases of the proposed Kamiesberg Project.

Construction

- The upper 30 cm of top soil must be stripped and stockpiled. It should be retained for re-spreading over disturbed surfaces during rehabilitation.
- An ECO should monitor all excavations to ensure backfilling with subsoil first and then topsoil afterwards takes place.
- An ECO should monitor depth and cover of topsoil spreading during rehabilitation to ensure a 30 cm depth.
- Rehabilitation of the affected landscape must start as soon as possible after mining to ensure a minimum amount of time allowed for soil/sand exposure.
- Ensure that the slopes and shape of the landscape conforms as far as possible to the pre-mining topography.
- Use only local sand to landscape the impacted areas during rehabilitation.

Operation

- Develop a Rehabilitation Plan that will ensure that the land can be utilised for agricultural purposed after closure and rehabilitation of the mining area.
- All run-off water must be collected, channelled and disposed of in an appropriate manner.
- The site must be visually monitored for occurrences of erosion, which must be recorded and immediately rectified.
- If erosion occurs the necessary changes to the surface drainage management system must be implemented.

- Ensure that all stockpiled material (subsoil and topsoil) are appropriately sited and shaped and protected (wetting, canvassing or netting down stockpiles, and the construction of wind break) to reduce wind-blown sand.
- The upper 30 cm of top soil must be stripped and stockpiled prior to commencement of the mining activity. It must be retained for re-spreading over disturbed surfaces during rehabilitation.
- Local seed mixes may be used to aid and speed up the rehabilitation process. These seed mixes must be approved by the ECO.

Decommissioning

- Develop and implement a Rehabilitation and Monitoring Plan to monitor rehabilitated areas.
- Implement measures such as wind-breaks, swales and watering to aid the initial growth of primary vegetation.

8.2 SURFACE AND GROUNDWATER ASSESSMENT

Potentially three activities may impact the groundwater conditions on site. These are the tailings storage facility and backfilling; groundwater abstraction and pollution by direct contact with contaminants. The impacts may be reduced to low negative associated with the latter two impacts and a moderate negative for the first impact if mitigation measures are adhered to.

Three potential impacts were identified to have a significant impact on the surface water of the proposed site and its surrounds. These impacts include activities associated with the tailings storage facility and backfill; abstraction from Groenrivier and infrastructure constructed to cross rivers. The potential impacts significance can be reduced to low negative after mitigation measures are implemented. The water crossing may potentially be reduced to a low negative from a moderate negative significance.

Operational impacts are expected to be of Low significance.

The following mitigation measures have been recommended to reduce the associated impacts on groundwater sources:

- Recover seawater from tailings via sumps in paddocks and recycle as process water.
- Optimise the use of slimes mixed with coarser material (co-disposal) to reduce the rate of infiltration and seepage.
- Continuously monitor the salinity of the groundwater in and around the mining area to confirm or otherwise the results of modelling, and continuously update the model to take account of the monitoring results and data from the weather station.
- If necessary, concomitant with the chosen form of post-mining land use, provide alternative sources of water for stockwatering if salinity levels exceed levels appropriate for animal consumption. New boreholes may need to be established outside the mining area to the east and west, and also on the south side of the Groenrivier.
- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- Continuously monitor groundwater levels via observation wells.
- All hydrocarbons of all types must be stored on impermeable surfaces with appropriately sized containment bunds and grease traps. Traps must be regularly

cleaned.

- All chemicals of all types must be stored on impermeable surfaces in secure and bunded designated storage areas.
- Cement must be stored on impermeable storage areas protected from the rain and mixed only in designated areas. Cement residue must be cleaned up immediately.
- Vehicle repairs, servicing, refuelling and washing must be done only in designated areas with impermeable surfaces with appropriately-sized containment bunds and grease traps.
- Where it is necessary to service, repair or refuel a vehicle or item of plant in the field drip trays must be used to catch drips, spills and leaks.
- Spill kits must be available at all locations where chemicals of hydrocarbons are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol appropriate to the material in question.

The following mitigation measures have been recommended to reduce the associated impacts on surfacewater sources:

- Mitigation measures proposed for Impact 1 may result in a reduction of salinity levels of around 5 000 mg/l.
- A pre-mining baseline of the salinity levels in the estuary, together with the general biological state of the estuary, should be established, and monitored at regular intervals thereafter.
- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- If necessary provide an alternative source of water for stockwatering if abstractions for mining purposes prejudice the yield of existing wells and boreholes used by local population.
- Continuously monitor groundwater levels via observation wells.

Road crossing

- If it is necessary to construct a new crossing, not on the alignment of the existing drift, it should be sited to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- The conditions of the Water Use Licence (or General Authorisation) must be strictly adhered to

Pipe crossing

- Site the crossing to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- As far as possible avoid the construction of structures below the level of the 100-year flood.
- Remove the pipe crossing after closure and decommissioning of the mine.
- The conditions of the Water Use Licence must be strictly adhered to

8.3 VEGETATION IMPACT ASSESSMENT

The vegetation and habitat in the project area is generally in good condition, but the effects of stock and crop farming are evident in places, some land portions being significantly more overgrazed than others. In general the western parts are less heavily impacted by grazing than the eastern parts, and areas with goats are more heavily impacted than areas without. Most of the coastal section is in good condition, apart from old diamond camps and diggings, numerous tracks, and some kelp harvesting stockpile areas. Altogether some 23 plant Species of Conservation Concern (SCC) were recorded in the study area (17 in the mining area), including 6 species not yet formally named or described, and large scale mining could thus have a significant negative impact on some of these species and the overall flora if adequate mitigation is not put in place.

The following mitigation measures are recommended:

- Mine construction phase planning should, as far as possible, be informed by the botanical sensitivity mapping, so as to minimize what could otherwise be very significant negative botanical impacts. Where possible, discretionary facilities (those that are not tied to any particular area) should be located in areas of lowest sensitivity.
- All Very High sensitivity areas (please refer to proposed corridor map in Chapter 11 of this report), with the exception of the small portion of Klipkop Shrubland that may be impacted upon by mining activities in the southern section of Leeuvlei, should be treated and managed as conservation areas and should not be subject to prospecting or mining.
- All High sensitivity areas that have been incorporated into the proposed ecological corridors, especially areas covered by northern Sand Fynbos, should be treated and managed as conservation areas and should not be subject to prospecting or mining.
- All Very High and High sensitivity areas not subject to mining (specifically on the Roode Heuwel Prospecting Area) should be offered to the Namaqua National Park, presumably after mining has ceased, but the northwestern areas (adjacent to the Park) should be offered as soon as possible. Areas of Very High and High sensitivity within the Leeuvlei and Sabies areas should also be offered to the NNP, if the land is acquired and mining proceeds at a later stage.
- Provided that the Namaqualand Strandveld and Namaqualand Heuweltjieveld areas within the total project area are treated and managed as conservation areas for the full Life of Mine no additional offset is required for these habitats, as significantly more than double the habitat area (for these two vegetation types) likely to be impacted by mining will be conserved within the project area.
- Suitable high quality areas of Namaqualand Sand Fynbos in the region, adjacent to the Namaqua National Park, have been identified. These could potentially be purchased by the applicant and donated to the appropriate national conservation authorities, or leased to them via contract. This would effectively be a biodiversity offset that would help reduce the significant residual botanical impacts remaining after all the above mitigation has been factored in (Moderate – High negative). Approximately 9000 ha of suitable land has been identified, made up of 11 cadastres, in three main areas. It is recommended that 2500 ha of this would be required to offset all biodiversity impacts to either moderate or low. It is recommended that consideration be given to purchasing suitable portions and donating them to the Park, within five years of project approval. Given that there are numerous factors that may impact on what land is actually purchased (including landowner willingness) no recommendation is made at this stage in terms of which portions have to be purchased, but it should be within either of these three target areas. If this quantum of land can be added to the National Park then the overall significance of the loss of Sand Fynbos for this project could be reduced to LOW negative.

- There must be a north-south corridor at least 300 m wide through the project area at all times. This corridor will be along the eastern side of Roode Heuvel during years 1-5 of mining and along the western edge of the project site once rehabilitation has been completed, for the remainder of the mine life. This corridor is particularly important in the case of the primary target habitat – Namaqualand Sand Fynbos. This vegetation type has a north – south regional distribution, through the western half of the study area (mainly on Roode Heuvel), and it is part of a largely continuous strip of habitat that runs from northeast of Hondeklipbaai in the north to the Olifants River in the south. Complete severance of this currently largely intact habitat through open cast mining across its width is not desirable from an ecological perspective (Desmet & Helme 2009). The corridors need to be of sufficient width to allow the potential natural movement of most faunal and plant species, and the wider the better in terms of functionality. The corridor will also function as a vital repository of rehabilitation material (seeds) for the post mining phase. This will significantly enhance rehabilitation success, and will also help limit wind erosion. A large part of the Sand Fynbos in the area also occurs on the property to the west of Roode Heuvel, owned by and currently being prospected by Exxaro, which suggests that mining may take place here at some stage in the future, severely compromising the corridor potential in the region. It is thus essential that both operations take corridors into account on their own land in order to avoid total loss of the north – south link in this area. The position, shape and extent of the corridor/s are fairly flexible, but need to be worked into mine planning.
- A significant buffer should be maintained along the part of the study area that borders the existing edge of the Namaqua National Park (northwestern corner of Roode Heuvel). Ideally this should be at least 5,000 m wide, and wider according to the Mining and Biodiversity Guidelines; but in reality this is not likely to be more than 3,200 m. This could serve a triple purpose as the main north – south ecological corridor, and would also conserve a large part of the northern Sand Fynbos area with at least 15 plant SCC.
- Primary processing takes place on or near site and involves washing with seawater. This will lead to a significant increase in the salinity of the soil returned to the areas requiring rehabilitation. This will compromise the rehabilitation potential of Namaqualand Sand Fynbos (Desmet & Helme 2003), which prefers acidic soils. Studies at Namakwa Sands have found that high soil salinity poses a challenge during rehabilitation (reducing species diversity), especially if rainfall is below average (and natural leaching is thus reduced). It is therefore recommended that topsoil of at least 300 mm depth (0.3 m) be set aside for rehabilitation purposes, as this will then retain its original pH, and will also include the bulk of the soil stored seedbank (including most of the bulbs, which are more deeply buried than most of the seeds). Furthermore, the top 2 metres of tailings returned to the surface after mining must be sand tailings only, as any clay will assist in the retention of salt.
- All livestock should be removed from the total authorized mining area and a 500 m buffer area around it (except where this is not feasible due to land ownership) from six months after any initial authorisation, throughout the life of the mine, and for at least ten (10) years after primary rehabilitation is completed on any particular block. Livestock preferentially eat the most tender flowering parts (including seeds), and also target annuals, such as grasses and herbs. The latter are often pioneers, which would normally be the first to stabilize a disturbed area and provide habitat for the longer lived shrubs. Thus, by removing livestock one maximizes the available seed bank, and hence the rehabilitation potential. It is the cheapest and easiest way of enhancing rehabilitation success.
- Livestock should, for the same reason, also be removed form the total project area (which will presumably be owned by the applicant) for the entire life of mine.

- The coastal seawater intake should be located at either Gulley Intakes 2, 6 or 7, which are of the lowest sensitivity and do not support any plant SCC. If neither of these is suitable for any reason there are also many potentially suitable gulleys with low sensitivity adjacent vegetation just north of Island Point (Gulley Intake Kmm5), and the botanist can advise on these. Intake site Kmm4 does support a population of a single plant SCC, but the area has good rehabilitation potential and could be considered for development. Intake sites 1 and 3 contain high sensitivity botanical elements and should not be further considered.
- The seawater pipeline should be an above ground pipeline if possible, as this entails significantly less disturbance than an underground pipeline. Frequent crossing zones should be incorporated to allow stock and wildlife movement. At this stage the exact route of the pipeline is not known and thus no further mitigation can be suggested.
- Botanical input into the mine EMP is required, and specifically in terms of site rehabilitation and management of the surrounding areas that will not be developed.
- All additional mitigation requirements (such as Search and Rescue for certain SCC, and alien invasive vegetation management) noted in the vegetation assessment should be considered mandatory, as they are considered reasonable and feasible, and have been factored into the assessments.

8.4 FAUNAL IMPACT ASSESSMENT

The project area as a whole is relatively pristine, but the effects of stock and crop farming are evident in places. Large tracts of Namaqualand, however, are still fairly intact in spite of general overgrazing. There are numerous birds, reptiles and mammal species which are either endemic to the project region or are of conservation concern. Of the 57 terrestrial mammal species which may occur on site, 10 are considered to be species of special concern (SCC). Fourteen (of a possible 33) avian SCC were recorded on site. Few species were recorded during the site visit but this does not necessarily mean that other species do not occur at the project site.

At this stage three features of particular sensitivity and of conservation concern have been identified in the project area. These features are:

- Drainage lines and rivers;
- Coastal Duneveld and Sandy Strandveld;
- Steep slopes, rocky areas and areas with shallow soils.

The Groen River and Bitter River occur on either side of the project areas. These river areas are identified as critical biodiversity areas and must be conserved and maintained as far as possible. As these water courses are not particularly close to the proposed footprint of the mine, they are not likely to be directly affected by it, and their functioning should remain relatively intact, provided that there is no abstraction from these catchments.

Several small drainage lines are present in the eastern section of Leeuvlei. These temporary wetland areas also constitute process areas even though they are seasonal, often dry, and do not have specific wetland vegetation. These areas need to be avoided, and will require adequate buffers.

Various components of developing and operating the mine site will cause faunal biodiversity loss directly or indirectly due to varied impacts. These include loss of vegetation that supply food or shelter, noise pollution, potential chemical pollution as well as loss and fragmentation of habitat. Many of the impacts assessed in the faunal report can be mitigated to a lesser significance. Noise pollution, however, is unlikely to be mitigated due to heavy and continuous vehicle movements and plant machinery use. In addition, climate change is likely to have a major negative influence on the biodiversity of the Succulent Karoo, given the specialized habitat requirements of the numerous local plant endemics and may have a further negative impact on the faunal biodiversity.

The proposed transport linkages and associated infrastructure will all cause additional habitat loss and fragmentation, over and above the mining area. The greatest impact on habitat loss and fragmentation will be associated with the mining pit, internal access roads, the transport of product by road to the N7 and less so with the proposed pipelines. The location of the proposed infrastructure for the MSP lies in a region of intermixed sand fynbos and sandveld. Although relatively few terrestrial vertebrates are associated with this habitat, sand fynbos harbours many SCC as outlined in the faunal assessment.

Developments such as mines and their associated roads create suitable corridors for the introduction of alien species. The threat presented by alien invasive fauna is limited. The deliberate introduction of alien species should be prohibited, unless a full environmental assessment is undertaken and control methods for escapees detailed. Eradication programs of problem animals should be undertaken in consultation with conservation authorities.

Impacts of the proposed developments on the surviving fauna will vary for the different groups. Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics due to storm water flow. However, most frogs in the region are widespread and have rapid colonizing abilities. The reptile fauna comprises some species relatively tolerant of agricultural development. All reptile and amphibian species are well protected elsewhere (e.g. Namaqua National Park) and need no further special treatment.

Birds are by far the most speciose vertebrate component in the region, but many species are tolerant of low to medium disturbance. The remaining mammal diversity in the region consists of small mammals. With the exception of introduced rodents and bats, most mammals in the region are poor colonizers and require protected habitats to maintain viable population levels. Due to disturbance resulting from habitat loss there will also be an increase in animal mortality as animals move away from the region.

No fatal flaws were identified in the faunal assessment. If current land use practices continue, there will be a moderate loss of faunal biodiversity and habitat. If this project goes ahead, it allows the opportunity to mitigate high and moderate impacts to that of moderate and low significance.

The following mitigation measures are recommended.

- Rocky outcrops in the northern Klipkop shrubland area should be avoided as this is a sensitive area for all reptile species.
- Avoid clearing or damaging drainage lines, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Limit the removal or damage to riparian vegetation surrounding the construction of the pipeline across the Groen River.
- Rivers and smaller drainage lines must be protected and/or rehabilitated if damaged.
- Maintenance of water quality and flow dynamics is required to prevent indirect impacts on drainage areas.
- All reptile and amphibian species are well protected elsewhere (e.g. Namaqua National Park) and need no further special treatment.

- Significant ecological corridors need to be maintained between all identified areas of High sensitivity, and this is particularly important in the case of the primary target habitat – Namaqualand Sand Fynbos. This vegetation type has a north – south distribution, through the western half of the study area, and it is part of a largely continuous strip of habitat that runs from Hondeklipbaai in the north to the Olifants River in the south. Complete severance of this currently largely intact habitat by means of open cast mining across its width is not desirable from an ecological perspective (Desmet & Helme 2003), and thus ecological corridors through this habitat (running mostly north to south) must be drawn up by the botanical specialist. The corridors need to be of sufficient width to allow the potential natural movement of faunal and plant species, and the wider the better in terms of functionality. These corridors can and will also function as vital repositories of rehabilitation material (seeds) for the post mining phase, thus significantly enhancing rehabilitation success, and they will also help limit wind erosion.
- A significant buffer (recommend at least 1-2000m wide) needs to be maintained along the part of the study area that borders the existing edge of the Namaqua National Park. This could serve a dual purpose as one of the main north – south ecological corridors (see Vegetation report).
- As far as possible, limit disturbance to areas of high faunal sensitivity.
- Ensure that representative areas of high and moderate ecological sensitivity remain intact, and that measures are put in place to manage the biodiversity of these "set aside" areas.
- Protect abiotic habitats, such as rock outcrops, which shelter many reptile species.
- Prohibit exploitation of SCC, e.g. tortoises and chameleons, by mine employees.
- Prohibit the trapping and killing of animals for the production of bush meat, by mine employees.
- Educate mine staff about the necessity of protecting snakes and other reptiles.
- Undertake habitat clearance in a systematic way to allow birds and other faunal groups to move to undisturbed areas.
- The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines.
- Road designs should incorporate, where possible, underpasses and culverts that allow the movement of animals.
- Where possible the road traffic on site should be limited after dark, as much of the surviving fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc.
- Limit transport of product to and from project on the main provincial road as far as possible after dark.
- Vehicle speed should be limited to the lowest possible speed on site, and should not exceed 40km/h.
- Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.
- All specific project actions associated with construction, access roads, borrow pits and cut-and-fill construction must avoid sensitive habitats as far as is practicable.
- Natural drainage should be maintained and the silt loads into rivers, streams and wetlands must stay within normal limits.
- Roads should be watered down or binders should be used during high wind conditions.
- Road speeds in sensitive regions e.g. near rivers, across drainage lines, and during extreme dry climatic conditions, should be limited to curtail dust production.
- Any material to be transported to and from project site should be done by covered trucks or containers to avoid contamination to the surrounding area.

8.5 ESTUARINE ASSESSMENT

The low-level road crossing, fences, agriculture and development in the floodplain has decreased the health of the Groen Estuary. The present ecological status is a ‘B’, however the estuary is in a protected area (Namaqua National Park) and should therefore be restored and maintained in the best possible state of health. The estuary should therefore be maintained in an ‘A’ or Best Attainable State. In order to maintain the estuary in its present state Thresholds of Potential Concern need to be set. Should these thresholds not be met the health of the estuary due to hypersalinity will decline and the ecosystem services it provides to this harsh region will be impacted. There are three main issues of concern:

- The proposed mining activities upstream of the estuary could potentially lead to an increase in groundwater salinity. However, there is no evidence of any hydrological connection between the mining site and spring. In addition, any potential passage of contaminated water across the 10 km distance will exceed hundreds of years on a temporal scale, as well as being subject to long-term dilution effects over this distance (SWS, 2015). Consequently, any potential increase in salinity at the head of the estuary is unlikely, but in the event of any flux of such water, salinity will increase in the upper estuary, but probably not beyond threshold levels of estuarine organisms that could potentially occur there.
- Mapping of habitats suggests that the area of estuarine open water appears to have decreased over past decades (supported by anecdotal statements made by local residents). This may be related to borehole extraction of water, at least in part, by farming practises and for other purposes (see Bickerton, 1981 and van Niekerk & Turpie, 2012), potentially leading to reducing spring water discharge. An immediate and important management objective would be to protect the freshwater spring in the upper reaches (quality and quantity) and to ensure that salinity in this area remains around 10 ppt or less. Although reeds tolerate higher salinity values (up to ca 20 ppt), current levels provide a buffer protection zone. Of added concern is the prediction that rainfall will decease along the west coast of South Africa (see CES, 2015) and that the Groen Estuary will become progressively drier and therefore more inhospitable to biota in the future.
- Thus, future changes of the Groen Estuary are potentially linked to both natural and anthropogenic influences.

As stated in the EIA report it is essential to conduct a pre-mining baseline assessment of salinity levels and the general biological state of the estuary, and to monitor these variables on a regular basis. The previous study (Bickerton, 1981) was conducted over 35 years ago and the present study was undertaken during an extreme hypersaline event. Different scenarios between a major flood (open mouth and freshwater dominated) and the present state (closed mouth and extreme hypersalinity) are lacking, primarily with respect to biotic response along the salinity continuum.

It is suggested that:

1. Permanent probes are deployed to continuously measure salinity in the upper reaches of the estuary.
2. Regular measurements of salinity and other physico-chemical characteristics are conducted along the length of the estuary (quarterly).
3. Vegetation mapping and biological surveys are needed to check for health of brackish wetlands and salt marshes (variable – linked to the rate of salinity change in the lower estuary).
4. Bird counts of the estuary should continue (quarterly).
5. With respect to the proposed mining operation, permanent salinity probes need to be deployed between the mining site and the head of the estuary to monitor any potential future change in groundwater salinity.

Points 1 to 4 should be the responsibility of SANParks, while Point 5 should be addressed by Zirco. To better understand the dynamic nature of the estuary and determine biotic response to salinity changes, it is essential that monitoring of the estuary be operational following the next flood. This will also establish the degree of estuary flushing and duration of various salinity conditions following mouth closure.

8.6 MARINE ASSESSMENT

The construction of a gully seawater intake system for the Kamiesberg Project at either of the gully sites proposed in the assessment will have a variety of impacts on the marine environment. These include the potential release of debris into the marine environment during and immediately following construction, the entrainment and impingement of organisms during the intake of seawater. The proposed mitigation procedures are well known and have been effectively applied in similar circumstances. If followed the overall effect of the perceived impacts will be significantly reduced.

Based on the results of the field survey, it is apparent that the sheltered gully sites displayed significantly lower biodiversity and abundance of intertidal rocky shore biota in comparison to the open water (exposed) sites – which had significantly greater levels of biodiversity and abundance. Furthermore the benthic biota at these sites is not of great significance in terms of conservation status. This would suggest that perceived impacts of the construction and decommissioning phases of the intake point would be fairly low within any of the proposed gully sites.

A complete analysis of the various alternatives is available in Chapter 7 of this report.

8.7 VISUAL IMPACT ASSESSMENT

The dry sand mining process to be employed in the project area, is a more visible type of mining than deep shaft mining and open pit mining. This is due to the fact that the surface of the mine area is cleared, and the mineralised sand to a depth of up to 20 meters is extracted for processing. This mining is spread out over a large area, whereas with shaft and pit mining it is concentrated to a small surface area (although these mining processes produce large unsightly waste rock dumps). The processed sand is filled in behind the mine path, but unless this is rehabilitated quickly and effectively, it can leave quite an obvious landscape scar. Also, the tall infrastructure that is required in order to separate the minerals via spirals will increase the visibility of the development. The vegetation of the area is very sparse, meaning that the screening effect of vegetation will be rather insignificant.

The most sensitive visual receptors identified, have been those associated with the Namaqua National Park: the accommodation camps and the 4x4 route. The Coastal Section of the Namaqua National Park, acquired in 2008, is located to the west of the mining license area, and actually borders it at one point. The location of the camp sites next to the ocean in all cases, and the 4x4 route which tends to run quite close to the coast, are all at lower elevation. The location of the mining area on higher ground that is inland (approximately 150 masl) means that none of the camp sites (excluding Groen River camp site which is about 13 kilometres from the processing area) will have any views of the mine. It is possible that a very small section of the 4x4 route will have views of a small amount of mine infrastructure, and this is only likely to be the Tailings Storage Facility when it reaches it’s maximum height of 27 meters. Some uninhabited areas on the western border of the park, will have views of up to 20% of mine infrastructure. It will also be necessary for the EIA to take cognisance of the DEA’s strategy for establishing buffer zones around parks. Although the strategy does not have the power to exclude development types, it does seek to promote decision making that will be beneficial to the park.

Some homesteads and non-park related accommodation in the project area will have views of up to 30% of infrastructure, although many will have no views. This is due to their location in the lower lying basins of the Groen, Outeep and Bitter rivers.

In conclusion, it can be said that the visual impact of the mine with not be high. Some surrounding landowners will certainly have views of the mine, but none of them have expressed unhappiness about this and they continue to be engaged via the EIA public participation process. Certain sections of the eastern border of the Coastal Section of the Namaqua Park will have views of the mine, but none of the camp sites (excluding Groen River) and only small sections of the 4x4 route.

The following mitigation measures are suggested:

- The construction contractor should clearly demarcate areas for roads, clearing and stockpiling so as to minimise site disturbance.
- To make space for stockpiles necessary during the construction phase, consider clearing areas for this purpose that will need to be cleared for mining activities during the operation phase.
- Treat roads to reduce dust emissions.
- Maintain as much natural vegetation as possible between the mine buildings and the edge of the mine area.
- Non-reflective paint should be used on all buildings and roofs of buildings. Galvanised steel structures should be darkened to prevent glare.
- Rehabilitate areas that have been cleared of vegetation during the construction phase.
- Light fixtures installed should not spill light beyond the mine area, where they are needed for 24 hour mine operation. Direct the light beams downwards, and use blinds as necessary.
- Use timer switches or motion detectors to provide light in areas where light is not needed continuously.

8.8 SOCIO-ECONOMIC IMPACT ASSESSMENT

From a community perspective, several small towns have been assessed as possible labour-sending communities. In general, the mine site is not in close proximity to any of these communities. Several interest groups are thus involved and will have different viewpoints and issues with the development in relation to how they will be affected. The interest groups include:

- The direct Project-Affected Farmers (PAFs) in and adjacent to the mine site,
- The direct PAFs falling within the pipeline's servitude line; and
- The possible labour-sending communities.

The PAFs are directly affected by the project since their land will be acquired. Several issues and impacts have been identified in the social impact assessment and Chapter 9 of this report pertaining to the farm-owners who will lose their land. Most of these relate to land acquisitioning, which will affect the economic viability of remaining farm titles (should some farmers decide to remain on their land). As sheep farming is one of the major income sources for these farmers, many owners were concerned that the mine would reduce their income-earning capacity. This situation is compounded by the fact that many owners want to remain resident on their land, and do not see compensation as restoring their livelihoods. In mitigation, however, is the fact that the proponent will compensate landowners above the land's commercial value. It is therefore argued that, from an economic viability perspective, compensation should allow farmers to either invest in their remaining land, or buy alternative land. This is therefore seen as having a positive impact on affected farmers.

Many farm-owners' land has been in their families for several decades. This reinforces their attachment to the land from a cultural and individual perspective. It is therefore not surprising that impacts related to altering owners' sense of land attachment have been listed as highly significant. This is the most significant impact rated in the social impact assessment, as there are no mitigation measures for this impact. The reality is that land will be altered.

A different set of impacts have been recorded from a labour-sending community perspective. As these communities are relatively far from the proposed mine site, issues relate more to Local Economic Development (LED), employment provision and a concern over an influx of job-seekers and outside workers. The data reveals that the project is highly desired from employment benefits and community development perspectives. No community member was opposed to the project.

However, issues pertaining to an influx of job-seekers and outsider workers have been analysed closely, and influx and community expansion are listed as significant impacts. In particular, there is a concern amongst community members that social pathologies in the communities, such as substance-abuse, risky sexual behaviours, crime and intra-household violence might increase in response to community expansion and the influx of 'outsiders'. These are major impacts for which several mitigation measures have been proposed. For example, it is recommended for the proponent to develop a Corporate Social Responsibility (CSR) Programme subsequent to a community needs analysis. Such a programme could include community projects, such as sports programmes or the upgrading of community playgrounds, for example.

In conclusion, the specialist is of the opinion that the project could ultimately uplift communities, which are in need of employment, skills transfer and learnership opportunities. Through the mine's Social and Labour Plan (SLP), the KLM would also be supported with LED projects and possibly basic social service provision. With regard to the affected farm-owners, further discussion and engagements are needed to resolve further land acquisition issues, especially if one or more farmers desire to remain living on their land.

8.9 ECONOMIC ASSESSMENT

According to the Economic Assessment, it is considered most likely that the proposed project would achieve an overall positive impact provided the financial projections of the applicant prove reasonably accurate and provided adequate mitigation measures are instituted including rigorous rehabilitation. It would present a significant opportunity for increased economic activity and associated job creation in the local area and region.

The achievement of a net benefit at a local and sub-regional scale would be particularly dependent on extensive mitigation as the key societal risks of the project would be felt at these spatial scales. Significant attention will need to be paid to mitigating air quality, visual, noise, water, social and botanical impacts as these have the potential to result in highly significant economic impacts on tourism, surrounding land owners and on the provision of ecosystem services in general. An appropriate biodiversity offset which is integrated into the Namaqua National Park also has the potential to reduce impacts on ecosystem services including tourism.

8.10 HEALTH IMPACT ASSESSMENT

The proponent need to consider two major factors related to community health. The first is the existing health needs of the community. These existing health needs are present regardless of the proposed project and represent the current health status of the community. Second, the proposed project will need to consider the future health impacts that it (the proposed project) may exert on the community.

This health impact assessment outlines the significant changes on the health status of the local community that may be caused by the proposed project. An attempt has been made to give a comprehensive outlook of the baseline health status of the proposed project area (where possible) (available in Chapter 4 of this report) and also to understand and prioritise future project health impacts (available in Chapter 9 of this report), based on the available evidence. Mitigation and management measures have been recommended and it is advised that these measures are incorporated into the overall environmental and social management plan for the project.

8.11 PHASE 1 HERITAGE ASSESSMENT

The baseline heritage assessment has captured a good record of the archaeological heritage present in the Roode Heuvel and Leeuvlei application area. Sites of particular importance include rare wind deflated sites with stone implements, decorated pottery, marine shellfish and ostrich eggshell, all attributes of domestic campsites. Sites with similar decorated pottery (i. e. vertical incisions, or punctuations) appear in the archaeological record after 1300 years ago in the Knersvlakte and Richtersveld (Orton 2012; Webley 1997). Historical records show that Governor Simon van der Stel travelled to Namaqualand in 1685 and found the first Namaqua kraals north of the Groenrivier (Webley & Halkett 2012). It is tantalising to suggest that the Leeuvlei and Roode Heuvel encampments may be remnants of some of these Namaqua kraals.

It is maintained that outcroppings of quartz in the Leeuvlei application area were targeted by Stone Age people as a source of raw material. As such quartz quarries are considered significant (heritage) features in the landscape. Quarry sites provide evidence of stone tool transport and also raise questions about group size and organization of activity among hunter-gatherer groups. They cannot be seen in isolation from the (above) wind deflated sites/campsites which are the repository of the quarried stone and finished artefacts.

The heritage assessment has also recorded well preserved archaeological deposits at the coast (shell middens and scatters of shellfish). Most of these scatters are probably the remains of brief occupations, where small quantities of food debris were discarded, perhaps from one or two meals. Other sites may have been more substantial but have been ravaged by wind and blowing sand, leaving only a light scatter of weathered shell fragments (Orton 2007).

Large numbers of tools were also recorded in a wind deflated site south of the Groenrivier, in the pipeline route, while nearby outcroppings of nearby quartz were likely exploited by hunter-gatherers as a source of raw material.

The nature, type and distribution of archaeological sites in the study area reveal a dynamic use of pre-colonial landscapes by Later Stone Age hunter-gatherers and Herders.

The results of the heritage assessment indicate that the proposed activity (i. e. mining of mineral sands) and associated infrastructure (mineral separation and primary concentrator plant, tailings dam, airstrip, offices, workshops and stores, for example), will not have an impact of great significance on the archaeological heritage, as these are expected to be limited.

The position of the gulley intake alternatives (Kmm4 & Kmm5), pump station and pipeline at the coast will impact negatively on archaeological heritage (shell scatters & shell middens).

The sea water intake pipeline (Kmm5) to the desalination plant on Roode Heuvel, will impact negatively on a wind deflated site (Site 136) and outcropping of quartz (Site 138) on the southern bank of the Groenrivier.

In archaeological terms, no fatal flaws have been identified and any sites that cannot be avoided could be easily mitigated if required. Mitigation also provides opportunities for better understanding pre-colonial land use patterns in this region of Namaqualand.

The following recommendations are made, which are subject to the approval of the South African Heritage Resources Agency (SAHRA).

Roode Heuvel

- Archaeological remains in wind deflated sites (Sites 328, 096, 097, 098, 086, 088, 090, 091 and 092, refer to Figure 11.3 for positions) must be mapped (on a grid system) prior to any mining or mining related activities commencing in that particular area. Sands should also be sieved for the presence of sub-surface material. The remains must be collected, curated and written up and a report presented to the South African Heritage Resources Agency (SAHRA). No archaeological material may be collected or damaged without a permit issued by SAHRA. It is acknowledged that some areas in which scatters of tools and organic remains occur (for example Site 096 on Brandkop) may not be mined at all, so archaeological mitigation will likely not be required.
- Should any unmarked human remains, or ostrich eggshell caches for example, be uncovered or exposed during mining or associated activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Leeuvlei

- Archaeological remains in wind deflated sites (Sites 025 and 050-055 refer to Figure 11.3 for positions) must be mapped on a grid system prior to any mining or mining related activities commencing in that particular area. Sands should also be sieved for the presence of sub-surface material. The remains must be collected, curated and written up and a report presented to SAHRA. No archaeological material may be collected or damaged without a permit issued by SAHRA. It is acknowledged that the above sites may not be mined (contingent on a final mine plan), so archaeological mitigation will therefore not be required.
- A Heritage Management Plan (HMP) must be implemented in order to protect important archaeological sites that fall within `non-mining areas', during the Construction and Operational Phase of the project. The HMP must be included as part of the Environmental Management Plan (EMP) for the proposed project. The HMP must be submitted to SAHRA for approval.
- A buffer of 5m must be established around outcroppings of quartz (Sites 101, 033, 037, 041 and 088). Alternatively, these sites must be fenced off. Fencing must be done in consultation with and under the supervision of the archaeologist.

- Should any unmarked human remains or ostrich eggshell caches be uncovered or exposed during mining or mining related activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Att: Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Proposed seawater intake, pump station and pipeline – Kmm5

- Shellfish deposits (Site 095) at the sea water intake must be sampled. This should take the form of a series of 1m x 1m excavations in order to test the significance and extent of the archaeological deposits. Shellfish and bone must also be collected for dating. Should significant sub-surface deposits be encountered during test excavations, a larger sample will need to be rescued.
- Scatters of shellfish (Sites 096-103 & Sites 105-115) in the pipeline route, and between the sea water intake and the pump station (Sites 277-279, Sites 283-286 and Site 296) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i. e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.
- Scatter of tools (Site 136) in the wind deflated site in the pipeline route south of the Groenrivier must be mapped on a grid system. Sand must also be sieved for the presence of sub-surface material. All the remains must be collected, curated and written up and a report presented to SAHRA. No archaeological material may be collected or damaged without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.
- Outcropping of quartz (sites 138 and 139) alongside the pipeline must be investigated. This will entail more detailed visual recording, mapping and collection. The material must be written up and a report presented to SAHRA. No archaeological material may be collected without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.
- Should any unmarked human remains or ostrich eggshell caches be uncovered or exposed during excavations for the pump station for example, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Att: Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Proposed seawater intake, pump station and pipeline – Kmm4

- Scatters of shellfish (Site 273, Sites 233, 236 and 237, Sites 244 and 245, Sites 250-255 and Site 261) in the pipeline route, and scatters of shellfish between the sea water intake and the pump station (Site 229 and Site 272) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i. e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.

Sabies

If prospecting rights are approved, the area known as Sabies must be assessed for archaeological heritage ahead of any mining or development activity.

8.12 AIR QUALITY ASSESSMENT

From the baseline air quality assessment and atmospheric dispersion modelling the following conclusions were drawn:

- The dominant wind-field is from the south (south-westerly) with occasional flow from the northerly sector. Wind speeds are moderate to high with few calm periods.
- Baseline emission sources are likely to be fugitive predominantly from windblown dust, and from vehicle dust entrainment on unpaved roads.
- The proposed mining operations and processing plant are not likely to result in non-compliance with NAAQS for $PM_{2.5}$, SO_2 or NO_2 in the short-term.
- Exceedances of the daily PM_{10} NAAQS (i.e. more than 4 days per year with average daily concentrations in excess of 75 µg/m^3) were simulated to be localized near the unpaved district road; however a watering programme or paving of the road surfaces will be effective in minimizing the area of impact.
- Dustfall rates are likely to exceed the National Dustfall Regulation standard for residential areas outside of the Prospecting Right boundary, even if emissions were mitigated through a watering programme, mainly as a result of vehicle entrainment. Further mitigation through paving the road surfaces is recommended

8.13 WASTE ASSESSMENT

Based on the available project description and supplementary information sourced from a variety of sources, it was possible to assess the likely impacts associated with the management of waste streams from the proposed Kamiesberg Project in South Africa. The project locality is relatively very poor and the knowledge amongst local community members of the implementation of the National Waste Management Strategy (DEA, 2011) is expected to be limited. As such, the developer should employ measures to effectively manage the waste generated from the project in order not to contribute to poor waste management.

A total of 13 impacts were identified and of these, with mitigation, 11 were considered to be of LOW negative significance and one of MODERATE negative significance. One impact was considered beneficial and of Moderate significance with mitigation. However, due to the potential long-term nature of waste-related impacts, it is essential that the developer adhere to national legislative requirements and international best practice with regards the management of all waste streams. While a number of specific mitigation measures have been included in the document, further detailed guidance on the management of key waste streams is provided in the documents referenced in the waste assessment.

The following recommendations are included in the assessment:

- All waste streams should be managed according to the waste management hierarchy in accordance with NEM:WA No.59 of 2008 and the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 3rd ed. (DWAF, 2005a). This specifies that wherever possible, production of wastes should be prevented or minimised at source. Where prevention or further minimization is not possible, wastes should be re-used, recycled and then disposed of responsibly so as to minimise impacts to the environment. Further guidance on the management of waste streams is provided in the IFC General EHS Guidelines (2007a) and the IFC EHS Guidelines for Mining (2007b). In the event that there are no national standards available, the proponent must comply with internationally recognised standards developed by international organisations such as the IFC. In the case where there are several standards available for use, the proponent must provide justification for the choice of use, other than the use of the most stringent.

- Separate assessments, including groundwater and air quality assessment as well as engineering landfill design and specifications would be required for the construction and licensing of the landfill site. The landfill design would have to be in accordance with the Minimum Requirements for Waste Disposal by Landfill, 3rd ed. (DWAF, 2005b).
- Due to the local situation as per the remote location of the project site and relevant legislation, it is recommended that the proponent establish a non-hazardous waste disposal facility on the site. Furthermore, practical options will need to be considered for the management and disposal of hazardous wastes. These would be to either develop a dedicated and specially-designed hazardous waste cell within the new on-site landfill or, alternatively, to construct a bunded and secure facility for temporary storage of hazardous waste on site until such time as it can be transported off-site for safe disposal.

8.14 TRAFFIC AND TRANSPORT ASSESSMENT

The risks and impacts related to project-generated traffic during construction and operation of the mine were identified as:

- Increased traffic on DR2938;
- Increased risk of vehicle collisions and personal injuries;
- Increased dust generation; and
- Increased traffic and disruption of traffic flows on the N7 highway, and on provincial roads between the N7 and the port at Saldanha.

An additional construction-phase impact was identified as the transport of large items of equipment requiring abnormally large vehicles.

The most significant impacts relate to project-related traffic using the DR2938 to access the mine site from the N7 highway, a distance of about 51 km. This road is currently unpaved, and is used to access farms and the coast at Groenriviermond. The impacts are most significant during the operational phase, when large volumes of mine product will be transported every day, by heavy, multi-axle vehicles, from the mine to the N7 en route to the port at Saldanha.

There will be traffic-related impacts on the N7 and the provincial roads, but these roads are designed for large volumes of traffic, and are already trafficked by heavy goods vehicles. Available data indicates that project-related traffic will not significantly affect existing traffic flows.

Two impacts (one for construction and one for operation) were rated as High without mitigation, and one (operation) was rated Very High without mitigation. With diligent and sustained implementation of mitigation measures all identified impacts can be reduced to Moderate or Low.

If the project does not proceed – the No-Go Alternative - there will be no increase in traffic on DR2938, the N7 highway or provincial roads between the port at Saldanha and the N7, and no project-related impacts in respect of traffic and transport.

With regard to cumulative impacts the Frontier Rare Earths mine at Zandkopsdrift, situated some 35 km south-east of the Kamiesburg project, is expected to commence production in 2015. The annual production from the mine, about 20 000 tonnes of mixed rare earth carbonate to be transported to a separation plant at Saldanha, is very small compared to the annual tonnage of product from Kamiesberg – approximately 570 000 tonnes - and the cumulative impact of traffic from the two projects on the N7 and provincial roads is expected to be negligible.

Measures proposed to mitigate the identified impacts are summarised as follows:

DR 2938

- Develop and implement a Traffic Management Plan for construction and operation.
- Develop and implement an Emergency Preparedness and Response Plan for construction and operation, including provisions to deal with traffic accidents, particularly accidents involving personal injuries. All drivers must be made aware of the procedures to be followed.
- Establish and rigorously enforce a speed limit appropriate to the design and construction factors and characteristics of the road (such as width, horizontal and vertical alignment, grade, sightlines and surfacing material) for all project-related traffic.
- Erect speed limit signage at regular intervals along the road, and other appropriate warning signage, including at intersections with farm access and other roads.
- Prohibit heavy vehicle trips between 10pm and 6am unless it is absolutely unavoidable. Vehicle trips between 10pm and 6am should be minimised, concomitant with operational requirements
- Schedule deliveries by heavy vehicles to avoid the formation of convoys. Sufficient distance must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- Provide regular information to the local community and individuals on the volumes of traffic particularly heavy vehicles, anticipated on the road during construction and operation.

N7 and provincial roads

- Heavy vehicle deliveries and vehicle returns during construction should be scheduled to avoid, as far as possible, morning and evening periods where roads pass through urban areas, or other stretches known to carry large volumes of morning and evening traffic. (It is acknowledged that this will not be practicable during operation, when materials haulage will take place for 10 hours a day.)
- Extreme care must be exercised when travelling through urban areas (Piketburg on the N7; Moorreesburg and Hopefield on the provincial roads), especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- The formation of convoys must be avoided.
- Sufficient distances between heavy vehicles must be maintained to allow light vehicles to overtake safely.
- An Emergency Preparedness and Response Plan must be developed to deal with accidents and incidents en route

Abnormal loads

- Arrangements must be made with the provincial traffic authorities – Western Cape and Northern Cape - for abnormal loads, and their requirements strictly adhered to.
- Speed limits must be strictly observed.
- As far as possible deliveries of abnormal loads should be scheduled to avoid periods when significant volumes of construction traffic are making deliveries to site.

Driver and vehicle management

- All drivers must be properly licensed for the class if vehicles they drive.
- All drivers must be made aware of the provisions in the Construction Emergency Preparedness and Response that deal with traffic accidents, particularly accidents involving personal injuries, of the procedures to be followed.
- All aspects of all vehicles must be in a good state of repair at all times, especially the exhaust system.
- Vehicle horns / hooters should be used only when absolutely necessary.
- A mechanism should be established, as part of the Stakeholder Engagement Plan, for recording traffic- and transport-related complaints from residents.

Road upgrades

- District Road DR2938 must be upgraded to ensure that it is wide enough to allow two heavy vehicles to pass safely. The carriageway may need to be widened in places, and realigned at sharp bends (particularly where the road crosses the Groenrivier). Construction work on the road upgrade must be done in such a way as to minimise disruption to local traffic.
- The upgrade of DR2938 must include measures to reduce the generation of fugitive dust, preferably by means of a bituminous sealing / wearing course, but otherwise by regular and frequent application of dust suppressant and/or water.
- To the extent practicable, concomitant with the requirements for durability and skid resistance, the surface of DR2938 should be designed to minimise rolling noise.
- The N7 at its intersection with DR2938 must be upgraded as required by SANRAL, which may include the construction of an auxiliary acceleration lane south from the intersection, and upgrading the DR2938 bellmouth entrance.

8.15 RADIATION ASSESSMENT

The purpose of the radiation specialist report was to present a preliminary qualitative radiation impact assessment as input into the ESIA process for the Kamiesberg Project.

In general, the way in which members of the public may be exposed to radioactivity from a specific operation, facility or activity, is evaluated through the development of site-specific public exposure conditions. Since the proposed project is still in early stages of planning, very little site-specific information is available that can be used as basis to define exposure conditions and assess the radiation safety. The scope of the assessment is therefore limited to a qualitative description of situations that could lead to public exposure conditions, in order to highlight those aspects that should be included in a comprehensive site-specific radiological public safety assessment. Consequently, unlike the other specialist studies, this specialist report does not include a detailed assessment, based on a standardised impact assessment methodology, of the specific radiation-related impacts potentially associated with the project radiation. Similarly, the identification and description of specific mitigation measures is also considered premature at this early stage. A comprehensive baseline radiation study and mitigation measures will, however, need to be included in the Authorisation Change Request (ACR) submission to the National Nuclear Regulator (NNR). Approval of this ACR will be required before operation of the mine or processing facility.

Based on the description of the development, the proposed mining and mineral processing operations will have the potential to alter the radiation background. Although specific information required for the characterisation of the sources or pathways (source-pathway-receptor analysis) is not yet available, one can assume that and water airborne radionuclides will be released from the operational facilities of the Kamiesberg Project into the environment through the atmospheric and groundwater pathway. Depending on the radioactivity concentrations of the material released, as well as the nearby human behavioural conditions, one can expect a radiological impact to members of the public. Although the focus of the study is the impact on humans, there is sufficient demonstrated evidence, which shows that by protecting humans against exposure to ionising radiation according to dose limits, non-human species are also provided adequate protection.

The impact through the atmospheric pathway is expected to be highest close to the facilities and generally decreases to insignificant levels at distances of 5 to 10 km from the site. The radiological impact through the groundwater pathway tends to be limited, mainly due to slow leaching and subsequent groundwater flow rates to receptor points. The potential radiological impact through the groundwater pathway tends to be visible during the post-closure period (hundreds of years after closure). It is expected that the contribution of the Kamiesberg Project to a total effective dose to members of the public will be below the dose constraint of 250 μSv per annum, which is well below the dose limit of 1,000 μSv per annum. Given that the Kamiesberg Project will be the only operating mine in the area, the dose limit in all likelihood will apply.

The regulatory framework defines criteria for the radiation protection of workers, which generally allows much higher level of radiation exposure than to members of the public. Within these criteria, workers are protected based on the activity that will be performed within specific work areas, and the associated total effective dose expected for that area. This allows for the classification of work areas into uncontrolled, supervised, controlled or restricted. Specific radiation control measures apply for each area classification. It was concluded that the mining area would in all likelihood be classified as an uncontrolled area, while the processing plant will be a supervised area. What is important to note as far as worker radiation exposure is concerned, is that workers will be exposed, but that the level of exposure can be controlled and managed to ensure compliance with regulatory limits for the protection of workers.
A comprehensive radiation baseline survey and site characterisation will have to be performed before operation commences and this, together with specific mitigation measures will need to be submitted to the NNR. It is recommended that the baseline be established at least a year before the operations commence. Continuous monitoring will be required during the operational phase.

8.16 NOISE ASSESSMENT

The impact of the noise pollution that can be expected during the operational phase will largely depend on the number of trucks that use the transport routes per day. Noise pollution is based on two main factors, namely the intensity of the noise and the number of occurrences per day.

The results indicate the following:

- The noise will increase along both transport routes (DR 2938 and N7).
- Community action can be expected if the trucks use the DR2938 during the night.
- The noise from the processing plants will not impact the residents in the noise sensitive areas along the DR2938 due to the distance from the processing plants.

The following is recommended:

a. All vehicles should be fitted with silencers and the use of exhaust brakes along the DR2938 of the transport route be severely curtailed.
b. The speed of the trucks should not exceed 60km/hr along DR2938 until it is upgraded and then should not exceed 80km/hr. This will reduce the noise impact even further.
c. The drivers should receive training in terms of sensitizing them to the noise issues.
d. It is highly recommended that Global Positioning System trackers be fitted to the vehicles in order to monitor vehicle speeds along the routes.
e. The hauling of final product along the DR2938 is curtailed to day light hours only.

8.17 REHABILITAION ASSESSMENT

The recommended decision is to rehabilitate the entire site to natural vegetation. In doing so, recommendations made in the vegetation specialist report, and the need to establish ecological corridors are important considerations. The overall rehabilitation plan for the mine site is therefore to achieve an indigenous vegetation cover, and to focus the rehabilitation programme on re-establishing the type of vegetation that occurred before mining. The primary focus of the rehabilitation programme would therefore be focused on re-establishing Sand Fynbos. A secondary focus would be to re-establish Standveld in the eastern portions of the area to be affected by mining. The rehabilitation will be facilitated by the presence of various ecological corridors, as these areas will act as seed banks and a possible a source of plants which could be transplanted from these areas. They also support various faunal groups, which play an important role in pollination and seed dispersal.

The rehabilitation programme will need to be guided by the mine plan. Once an area has been mined out, rehabilitation can start shortly thereafter, since mining activities (essentially bulk earth works) will move onto the next parcel of land. Thus, a rolling rehabilitation process can take place, and at the end of the mine life, the area mined in year one will support vegetation close to 20 years old. The sequence of rehabilitation will need to closely follow the sequence of mining. Mining will be initiated in the south-western section of the Roode Heuvel deposit, and will then proceed south-west and then north-west. In the first year of mining a void will be created, as there is no area to backfill. The coarse tailings will be used to construct the walls of an off mine path tailings storage facility (TSF). In year 2 coarse tailings will continue to be used to construct the TSF, and hence there will be no or limited backfilling in years 1 and 2. It is only likely that rehabilitation could begin on the year 1 and 2 parcels (100 and 130ha respectively) after year 2, as sufficient space would be required for mining operations. Thus, it is anticipated that rehabilitation will lag 2 years behind excavation and mining.

9. IMPACT ASSESSMENT

9.1 BIOPHYSICAL IMPACTS

9.1.1 Planning and Design Phase Impacts

Activities associated with the design and pre construction phase pertains mostly to exploration. As the project has an exploration license impacts associated with exploration and the mitigation of these impacts were included in the Exploration EMP compiled to obtain this license and will therefore not be repeated in this section. Other activities associated with the design and pre construction phase will not have impacts on the biophysical environment as this phase consists of planning and design of the proposed development, and is done at a desktop level. In some cases site visits need to take place but the impact of these visits is negligible, if any, e.g. photographs, borehole pump testing, botanical and other field surveys, etc.

9.1.2 Impacts resulting from the existing land use / no-go options

i. Impacts on topography and geology

Existing impacts on the topography of the area consists of relatively minor excavations for agricultural purposes and secondary and tertiary roads. These are considered to be negligible. No existing impacts on geology have been identified.

ii. Impacts on soils and agriculture

Currently there are no existing impacts on soils and agriculture. The condition of the soils are pristine and un-impacted on. The only potential existing impact on agriculture is the current drought, however this is a natural feature and cannot be controlled or mitigated.

iii. Impacts on surface and groundwater resources

Surface water
The flow in the rivers in the project area is episodic, following rainfall on the upper parts of their catchments. As a result surface water resources are insufficiently reliable for them to be used to any significant extent in the area, either for domestic use or stockwatering.

The Groenrivier wetland is situated at the mouth of the river in the Namaqua National Park, which is relatively easily accessible from the N7 highway via District Road DR2938. As a result the wetland has been subjected to a number of impacts associated with the formation of a number of informal access routes for watching birds, as well as short hiking trails, all of which have increased the impact of erosion and sedimentation by providing preferential flow routes for surface water draining from te riparian zones into the wetland (Working for Wetlands 2014).

Groundwater
A hydrocensus in the project area identified a total of ten boreholes within the Roode Heuvel project area and within 1 2 km radius of the concession boundaries. All operational boreholes in the area are equipped with wind pumps, which deliver water to storage. Because groundwater is brackish (in general TDS values were between about 3 000 to 8 000 mg/l) most of the water is distributed to livestock watering positions, but some is used for domestic purposes such as washing and cleaning. All drinking water is obtained from rainwater harvesting from the roofs of the farmsteads.

Conclusion:
There are no current activities in the project area that could adversely affect the quality or quantity of surface or groundwater resources.

iv. Impacts on the marine environment

Included below is a list of the various existing impacts in the immediate vicinity of the proposed study site, including the approximate distance of each existing impact from the proposed Zirco gully seawater intake site. Please note that none of these occur within a 10 km radius of the proposed project site.

- Tronnox Namaqua Sands seawater intake - 46km
- Tronnox Namaqua sands outfall - 46km
- Abalone ranching at Kleinzee (Port Nolloth Sea Farms) - 140km
- Oyster farm (Quiryn) and Abalone Farm (De Beers) at Kleinzee - 150km
- Benguela Abalone (Abalone Farm at Port Nolloth) - 204km
- Septic tanks at National Parks rest camp at Groen Rivier - 15km
- Diamond mining (from Olifants River Mouth to Orange River Mouth - both historical and active mining activity).
- Recreational shore fishing (mostly Hottentot, Galjoen, and West Coast Rocklobster in proximity to recreational camping areas and holiday accommodation).

It is therefore unlikely that any of these will impact on the marine environment in the vicinity the proposed Zirco gully seawater intake site.

v. Impacts on flora

To contextualise the potential impacts of the proposed mining project the existing impacts (or status quo), associated with current ecological conditions need to be described in terms of vegetation patterns, structure and composition. This baseline or status quo should be used as the comparison against which project impacts are assessed. The main issues associated with the likely impacts are discussed below:

Issue 1: Loss of Vegetation Type

Impact 1.1: Loss and Degradation of Strandveld (Namaqualand Strandveld)

Cause and Comment

Strandveld is the dominant vegetation unit in the study area (but is only 40% of the mining area) and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas. It is also found scattered throughout Sabies, and extends into Leeuvlei. Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld (181 ha) occurs along the southern section of Roode Heuvel. The cause of degradation is overgrazing, resulting from water points and livestock pens (kraals) which occur along the road, and incidentally along the Groen River.

Significance Statement

The permanent loss of Strandveld (i.e. habitat transformation) is currently negligible, but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate. Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact (as removal of grazing pressure will often allow vegetation recovery). The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Low to Moderate	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.2: Loss of Sand Fynbos (Namaqualand Sand Fynbos)

Cause and Comment

Sand Fynbos is the second largest vegetation unit in the project area, and it makes up about 60% of the mining area. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei. Sand Fynbos occurs on slightly undulating plains and is often dominated by restios in the dune slacks (troughs), and asteraceous fynbos or restios on the dune ridges. The vegetation on the dune ridges often includes Strandveld elements.

Significance Statement:

The permanent loss of Sand Fynbos (i.e. habitat transformation) is currently negligible (although some has occurred in the past), but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate. Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact. The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Low to Moderate	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.3: Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)

Cause and Comment

Heuweltjieveld may be found all along the eastern extent of Leeuvlei, and a large part of north eastern Sabies. It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld occurs in the south eastern sections of Sabies adjacent to alluvial corridors, where it has been both cultivated and heavily grazed. This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals.

Significance Statement

The permanent loss of Heuweltjieveld (i.e. habitat transformation) is currently negligible (although some has occurred in the past), but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate.

Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact. The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Low to Moderate	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.4: Loss of Riparian Vegetation (Namaqualand Riviere)

Cause and Comment

Riparian areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also include tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins. The vegetation varies from *Acacia* thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species and are classified as areas of high sensitivity.

Significance Statement

The loss of the riparian vegetation has definitely occurred in the past, but does not appear to be ongoing, although degradation is ongoing (due to heavy grazing). Previous and current pressures have had a Moderate to Severe, temporary to permanent impact. The environmental significance of this unmitigated impact is MODERATE to HIGH negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Moderate to Severe	Definite	**MODERATE TO HIGH**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.5: Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)

Cause and Comment

Klipkop Shrubland vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies. No SCC is likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively, and various SCC are known from this unit nearby.

Significance Statement

No loss of the Klipkop Shrubland has occurred within the project area, but minor degradation (due to grazing) is ongoing. Most of this degradation is reversible, and is thus temporary. The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Low	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.6: Loss of Seashore Dunes

Cause and Comment

Seashore Dunes occur as a belt along the coastline, above the high tide water mark, and on the seaward side of the Coastal Duneveld. Essentially it consists of Namaqualand Seashore Vegetation, but also includes transition zones of seashore vegetation occurring on white dune sands, which have taller shrubs, but are not considered part of the Coastal Duneveld.

Significance Statement

No loss of the Seashore Dune vegetation has occurred within the project area, but some localised degradation has occurred and is ongoing (due to kelp harvesting and offroad vehicle tracks). Most of this degradation is reversible, and is thus temporary. The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Low	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 1.7: Loss of Coastal Duneveld

Cause and Comment

Coastal Duneveld is situated on the inland side of the Seashore Dunes, and gradually merges with Strandveld further inland. No SCC was recorded in this unit.

Significance Statement

There has been minor loss of the Coastal Duneveld (due to a few diamond exploration pits), but the unit does not appear to be experiencing any ongoing degradation. The severity of the impact is low, and the environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Low	Definite	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Issue 2: Loss of Biodiversity and Species of Conservation Concern

Impact 2.1: Loss of Biodiversity (general)

Cause and Comment

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing has resulted in a loss of biodiversity in the area. Overall no species or habitats are likely to have been lost, although degradation in certain areas (around stock kraals) has been intense.

Significance Statement

The current land use is probably having a moderately severe, long term impact on the biodiversity within the project area. The environmental significance of this unmitigated impact is MODERATE negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	Probable	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 2.2: Loss of Species of Conservation Concern

Cause and Comment

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing is unlikely to have resulted in total loss of any plant SCC in the area. However, land use has undoubtedly impacted on the isolated populations of SCC, and reduced the total population numbers of about 5-10 SCC.

Significance Statement

The current land use is probably having a moderately severe, long term impact on at least some of the SCC within the project area. The environmental significance of this unmitigated impact is MODERATE negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	Probable	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 2.3: Fragmentation of vegetation and edge effects

Cause and Comment

Habitat fragmentation is one of the most important impacts on vegetation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. This impact usually occurs when large areas are cleared for agriculture, development or mining. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced movement due to the absence of ecological corridors.

Habitat fragmentation is currently not a major feature of the study area, as most cultivation consists of narrow strips (<30 m wide) surrounded by natural vegetation. Most of the heavily disturbed areas are close to homesteads and livestock kraals, and are generally <10 ha in extent.

Significance Statement

Habitat fragmentation is fairly likely to be an issue within the project area, but it is of low severity and has a long term impact. The environmental significance of this unmitigated impact is LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Low	Likely	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

vi. Impacts on fauna

Issue 1: Loss of faunal biodiversity

Historically, Namaqualand supported a large diversity of animals as noted by early travellers (Skead, 1980) and as recorded in present day place names (Acocks, 1979; Dean and Milton, 2003). A long list of small (e.g. steenbok, duiker) and large ungulates (e.g. gemsbok, eland) as well as mega-herbivores (such as elephant, black rhinoceros and hippopotamus) and predators (e.g. lion, hyena) were recorded in the region and reflect this diversity (Skead, 1980). However, the density of animals, as well as the extent of population fluctuations that would have occurred in Namaqualand prior to colonial settlement at the Cape, is harder to determine (Hoffman & Rhode 2006).

It appears that wildlife was not abundant in Namaqualand prior to colonialism, and large springbok ‘treks’ that are recorded in the eastern Karoo during the 19th century, were probably a rare event (Hoffman & Rhode 2006). Despite this, farmers regarded wildlife as vermin as they competed with their sheep for food, space and water, and thus shot as many springbok as they could, using the carcasses for dried spiced meat (Lovegrove 1993). This slaughter, along with habitat loss to fenced livestock farms and a rinderpest outbreak at the end of the 19th Century, reduced springbok numbers dramatically. Springbok are now, for the most part, farmed livestock and restricted to fenced enclosures (Kingdon 1997). Fortunately, fences do not limit birds or reptiles. Many granivorous birds migrate hundreds of kilometres to find food in the region after good rainfall events stimulate plant growth (Dean and Milton 1999).

Existing land use is primarily focused on agriculture, with livestock grazing as a dominant land use in the region. Cultivation is also practiced along the major perennial rivers, and in drier areas, where this largely depends on rainfall. According to Hoffman & Rhode (2006), the number of domestic livestock in Namaqualand spiked in 1957 largely as a result of an increase in the number of sheep. Numbers have fallen steadily since this peak. Crop production was absent from Namaqualand’s pre-colonial landscapes but increased to cover nearly 30 000 ha in the early 1970s. The area under cultivation has now declined by nearly two thirds, largely as a result of the large-scale abandonment of wheat farming in marginal environments.

Pastoralism is considered a major threat to the biodiversity of the region. In addition to pastoralism, alien invasive plants, mining, agriculture, and the collection of succulents and reptiles for the pet trade, also threaten the regions biodiversity (Lovegrove 1993, Lloyd 1999, Branch 2013).

Impact 1.1: Existing land use impacts on fauna

Cause and Comment

While many of the larger mammals were extirpated in historical times, present day impacts on fauna come in numerous forms. Predatory animals such as black-backed jackal (*Canis mesomelas*), caracal (*Felis caracal*) and leopard (*Panthera pardus*) have been known to effect stock numbers, thus impacting upon local livelihoods in the region. However, the hunting and trapping of predators can often lead to an increase in predator numbers because of the elimination of alpha males that restrict access of other predators within their territory (NDBSP 2008). Thus, common methods of predator control can have the opposite effect to that which is intended.

Fence lines along roads and between farm paddocks may restrict the movement of non-volant large animals across the landscape. The faunal impact depends on the size and structure of these linear barriers. Low electric fences, designed to restrict the moment of small predators, e.g. jackal, are particularly lethal to larger tortoises (Burger & Branch 1994). The use of poisoned carcasses by livestock farmers to kill "problem" animals such as black-backed jackal and caracal often results in poisoning of non-target raptors and other scavenging species (Lloyd 1999, Anderson 2000). Some species, like the martial (*Polemaetus bellicosus*) and black (*Aquila verreauxii*) eagles, perceived to prey on domestic livestock and poultry, may be deliberately targeted (Anderson 2000). Practices such as the use of gin traps are also problematic for local biodiversity, as it is an indiscriminate method that usually serves to eradicate more non-target animals, such as tortoises, aardvarks, etc, than it does the predator in question.

Drowning in farm reservoirs also account for a significant number of raptor mortalities in the Karoo (Anderson 2000), whilst pesticides used to control brown locust (*Locustana pardalina*) outbreaks also impact wildlife severely, with high concentrations being found at the top of the food chain, particularly lizards (Alexander et al. 2002) and raptors (Lovegrove 1993).

Significance Statement

Existing land use impacts on fauna in the project area results in a moderate negative impact in the medium to long-term in the study area. The environmental significance of this impact is MODERATE.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium to Long Term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Issue 2: Habitat impacts

The Succulent Karoo has been utilised extensively for livestock farming for many years (Allsopp 1999; Todd & Hoffman 1999), and the resultant problems of selective overgrazing, overstocking and trampling are therefore widespread (Hilton-Taylor & Le Roux 1989). The earliest evidence of livestock farming, a practise that was brought into the Succulent Karoo by the Khoikhoi, dates back as far as 2 100 years.

The livestock farming that is practiced on the communal areas has resulted in severe overgrazing of the veld, due to high stocking rates and limited opportunities for herd rotation (Todd & Hoffman 1999). On the other hand, private, commercial farms are fenced (such as those in the project area), and this allows some form of internal rotational grazing that may reduce the severity of overgrazing (Cowling & Pierce 1999).

Hoffman & Rhode (2006) describe three key eras in Namaqualand's history, in terms of distinct phases of human intervention:

1. The ***pastoral ecological revolution*** that took place as a result of the introduction of domestic livestock and pastoral societies into the area approximately 2000 years ago and which, prior to this time was occupied by people with predominantly hunter-gatherer lifestyles.
2. The ***colonial ecological revolution*** which in Namaqualand first made itself felt through the rapid spread of smallpox from the Cape Colony after its outbreak there in 1713, decimating pastoral societies. From about 1750, and for the next two and half centuries, colonial settlers appropriated the mostly empty land for commercial livestock farming and mining, confining the original inhabitants to increasingly small communal reserves resulting in the formation of two distinct social, economic and ecological outcomes.
3. The ***post-agrarian ecological revolution*** includes the decline in commercial agriculture in the region, particularly cultivation, during the second half of the 20th century and the more recent transformation of the South African social economy after 1994. The influence of the latter has been accompanied by an end to agricultural subsidies, a major focus on land reform in the region, and the expansion of conservation areas such as the Richtersveld and Namaqua National Parks.

Removal of natural vegetation for cultivation destroys the natural habitat of many plants and animals. Where vegetation has been removed by cultivation, old fields take several years for vegetation to be restored, and may even fail to revert to natural vegetation for several decades (Allsopp 1999). Since the decline in commercial agriculture, most of the region is now rangeland for livestock grazing (Hoffman et al. 1999), and therefore still relatively intact. However, heavy grazing has left parts seriously degraded and has also transformed the plant spectrum in others (Lloyd 1999).

Mining is important in the region and also threatens the ecology, although in some cases, attempts are being made to rehabilitate historically mined areas (Lovegrove 1993) and current legislation enforces rehabilitation of mine sites. Mining activities result in loss of vegetation cover which may lead to wind erosion, whilst the creation of many access roads, tracks and borrows pits to service the mined areas and the processing plants and slime dams can generates significant secondary effects, e.g. increased mortality and barriers to migration (Jackelman & Moll 1989).

Impact 2.1: Habitat Loss

Cause and Comment

Large tracts of Namaqualand are still fairly intact in spite of general overgrazing. However, certain areas have also been converted for wheat agriculture. Land-use practices that will further threaten the regions biodiversity are listed below, in their probable order of importance (Cowling 2013).

- The increase of communally-owned land and accompanying small scale livestock use, may lead to overgrazing to desertification.
- Overgrazing of commercial (privately–owned) rangelands.
- Agriculture, especially in the valleys of perennial rivers.
- Mining for diamonds, heavy minerals, gypsum, limestone, marble, monazite, kaolin, ilmenite, and titanium. For example, 65% of the Namaqualand coastline is or has been mined at some level.
- Illegal and large scale collection of succulents and geophytes.
- In addition, climate change is likely to have a major negative influence on the biodiversity of the Succulent Karoo, given the specialized habitat requirements of the numerous local plant endemics (Rutherford et al 1999).

Significance Statement

Habitat loss through existing land use impacts in the project area has resulted in a moderate negative impact in the long-term in the study area. The environmental significance of this impact is MODERATE.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

vii. Visual impacts

The area surrounding the Zirco Kamiesberg project, is characterised by its remoteness and low level of development compared to most other parts of South Africa. It is part of the well-known greater Namaqualand. In this semi-desert environment, the screening effect of vegetation will be minimal as vegetation is very sparse, and there are virtually no tall trees. Most sensitive visual receptors identified within 20 km of the project area are those associated with the Namaqua National Park: the camping spots alongside the coast and the 4x4 route which runs adjacent to the coast and connects the camp sites. The homesteads of farmers within a 12 km radius of the edge of the prospecting areas are also considered to be sensitive receptors. There are two tourist accommodation facilities in the area: The Groenrivier Mond Akkomodasie and Sarri-Safari self-catering lodge. The Namaqua Flower Festival attracts large numbers of visitors to Namaqualand in the flower season. The Namaqua National Park establishes a temporary camp at the Groen River mouth during the flower season to accommodate extra guests visiting the park during this season. These factors combined lead to the conclusion that the Kamiesberg project area is a visually sensitive area. However, the topographical characteristics of the area mean that fixed mine infrastructure are only likely to be visible to a small number of sensitive receptors. Most camp sites are located adjacent to the ocean and are further than 12 km from the edge of the project area. Mining activities will be in an area averaging 150 metres above sea level, meaning it will be mostly invisible to these camp sites. Most homesteads tend to be located along the lower lying drainage basins of the Groen, Bitter and Outeep rivers, which means many of them will also be protected from major visual impacts. Some homesteads however, will have views of fixed mine infrastructure. Not proceeding with the project will definitely contribute towards preserving the unique character of the area. However the project is expected to have only a low visual impact on surrounding sensitive receptors.

9.1.3 Impacts that may result from the construction phase

i. Impacts on topography and geology

Cause and Comment

The construction of the airstip, landfill site, internal roads, etc. will require excavations in order to lay adequate foundations. Furthermore, minor excavations will be required for the upgrading of the existing access road.

Mitigation and Management

None required.

Significance statement

It is envisaged that only minor topographical manipulation will be required during the construction phase of the development. Topographical manipulation will not be required over the entire area but only within selected areas. In addition, large parts of the area are relatively flat, and therefore, impacts associated with topography of the area are considered to be of a low negative significance. There are no mitigation measures for this impact.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long-term	Localised	May Occur	Slight	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

ii. Impacts on soils and agriculture

Issue 1: Soil profile disturbance and resultant decrease in soil capability

Soil capability of a specific area is determined by the collective influences of soil, terrain and climate features on that area. As this is a natural process, any unnatural interference such as excavations and mining activities will have a major effect on the soil capability, and may directly or indirectly lead to various issues such as ground water drainage, erosion and a decline in agricultural potential.

Impact 1.1: Large scale excavations that will disturb the soil profile.

Cause and Comment

Clearing and levelling of the site and excavations of soil during the construction of the mine and associated infrastructure will disturb the existing soil profile. If topsoil becomes buried, or subsoil material that is less suitable for root growth remains at the surface, the agricultural suitability of the soil that will become available for agriculture again after rehabilitation of the mined areas will be reduced.

Mitigation and Management

- The upper 10cm of top soil must be stripped and stockpiled. It should be retained for re-spreading over disturbed surfaces during rehabilitation.
- An Environmental Control Officer (ECO) should monitor all excavations to ensure backfilling with subsoil first and subsequently topsoil spreading takes place.
- An ECO should monitor depth and cover of topsoil spreading during rehabilitation to ensure as close as possible to a depth of 10cm.

Significance Statement

This impact is considered to be short term, localised and severe and thus of MODERATE significance. With mitigation measures in place this impact can be reduced to LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Localised	Severe	Definite	**MODERATE**
With Mitigation	Short term	Localised	Slight	Unlikely	**LOW**

Issue 2: Soil erosion through wind ablation as a result of vegetation clearing

As the Kamiesberg Project area is situated on sand-dominated land the associated soils are considered as having high wind erosion susceptibility, as well as low to moderate water erosion susceptibility within the project area (AGIS, 2007). This effect will be severely enhanced with the removal of the protective top layer of vegetation

Impact 2.1: Soil erosion through wind ablation.

Cause and Comment

Mining of the site will result in large scale vegetation clearing. The vegetation layer in the Namaqualand serves an important role in acting as a buffer for aeolian sand movement in the area. Prompt rehabilitation will aid in reducing wind ablation and subsequently erosion of sand.

Mitigation and Management

- Rehabilitation of the affected landscape must commence as soon as possible after mining to minimise the period during which the soil surface is exposed;
- Use of wind breaks is recommended;
- Rehabilitation should, as far as possible, restore the pre-mining slopes and shape of the pre-mining landscape; and
- Only local sand should be used to landscape the impacted areas during rehabilitation.

Significance Statement

This impact is considered to be short term, severe and definite and thus of HIGH significance. With mitigation measures in place this impact can be reduced to MODERATE significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Study Area	Severe	Definite	**HIGH**
With Mitigation	Long term	Study Area	Moderate	Probable	**MODERATE**

iii. Impacts on surface and groundwater resources

Impact 1: Impacts of groundwater abstraction

Cause and Comment

The severity of the impacts is assessed on the assumption that it will probably be necessary to abstract groundwater from boreholes in the Groenrivier valley for construction purposes. Thus, impacts on groundwater levels may occur when groundwater is abstracted for construction purposes.

Mitigation and Management

- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- If necessary provide an alternative source of water for stockwatering if abstractions for mining purposes prejudice the yield of existing wells and boreholes used by local population.
- Continuously monitor groundwater levels via observation wells.

Significance Statement

Although the likelihood of the impact occurring will be reduced by implementing mitigation measures, the overall severity of the impact for the construction phase will be LOW negative before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Local	Moderate	Probable	**LOW**
With Mitigation	Long term	Local	Slight	Possible	**LOW**

Impact 2: Impacts on groundwater of pollution by contaminants

Cause and Comment

Groundwater may be polluted by a range of substances that, if not stored, handled and managed properly, may find their way into the aquifer underlying the mine site and permanently contaminate the water. The main contaminants during construction are hydrocarbons such as fuel, oil and other lubricants, paints and solvents, which must be stored, handled and managed to prevent spills and leakage, and measures put in place to rectify incidents immediately they occur. Other contaminants such as cement must be properly managed to prevent spillage onto exposed soil surfaces.

Mitigation and Management

- All hydrocarbons of all types must be stored on impermeable surfaces with appropriately-sized containment bunds and grease traps. Traps must be regularly cleaned.
- All chemicals of all types must be stored on impermeable surfaces in secure and bunded designated storage areas.
- Cement must be stored on impermeable storage areas protected from the rain and mixed only in designated areas. Cement residue must be cleaned up immediately.
- Vehicle repairs, servicing, refuelling and washing must be done only in designated areas with impermeable surfaces with appropriately-sized containment bunds and grease traps.
- Where it is necessary to service, repair or refuel a vehicle or item of plant in the field drip trays must be used to catch drips, spills and leaks.
- Spill kits must be available at all locations where chemicals of hydrocarbons are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol appropriate to the material in question.

Significance Statement

Without mitigation the impacts during the construction phase will be of MODERATE negative significance, which can be reduced to LOW negative by diligent and sustained implementation of mitigation control measures.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	Probable	**MODERATE**
With Mitigation	Short Term	Study Area	Moderate	Possible	**LOW**

Impact 3: Impact on surface water of groundwater abstraction from the Groenrivier valley

Cause and Comment

The 2015 study by SWS indicates that there is negligible perennial flow in the Groenrivier system, either at the surface or in the shallow substrate or channel fill, and that the lagoon is sustained by discharge from the spring at the head of the estuary. The spring is fed by a shallow groundwater system in the riparian zone. The discharge from the spring was estimated to be 1 litre per second. The study also showed, by means of hydrochemical fingerprinting, that a direct hydrogeological connection between the general groundwater resources adjacent to the river at the site and the spring is highly unlikely. The river and estuary will only be affected in the unlikely event of water being abstracted from the shallow groundwater system in the riparian zone that feeds the spring. Since the discharge from the spring has been observed to be very low (around 1 litre per second in February 2015) compared to the estimated yield of the deeper groundwater system (possibly up to 30 litres per second), there is no intention to abstract water from the riparian groundwater system.

Provided no water is abstracted from the groundwater system that feeds the spring no impacts on the river or estuary are anticipated during construction or operation, or in the long-term after mine closure.

Mitigation and Management

- Ensure that water is not abstracted from the shallow groundwater system in the riparian zone

Significance Statement

No impact

Impact 4: Impacts of river crossing infrastructure

Cause and Comment

It will be necessary to upgrade (or possibly even to replace) the existing DR2938 road crossing over the Groenrivier to accommodate increased mine-related traffic. It will also be necessary to construct a pipeline across the river to convey mineral processing water from the seawater intake on the coast south of the mine site to the mine site. The construction of the road crossing and pipeline will necessitate working in and immediately adjacent to the river channel, and may require excavation in or alterations to the river bed and riparian zones.

The existing road crossing is a drift, with no culverts. The structure prevents subsurface flow, when it occurs, which backs up and flows over the road slab[9]**.** The road is impassable during the infrequent high-flow events. The upgraded / new crossing will not result in any impacts on the flow regime of the river that do not already occur. If the upgraded crossing is designed to include culverts it will not obstruct low flows up to the culvert capacity.

Mitigation and Management

Road crossing

- If it is necessary to construct a new crossing, not on the alignment of the existing drift, it should be sited to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- The conditions of the Water Use Licence (or General Authorisation) must be strictly adhered to.

Pipe crossing

- Site the crossing to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- As far as possible avoid the construction of structures below the level of the 100-year flood.
- Remove the crossing after closure and decommissioning of the mine.
- The conditions of the Water Use Licence must be strictly adhered to.

Significance Statement

9 This is evident on the Google Earth images of the road crossing, which are dated 24th September 2013, two days after a flow rate of 1.7m^3/sec was recorded at the Swartdoring gauging station.

Without proper care in siting and constructing the crossings the bed and banks of the river could be damaged, resulting in impacts of MODERATE significance. Impacts can be reduced to LOW significance by adhering to the conditions in the Water Use Licence / General Authorisation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Local	Moderate	Probable	**MODERATE**
With Mitigation	Short Term	Local	Slight	Possible	**LOW**

iv. Impacts on the marine environment

Impact 1: Direct losses of intertidal and infratidal biota in development footprint

Cause and Comment

Constructing an intake pipeline across sub tidal reefs and the intertidal rocky shore will require permanently attaching the pipeline to the substratum in a manner that is sufficiently strong to resist the action of the sea. The use of concrete to cement the pipeline in place is the most feasible option. This will result in the death of all sessile (attached) biota along the pipeline path or in the areas where concrete is placed, disturbance of mobile fauna and habitat alteration.

Mitigation and Management

The impact is regarded as permanent, but may be mitigated to some extent by the choice of pipeline material, as some sessile rocky shore and reef organisms are predicted to recolonize the concrete and pipeline surface in time. Further mitigation measures include minimising the surface area impacted by cementing. Alternatively bolting the pipeline directly to the rocky substratum or to concrete bases would minimize the area impacted.

Significance Statement

The duration of the construction phase impacts will be Medium Term. The extent is Localised as it will only directly impact the area where the intake and pipeline will be constructed. The severity of the impact is expected to be MODERATE should mitigation measures not be employed. If they are, the impact is expected to be Slight. The likelihood of of the impact occurring is Definite.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Localised	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Slight	Definite	**LOW**

Impact 2: Barotrauma of marine fauna as a result of blasting

Cause and Comment

The energy of detonating an explosive is released as physical, thermal and gaseous products. The thermal and detonation impacts associated with an explosion are only important to consider near the blast (3 m to 10 m) while the impacts of shockwaves, noise and gaseous chemical products are likely to be experienced at greater distances from the blast. Explosive charges in, adjacent to or beneath a water column produce pressure waves or shockwaves which pass into the water medium. Shockwaves produced by an explosive detonation are "converted suddenly into potential energy of compression and kinetic energy of outward motion in the water medium" (Kramer et al. 1968). Shockwaves have harmful and often fatal impacts on organisms with gas cavities, for example swim bladders in fish and sinus cavities and lungs in birds and mammals.

Results of several experiments have shown that underwater blasts can cause lung haemorrhages, gastrointestinal lesions and ruptured eardrums in mammals; pulmonary haemorrhages, coronary air embolisms and ruptured airsacs, eardrums, livers and kidneys in birds (Yelverton *et al*. 1973); and air bladder and intestinal and organ ruptures and broken ribs in fish (Aplin 1947, Yelverton *et al*. 1975, Wright 1982). Marine invertebrates do not possess gas filled cavities and the direct impacts of shockwaves produced by blasting are therefore predicted to be negligible and insignificant. The impacts of underwater blasting on marine fauna are related to the size of the explosion, the type of explosive used and water depth.

Fauna likely to be at risk from blasting activities at the proposed sites include coastal fish species, marine birds, sharks and mammals. The marine habitats in the vicinity of the proposed sites are not unique and are relatively well represented along adjacent sections of coast and are soon to be protected within the Namaqualand Marine Protected Area. The fish kills that are likely to result from the blasts will not result in an irreplaceable loss of resources and will be replenished following recruitment from adjacent areas. A potential problem may arise where several blasts are triggered throughout a particular day as predators (birds, fish and mammals) are likely to be attracted to the area to feed on fish killed by the initial blast. This could be mitigated by limiting blasting activities to one detonation series per day.

Mitigation and Management

It is recommended that all blasting be conducted using a rock breaking technology known as NoneX (www.nonex.co.za). This is a non-explosive technology. It is propellant compound encased in a cartridge which reacts very quickly to produce high volumes of harmless gas (nitrogen, carbon dioxide and steam). The cartridge is sealed inside a drilled hole and ignited. High pressure gas is released and enters into the fractures caused by drilling and natural fractures or planes of weakness in the rock. The gas pressure causes the fractures to expand and the rock to split apart. The cartridges do produce a high pressure over a short time frame and so will produce noise. Blasting activities must be limited to one detonation series per day to avoid or reduce the mortality of predators and seabirds attracted to fish kills from previous blasts. The use of NoneX reduces impact significance to LOW.

Significance Statement

The duration of the construction phase impacts will be Short Term and the extent is Regional. The severity of the impact is expected to be severe should mitigation measures not be employed. If as suggested NoneX is used, the impact is expected to be LOW. The likelihood of the impact occurring is Probable.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Regional	Severe	Probable	MODERATE
With Mitigation	Short term	Regional	Slight	Probable	LOW

Impact 3: Impaired water quality impacts to marine fauna

Cause and Comment

Construction activities such as drilling and blasting are likely to generate sediment plumes, which will increase the turbidity of the water and settle on the surrounding seafloor. Another potential source of contamination of the water in the vicinity of the construction site is the potential chemical pollution from the casting of concrete.

The area surrounding the construction site is particularly exposed. It is anticipated that sand particles suspended by drilling and blasting will be readily dispersed with no significant impact on the marine biota. Similarly in the event of exposure of cement directly into the marine environment any chemical pollution is expected to be readily dispersed and as such impacts are expected to be of low significance to the marine biota in the area. The construction activities will involve the use of heavy vehicles and machinery in the coastal zone and there is a potential for hydrocarbon spills. Suitable management mechanisms must be implemented to mitigate this risk and contingency plans in the event of accidental spills must be prepared. This should include measures required to ensure that no storm water from the site be allowed to enter the sea.

Mitigation and Management

- NoneX should be used for all blasting. The NoneX rock breaking process produces a much courser fragmentation when compared to the smaller particles produced by explosives. Furthermore NoneX detonations on land have been reported to produce negligible dust and fumes. The use of NoneX blasting technology will result in the release of gases into the water column. None of the gases produced will be noxious given that the cartridge is oxygen balanced and sufficient oxygen is available to achieve optimal oxidation to produce gases consisting of carbon dioxide, nitrogen and steam.
- All fuel and oil is to be adequately stored and no leaking vehicles are to be permitted on site. Contingency plans in the event of an accident must be prepared. Containment of storm water from construction areas is also important.
- The casting of cement for attachment of the pipeline should take place within water tight plastic canvas bags supported and shaped within metal frames with shuttering beams.

Significance Statement

The duration of the construction phase impacts will be Short Term and the extent is considered to be Localised. The severity of the impact is expected to be moderate should mitigation measures not be employed and slight with mitigation. The impact is expected to be LOW without mitigation and remains as such with mitigation. The likelihood of the impact occurring is Probable.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Localised	Moderate	Probable	**LOW**
With Mitigation	Short term	Localised	Slight	Probable	**LOW**

Impact 4: Litter during construction

Cause and Comment

Large numbers of marine organisms, including fish and marine mammals, are killed or injured by becoming entangled in debris (Wallace 1985), while others, including seabirds, are at risk through the ingestion of small plastic particles (Shomura and Yoshida 1985). All reasonable measures must be implemented to ensure there is no littering by construction workers. During the construction phase of the gully seawater intake pipeline, piping off-cuts and other materials used or brought to site during construction, may enter the sea. The problem of litter entering the marine environment has escalated dramatically in recent decades, with an ever-increasing proportion of litter consisting of non-biodegradable plastic materials.

South Africa has laws against littering, both on land and in the coastal zone, but these laws are seldom, if ever, rigorously enforced. The fact that this form of pollution can be obviated is clearly demonstrated by the lack of such material in countries where the laws are strictly adhered to (e.g. Germany and Holland). Objects which have a particular impact on marine fauna include plastic bags and bottles, pieces of rope and small plastic particles (Wehle and Coleman 1983). Large numbers of marine organisms, including fish, birds and marine mammals, are killed or injured by becoming entangled in debris (Wallace 1985) while others, including seabirds, are at risk through the ingestion of small plastic particles (Shomura and Yoshida 1985).

A potential source of such pollution associated with the construction of the gully seawater intake pipeline is that small cuttings of material may exist inside the piping and pumps and will be backwashed out upon start-up of the system. These materials, being largely plastics, may be transported by currents for long distances out to sea or around the coast. Thus, unlike fuel or sewage contamination, the extent of the damage is in theory limitless. The impact on certain forms of marine life by floating or submerged solid materials can hardly be overstressed. Most at risk are seabirds and fish, including possibly rare or even endangered species.

Mitigation and Management

The following mitigation measures must be taken to avoid or reduce the risk of litter and debris entering the marine environment:

- Inform and empower all staff about sensitive marine species and suitable disposal of construction waste.
- Filter effluent on start-up of plant to remove plastic particles.

Significance Statement

The duration of the construction phase impacts will be medium term and the extent is considered to be regional. The severity of the impact is expected to be moderate should mitigation measures not be employed. The impact is expected to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Regional	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Regional	Moderate	May Occur	**LOW**

v. Impacts on flora

This section assesses the impacts associated with the construction of the mine facilities and associated infrastructure, and does not include assessment of the actual mining, which falls within the operational phase.

Issue 1: Loss of Vegetation Type

Impact 1.1: Loss of Strandveld (Namaqualand Strandveld)

Cause and Comment

Strandveld is the dominant vegetation unit in the study area, but it occupies only about 40% of the proposed mining area (1500 ha), and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas. It is also found scattered throughout Sabies, and extends into Leeuvlei. Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld occurs along the southern section of Roode Heuvel. Relatively few SCC are known to occur in true Strandveld, but nevertheless six SCC were recorded in this unit (24% of those in the total study area).

Strandveld is likely to be easier to rehabilitate than Sand Fynbos, as it is adapted to growing on slightly saline soils, whereas Sand Fynbos prefers more acid sands. The primary processing of the mineral sands will be undertaken with seawater, raising the salinity of the sands returned to site, and thus Strandveld is likely to benefit at the expense of Sand Fynbos.

Most of the Strandveld in the mining area has a High botanical sensitivity rating.

Mitigation and Management

The following mitigation actions are required:

- Areas impacted by construction that are no longer required during the operational phase must be rehabilitated as soon as possible after cessation of disturbance;
- Topsoil of at least 300 mm (0.3 m) depth must be harvested from within all development footprints and used for rehabilitation purposes. This is regarded as the minimum depth required in order to include at least 60% of the bulbs (geophytes).
- Mine planning has been informed by the botanical sensitivity mapping to minimize what could otherwise be very significant negative botanical impacts, through the establishment of ecological corridors.
- Where possible associated infrastructure (not tied to any particular area) has been located in areas of lowest sensitivity.

Significance Statement

The loss and degradation of up to about 50 ha of currently natural Strandveld will definitely occur and will have a moderate, permanent impact, as ecosystem functioning in these areas will be effectively lost and/or significantly altered, but the scale is relatively small. The unmitigated environmental significance of this impact is MODERATE negative. This could be reduced to a LOW – MODERATE negative with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Localised, within Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Permanent	Localised, within Study Area	Moderate	Definite	**LOW TO MODERATE**

Impact 1.2: Loss of Sand Fynbos (Namaqualand Sand Fynbos)

Cause and Comment

Sand Fynbos is the second largest vegetation unit in the study area, and makes up about 60% of the proposed mining area, and is consequently the most important vegetation type in terms of habitat loss to this project. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei. Sand Fynbos occurs on slightly undulating plains, on fairly acid sands, and is often dominated by restios in the dune slacks (troughs), and asteraceous fynbos or restios on the dune ridges. The vegetation on the dune ridges often includes Strandveld elements. All Sand Fynbos on site has at least a High sensitivity, especially since all 15 plant SCC recorded from the Sand Fynbos are found in the Northern Sand Fynbos. Sand Fynbos is currently significantly underconserved on a national basis, and its rehabilitation potential is fairly low when compared to Strandveld.

Mitigation and Management

The following mitigation actions are required:

- Areas impacted by construction that are no longer required during the operational phase must be rehabilitated as soon as possible after cessation of disturbance;
- Topsoil of at least 300 mm (0.3 m) depth must be harvested from within all development footprints and used for rehabilitation purposes. This is regarded as the minimum depth required in order to include at least 60% of the bulbs (geophytes).
- Mine planning has been informed by the botanical sensitivity mapping to minimize what could otherwise be very significant negative botanical impacts, through the establishment of ecological corridors.
- Where possible associated infrastructure (not tied to any particular area) has been located in areas of lowest sensitivity.

Significance Statement

The loss of the Sand Fynbos during the construction phase is likely to be relatively minor, as most infrastructure will be located south of the Sand Fynbos, in the Strandveld areas. Loss of up to 20 ha will definitely occur and will have a minor, permanent impact. The environmental significance of this unmitigated impact will be LOW - MEDIUM negative. This could be reduced to a LOW negative with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Localised, within Study Area	Fairly Minor	Definite	LOW TO MODERATE
With Mitigation	Permanent	Localised, within Study Area	Minor	Definite	LOW

Impact 1.3: Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)

Cause and Comment

Heuweltjieveld may be found all along the eastern extent of Leeuvlei, and a large part of north-eastern Sabies. It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld occurs in the south eastern sections of Sabies adjacent to alluvial corridors. This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals. The unit also supports isolated quartz patches, such as along the Outeep River, and these support many plant SCC, including at least two undescribed species new to science, which are not known to occur outside the study area.

The proposed mining footprint does not include any Heuweltjieveld. Prospecting and mining is unlikely to be undertaken to any great degree in this unit as it is not known to support any target minerals, but much of the anticipated impact is associated with possible prospecting in the few quartz patches.

Mitigation and Management

No special mitigation proposed as this unit is unlikely to be impacted by the construction phase.

Significance Statement

The loss of significant areas of Heuweltjieveld is unlikely to occur at the construction phase and prospecting would have a low temporary to permanent impact. The environmental significance of this unmitigated impact will be LOW negative. This could easily be reduced to LOW negative with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Low	Definite	LOW
With Mitigation	Temporary to Permanent	Study Area	Low	Definite	LOW

Impact 1.4: Loss of Riparian Vegetation (Namaqualand Riviere)

Cause and Comment

Riparian areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also includes tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins. The vegetation varies from *Acacia* thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species and are classified as areas of high sensitivity. The only impact on this vegetation type will be due to the routing of the main aboveground seawater pipeline (and probably an associated service track) across the Groen River, but impacts are likely to be limited to less than 2 ha.

Mitigation and Management

No specific mitigation required for this habitat in terms of mining, as it will not be impacted by mining. The following mitigation actions are suggested:

- Locate the seawater pipeline in relatively disturbed parts of the Groen River crossing, and minimise impact to natural vegetation in this area.

Significance Statement

Very minor loss of riparian vegetation is likely. The environmental significance of this impact will thus be LOW negative, before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Minor	Probable	**LOW**
With Mitigation	Temporary	Study Area	Minor	Probable	**LOW**

Impact 1.5: Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)

Cause and Comment

Klipkop Shrubland vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies. No SCC are likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively.

Mitigation and Management

No special mitigation proposed as this unit is unlikely to be impacted by the construction phase.

Significance Statement

No loss of the Klipkop Shrubland is likely to occur. The environmental significance of this impact will thus be LOW negative, before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Minor	Unlikely	LOW
With Mitigation	Temporary	Study Area	Minor	Unlikely	LOW

Impact 1.6: Loss of Seashore Dunes

Cause and Comment

Seashore Dunes occur as a belt along the coastline, above the high tide water mark, and on the seaward side of the Coastal Duneveld. Essentially it consists of Namaqualand Seashore Vegetation, but also includes transition zones of seashore vegetation occurring on white dune sands, which have taller shrubs, but are not considered part of the Coastal Duneveld. No mining will occur in this habitat, and loss would be caused by the installation of the seawater pump, pipe and associated facility, which would probably occupy less than 0.01 ha.

Mitigation and Management

The following mitigation actions are suggested:

- Locate the plant outside the identified areas of High dune sensitivity that cannot be easily rehabilitated.
- Minimise disturbance around pump infrastructure, and allow for natural rehabilitation of disturbed areas.

Significance Statement

The loss of Seashore Dune habitat will definitely occur and will have a minor, permanent impact. The environmental significance of this unmitigated impact will be LOW to MODERATE negative. With mitigation measures this can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Definite	LOW TO MODERATE
With Mitigation	Permanent	Study Area	Low	Definite	LOW

Impact 1.7: Loss of Coastal Duneveld

Cause and Comment

Coastal Duneveld is situated on the inland side of the Seashore Dunes, and gradually merges with Strandveld further inland. No SCC was recorded in this unit. The main seawater pipeline and associated access track will cross this habitat type, along with the Namaqualand Strandveld and the riverine habitat, but the routing thereof has not yet been finalised. Total habit loss is likely to be <5 ha.

Mitigation and Management

The following mitigation actions are suggested:

- Minimise impact to natural vegetation in this habitat, and allow for natural rehabilitation of disturbed areas.
- Ongoing, annual alien invasive vegetation management along the pipeline route.

Significance Statement

The loss of the Coastal Duneveld will definitely occur and will have a low - moderate, permanent impact. The environmental significance of this unmitigated impact will be LOW to MODERATE negative. With mitigation measures this can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Low - Moderate	Definite	**LOW TO MODERATE**
With Mitigation	Permanent	Study Area	Low	Definite	**LOW**

Issue 2: Loss of Biodiversity and Species of Conservation Concern

Impact 2.1: Loss of Species of Conservation Concern

Cause and Comment

Although mining activities and the associated infrastructure will result in the loss of portions of the local subpopulations of at least 17 plant Species of Conservation Concern (SCC), as well as other species that are important to ecosystem functioning, no significant populations of any SCC are likely to be lost during the construction phase alone. It is possible that small portions of the local populations of up to 5 SCC may be impacted at the construction phase.

Mitigation and Management

The following mitigation actions are suggested:

- All bulbs (geophytes) of Conservation Concern in the construction phase footprints (notably *Lachenalia* sp nov/*arenicola*) should be subject to Search and Rescue in the winter to spring season (June – September) preceding any mining. These plants should be located by suitably qualified staff or consultants who can identify the species. The plants should be immediately translocated to a similar, suitable receiving environment that will not be disturbed by mining activities at any stage in the future.
- All succulents of Conservation Concern in the construction phase footprints (notably *Lampranthus procumbens*) should be subject to Search and Rescue in the autumn (April – May) preceding any mining. These plants should be located by suitably qualified staff or consultants who can identify the species. The plants should be immediately translocated to a similar, suitable receiving environment that will not be disturbed by mining activities at any stage in the future.

- A nursery should be set up in the project area to propagate all possible SCC from within the mining and construction phase area, and the propagated plants should be returned to the post mining landscape about three years after initial rehabilitation has been completed. Planting out should take place after the first good winter rains, typically in May or June. Material for propagation should be sourced from the pre mining and construction phase areas.
- The applicant should set aside for conservation undisturbed habitat that conserves at least 30% of the project area populations of all SCC recorded from the project area.

Significance Statement

The construction phase may result in the loss of portions of local subpopulations of up to 5 plant SCC and this will have a moderate permanent impact. The environmental significance of this unmitigated impact would be MODERATE negative. Mitigation measures may reduce this to a LOW negative impact.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Permanent	Study Area	Low - Moderate	Probable	**LOW**

Impact 2.2: Fragmentation of vegetation and edge effects

Cause and Comment

Habitat fragmentation is potentially one of the most important impacts on the vegetation, and this also has knock on effects on the associated fauna. Fragmentation occurs wherever previously continuous vegetation is lost or degraded, and results in a reduction in the total gene pool and a decrease in species richness and diversity. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced movement due to the absence of ecological corridors. The site is currently unfragmented in about 90% of the area, with partial fragmentation due to clearing of agricultural lands and heavy grazing in about 10% of the total area. Many of these agricultural lands have been fallow for over a decade and are now partly rehabilitated (although most are heavily grazed, which reduces their rehabilitation potential). Edge effects relate to the proximity of natural vegetation to disturbed or mined areas, and these edges are often invaded by alien species, and may also be impacted by windblown dust, etc.

Mitigation and Management

The following mitigation actions are suggested:

- Ongoing alien invasive vegetation management in the project area for the duration of life of mine.
- Maintaining at least one 300m wide infrastructure free north – south ecological corridor along the entire western edge of the project area.
- Keeping vegetation clearing during construction to a minimum.
- Design and implement a Rehabilitation Management Plan which ensures that construction phase footprints are rehabilitated to acceptable standards (minimum of 60% of original plant species present) as soon as possible after the area is no longer in use.

Significance Statement

The construction phase activities may result in minor habitat fragmentation and edge effects and this will have a minor permanent impact. The environmental significance of this unmitigated impact would be LOW negative. This will remain a LOW negative impact with mitigation measures (which are mainly related to post mining rehabilitation).

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Minor	Probable	LOW
With Mitigation	Permanent	Study Area	Minor	Probable	LOW

vi. Impacts on fauna

Issue 1: Loss of Biodiversity

All faunal groups will suffer a general loss of biodiversity due to varied impacts, such as increased mortality from vehicle movements, loss and fragmentation of suitable habitat due to the footprint of project structures, and various forms of pollution associated with traffic and development. This will be greatest for small, slow-moving species, e.g. amphibians, tortoises and snakes and terrestrial species will suffer higher mortalities than arboreal or burrowing species. Volant species (birds and bats) will suffer less mortality, except where important breeding or roosting sites are lost. For all groups there will be increased mortality.

Impact 1.1: Loss of Amphibian Diversity

Cause and Comment

Amphibians are the least specious group of terrestrial vertebrates in the concession area. Due to habitat loss and mortalities directly associated with specific project actions, a loss of amphibian diversity will probably occur. Amphibian mortalities will occur during all phases (construction and operational) but will be most significant in association with habitat loss, particularly of wetlands. The most widespread and common species in the region is the Namaqua Rain Frog (*Breviceps namaquensis*) which undergoes direct development, free of standing water. The Common Platanna (*Xenopus laevis*) and Cape River Frog (*Amietia fuscigula*) are both restricted to permanent pools (e.g. in the Groen River valley and these are essential for their survival.

Mitigation and Management

- Avoid clearing or damaging riparian vegetation and limit river and stream crossings (especially the Groen River at pipeline crossing) as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Limit the removal or damaged to riparian vegetation surrounding the construction of the pipeline across the Groen River. Maintenance of water quality and flow dynamics is required to prevent indirect impacts on the Groen River.

Significance Statement

The duration of the construction phase impacts will be medium term and the extent is considered to be localised. The severity of the impact is expected to be moderate should mitigation measures not be employed. The impact is expected to be LOW without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Localised	Moderate	Probable	**LOW**
With Mitigation	Medium term	Localised	Slight	Unlikely	**LOW**

Impact 1.2: Loss of Reptile Diversity

Cause and Comment

The Project Area probably contains a greater diversity of reptiles than discovered during the survey. Reptile populations, particularly snakes, are difficult to study. Increased human numbers associated with the development of the project will lead to increased mortality of reptiles, particularly tortoises and snakes, directly from road mortalities and human attitudes, as well as the loss of others from habitat loss and fragmentation.

Mitigation and Management

- Avoid clearing or damaging areas of high faunal value as defined in the faunal assessment.
- Protect abiotic habitats, such as rock outcrops, which shelter many reptile species.
- Basic search and rescue of SCC need to be conducted before each plot gets stripped from vegetation and erecting low drift fences around these plots (or at least on the border of the adjacent plot) will limit the movement of reptiles (especially tortoises) back onto site.
- Prohibit exploitation of SCC, e.g. tortoises and chameleons, by employee's onsite.
- Educate mine staff about the necessity of protecting snakes and other reptiles.

Significance Statement

The duration of the construction phase impacts will be medium term and the extent is considered to be limited to the study area. The severity of the impact is expected to be moderate should mitigation measures not be employed. The impact is expected to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Moderate	Probable	**LOW**

Impact 1.3: Loss of Bird Diversity

Cause and Comment

Birds are by far the most speciose vertebrate component in the region. Birds play important and diverse roles in ecosystem functioning (e.g. seed dispersal and trophic transfer) and maintenance of bird diversity is important to maintain viable habitats. Although a few birds are commensal, and can rapidly and successfully adapt to disturbed environments, the majority of birds are sensitive to disturbance and either migrate away from, or suffer greater mortality within, degraded habitats. However, because of their high mobility, birds are capable of rapidly re-colonising rehabilitated habitats, provided suitable microhabitats are available.

Mitigation and Management

- Avoid clearing or damaging areas of high faunal value as defined in faunal specialist assessment.
- Maintain habitat connectivity, particularly to protected areas, via habitat corridors.
- Undertake habitat clearance in systematic way to allow birds or other animals to move to undisturbed areas.

Significance Statement

The duration of the construction phase impacts will be medium term and the extent is considered to be localised. The severity of the impact is expected to be moderate should mitigation measures not be employed. The impact is expected to be LOW without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Localised	Moderate	Probable	**LOW**
With Mitigation	Medium term	Localised	Slight	Unlikely	**LOW**

Impact 1.4: Loss of Mammal Diversity

Cause and Comment

The long history of human settlement, associated with subsistence and later commercial farming, has greatly reduced the presence of large mammals in the region. The maintenance of the small mammal diversity depends on the maintenance of habitat corridors and diversity.

Mitigation and Management

- Avoid clearing or damaging areas of high faunal value as defined in the faunal assessment.
- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small mammals, including bats.

Significance Statement

The duration of the construction phase impacts will be medium term and the extent is considered to be limited to the study area. The severity of the impact is expected to be moderate should mitigation measures not be employed. The impact is expected to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	MODERATE
With Mitigation	Medium term	Localised	Moderate	Probable	LOW

Impact 1.5: Loss of Faunal Species of Conservation Concern

Cause and Comment

Numerous birds, reptiles and mammal species are either endemic to the region or are of conservation concern. The Namaqua Dwarf Adder (Bitis schneideri) is restricted to the coastal duneveld and is threatened by mining activity further north and south of the Groen River. They prefer semi-stable, vegetated coastal sand dunes. The coastal duneveld is also listed by SKEP as an important area for reptiles. This is due to the fact that many sensitive taxa (Namaqua Dwarf Adder and Desert Rain Frogs) occur on this narrow band, which is also heavily mined.

Thirty three (out of the possible 246 bird species) avian SCC may occur in the greater project area; 14 of which were recorded on site. The most significant avian SCC recorded on site include the Ludwig's Bustard (En), Secreaty Bird (Vu) and Black Harrier (Vu). Three bird species (Southern Black Korhaan, Cape Long-billed Lark and Cape Bulbul) are endemic South African species, all of which were recorded during the site visit.

Of the 57 terrestrial mammal species which may occur on site, 10 are considered to be SCC. The project area is highly relevant in terms of the golden moles. Coastal Duneveld and sandy Strandveld areas are important habitats for the three golden mole species which may occur in the project area: Cape Golden Mole (*Chrysochloris asiatica*), Van Zyl's Golden Mole (*Cryptochloris zyli*: EN), and Grant's Golden Mole (*Eremitalpa granti*). In addition, the Namaqua Dune Molerat (Near Threatened) also inhabits areas of coastal sand dunes, and consolidated alluvial soils with mean annual rainfall less than 400 mm. Evidence of a mole-rat was recorded.

Mitigation and Management

- Avoid clearing or damaging areas of high faunal value as defined in the faunal assessment.
- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small faunal species, including reptiles and bats. The eastern edge of Sabies is a particularly important habitat in this regard.
- The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines and associated temporary wetlands.
- Road designs should incorporate, where possible, underpasses and culverts that allow the movement of animals.
- Where possible the road traffic should be limited after dark, as much of the surviving fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc.
- Vehicle speed should be limited to the lowest possible onsite, and should not exceed 40km/h (this limit is not applicable on the main provincial road which is set at 80km/h).
- Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.

Significance Statement

The duration of the construction phase impacts will be long term and the extent is considered to be regional. The severity of the impact is expected to be severe should mitigation measures not be employed. The impact is expected to be HIGH without mitigation and MODERATE with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Regional	Severe	Definite	**HIGH**
With Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**

Issue 2: Habitat loss and fragmentation

Impact 2.1: Impacts on fauna due to habitat fragmentation and habitat loss

Cause and Comment

Various components of the development will cause biodiversity loss directly or indirectly through fragmentation of viable habitats for the various faunal groups. This is usually caused by a loss of vegetation (plant communities) that supply food or shelter, but may include abiotic features such as the loss of temporary wetlands, caves or rock outcrops.

Impacts to sensitive habitats are highly probable and will be local and negative in nature, and occur over the long-term. The significance of these impacts may vary from low to high depending upon the local importance of the habitat and the particular fauna that it harbours.

The proposed transport linkages and associated infrastructure will all cause additional habitat loss and fragmentation, over and above the mining area. The greatest impact on habitat loss and fragmentation will be associated with the internal access roads, the transport of product by road to the N7 and less so with the proposed pipelines. The location of the proposed infrastructure for the MSP lies in a region of intermixed sand fynbos and sandveld. Although relatively few terrestrial vertebrates are associated with this habitat, sand fynbos harbours many SCC as outlined above.

Mitigation and Management

The negative impact of habitat loss associated with the development of the mine cannot be fully mitigated; but the following can assist in reducing the severity of the impact:

- All specific project actions associated with construction, access roads, borrow pits and cut-and-fill construction must avoid sensitive habitats as far as is practicable.
- Natural drainage should be maintained and the silt loads into rivers, streams and temporary wetlands must stay within normal limits.
- Avoid clearing or damaging areas of high faunal value as defined in the faunal assessment.
- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small faunal species, including reptiles and bats.
- The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines.

- Comply with procedures laid out in the Rehabilitation Report.
- Include post rehabilitation monitoring of faunal species.

Significance Statement

The duration of the construction phase impacts will be long term and the extent is considered to be regional. The severity of the impact is expected to be severe should mitigation measures not be employed. The impact is expected to be HIGH without mitigation and MODERATE with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Regional	Severe	Definite	**HIGH**
With Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**

Issue 3: Additional construction impacts on fauna

A variety of impacts are likely to result from the construction of the various components of the mine. However, a significant and widespread impact results from increased transport in the region. Roads are known to alter physical characteristics of the environment and through these impacts roads affect ecosystems, biological communities and species in numerous and different ways.

Impact 3.1: Faunal impacts from dust

Cause and Comment

Increased dust levels are common during construction, especially from veld clearance and increased vehicular traffic. Short-term increased dust levels will accompany all land preparation associated with construction of mine infrastructure, and establishment of the mine pit.

Mitigation and Management

- Roads should be watered down, or binders used during high wind conditions (refer to section 9.4.2 for additional dust mitigation measures).
- Road speeds in sensitive regions e.g. near rivers, across drainage lines, and during extreme dry climatic conditions, should be limited to curtail dust production.
- Vehicle speed should be limited to the lowest possible speed onsite, and should not exceed 40km/h.
- Any material to be transported to and from project site should be done by covered trucks or containers to avoid contamination to the surrounding area.

Significance Statement

The duration of the construction phase impacts will be short term and the extent is considered to be limited to the study area. The severity of the impact is expected to be severe should mitigation measures not be employed. The impact is expected to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Severe	Definite	MODERATE
With Mitigation	Short term	Localised	Slight	Probable	LOW

Impact 3.2: Disruption to fauna from increased noise levels

Cause and Comment

Mining construction and associated vehicle traffic will create noise pollution that can depress local populations of sensitive faunal groups. Animals differ in the degree to which they tolerate such disturbance, and can be expected to have potentially negative and positive impacts on various faunal groups. Large breeding birds do not usually tolerate continuous disturbance. Increased noise and motor vibrations in temporary wetlands and rivers may also impact amphibian breeding choruses, but these impacts will be localised and many amphibian species are surprisingly tolerant of vehicle noise. Noise pollution will occur during all phases (construction, operational, and de-commissioning/closure). Little mitigation is possible.

Mitigation and Management

- Mitigation of this impact is difficult, but noise reduction measures should be implemented in all sensitive areas (e.g. adjacent to the Groen River) at sensitive times (e.g. at night).
- A reduction of construction activities after dark should be considered. However, this mitigation measure is economically unfeasible and therefore it is unlikely to be implemented and hence the impact after mitigation remains of low significance.

Significance Statement

The duration of the construction phase impacts will be short term and the extent is considered to be limited to the study area. The severity of the impact is expected to be severe should mitigation measures not be employed. The impact is expected to be LOW without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Severe	Definite	LOW
With Mitigation	Short term	Study Area	Moderate	Definite	LOW

vii. Visual impacts

Impact 1: Visual intrusion on views of sensitive visual receptors due to mine construction

Cause and Comment:

There are various activities which will take place during construction which will have impacts on sensitive visual receptors:

- Large areas of vegetation will need to be cleared to make way for construction of the processing plant, accommodation, site offices, etc.
- There will be a large increase in the movement of vehicles in the area: large trucks delivering supplies and construction material; graders, excavators and bulldozers; light vehicle movement around site; large trucks hauling rubble and construction waste, etc.
- Soil stockpiles and heaps of vegetation debris.
- Dust emissions from construction activity.

Mitigation and Management

The following mitigation measures are proposed:

- The construction contractor should clearly demarcate areas for roads, clearing and stockpiling so as to minimise site disturbance.
- To make space for stockpiles necessary during the construction phase, consider clearing areas for this purpose that will need to be cleared for mining activities during the operation phase.
- Treat roads to reduce dust emissions.

Significance Statement

The duration of the construction phase impacts will be Short Term. The extent is Study Area as people beyond the immediate environs will not be impacted by construction activity. The severity of the impact is expected to be MODERATE should mitigation measures not be employed. If they are, the impact is expected to be Slight. The likelihood of surrounding farmers having their views impacted by surrounding construction activity is Definite, there are no feasible mitigation measures to reduce this. Since a person’s perception of the impacts from the construction activities relies on their own judgement. The true impact in this regard is best assessed through public consultation. Interviews conducted during the site visit did not reveal any unhappiness about the potential visual intrusion of the mine.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study area	Moderate	Definite	**MODERATE**
With Mitigation	Short term	Study area	Slight	Definite	**LOW**

Impact 2: Impact of mine construction in light of the Department of Environmental Affairs’ Strategy on Buffer Zones for National Parks

Cause and Comment

“*The Constitution of South Africa, under Schedule 4A, accords national and provincial government concurrent legislation competence in terms of most functions of relevance to biodiversity conservation. However, national parks, botanical gardens and marine resources are the responsibility of national government only. It is also national government’s role to administer international treaties. Thus it is the responsibility of the Department of Environmental Affairs to formulate general policy and strategies concerning the conservation and use of biodiversity, the implementation of which will be undertaken by different government institutions within national, provincial, and local spheres.*

In terms of the Act, the Minister responsible for Environmental Affairs has sole responsibility for the declaration of a national park and the assignment of its management to a management authority.

It is in this context that the Minister responsible for Environmental Affairs presents this strategy. It is noted that those areas adjacent to national parks which are influenced by and have influence on the parks are subject to control of all three spheres of government. Thus, while it is the Minister's prerogative to formulate strategies on the conservation and use of biodiversity, the implementation of such strategy will be undertaken by different government institutions within the national, provincial and municipal spheres of government". (Government Gazette, 2012).

The implication of these 3 quoted paragraphs to the project, is that it will be necessary to interact closely with SANParks, and relevant government departments, and reach an agreement that is mutually beneficial to both the developer and SANParks in it's efforts to conserve the Namaqua National park and conserve the areas that link directly to it.

According to the viewshed analysis, no camp sites (except the Groen River Camp site) will have views of the mine infrastructure. Neither will the infrastructure be visible from the 4x4 trail. However, it is quite clear from the viewshed analysis that many parts on the eastern border of the Coastal Section of the Namaqua National Park will have views of the mine infrastructure.

Mitigation and Management

There is little that can be done to mitigate visual impacts, besides those mitigation measures already mentioned above. It will be necessary to interact closely with SANParks, and reach agreement on a way forward that will assist the Namaqua National Park in achieving its function as specified in its management plan.

Significance Statement

Not applicable.

9.1.4 Impacts that may result from the operational phase

i. Impacts on topography and geology

Issue 1: Changes in landform

Impact 1.1: Changes to topography

Cause and comment

Mining activities will result in the excavation of large areas which will change the natural surface topography. Although the area is largely flat and mainly used for grazing, the growth and agricultural potential will be compromised when mined and should be restored during rehabilitation.

Mitigation and Management

- Excavated areas should be filled in and reprofiled so that the slope is approximately the same as what it was before excavation commenced.

- Topsoil should be stockpiled prior to mining and replaced on top of the reformed land as part of the rehabilitation process.

Significance Statement

The impact on topography is considered long term to permanent at a scale affecting the *mine path*. The issue is definitely considered severe and of MODERATE significance. It is probable that the impact will occur. With mitigation measures in place this impact should be reduced to that of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Study Area	Definite	Moderate	**MODERATE**
With Mitigation	Long term	Study Area	Definite	Slight	**LOW**

ii. Impacts on soils and agriculture

This section presents the issues that may impact soil conditions and agricultural activities arising from the operation of the mine, the haul road and the mineral separation plant and associated infrastructure.

Issue 1: Loss of agricultural land

The occupation of the land by the Zirco Kamiesberg mineral sands mine and associated infrastructure will exclude agricultural use of that land for the duration of mining activities.

Impact 1.1: The occupation of the land by a mining activity and associated infrastructure will exclude agricultural use of that land for the duration of the project.

Cause and Comment

Landowners will either lease or sell their land to the developer. As all these landowners are currently farmers farming with livestock (sheep), these agricultural lands will be lost for agriculture for the duration of the mining activity. The lands may be returned to agriculture after mining has been completed and the land sufficiently rehabilitated.

Mitigation and Management

- Develop a Rehabilitation Plan that will ensure that the land can be utilised for agricultural purposes after closure and rehabilitation of the mining area.

Significance Statement

The impact is considered medium term at a scale affecting the study area. The issue is definitely considered severe and of HIGH significance. It is definite that the impact will occur. With mitigation measures in place this impact should be reduced to that of MODERATE significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Severe	Definite	HIGH
With Mitigation	Medium term	Study Area	Moderate	Probable	MODERATE

Issue 2: Surface water and run-off disturbance and resultant erosion potential

Soil erosion is a form of soil degradation. Other forms include soil compaction, loss of organic material, loss of soil structure, poor internal drainage, salinization, and soil acidity problems, and these forms of soil degradation usually contribute to accelerated soil erosion. Soil erosion is a naturally occurring process and is essential for soil formation. Soil erosion takes place on all landforms. The natural agents of soil erosion are water and wind.

Soil erodibility is the estimate of the ability of soils to resist erosion. This is based on the physical characteristics of each soil type. Generally sand, sandy loam and loam textured soils tend to be less erodible than silt, fine sand and clay soils.

Impact 2.1: The existence of hard surfaces (concrete foundations and roads) will increase run-off and potentially lead to erosion.

Cause and Comment

Erosion becomes a problem when anthropogenic activities cause soil erosion to occur at an accelerated rate compared to natural conditions. At the Kamiesberg mineral sands mine site this may be caused by an increase in hard surfaces (e.g. new roads, parking areas, concrete slabs etc.) where high energy stormwater (i.e. fast moving surface water) originating from the hard surfaces caused by the removal of the protective vegetation layer, flow. Excessive erosion reduces soil productivity and settlement of eroded soils can block and/or contaminate water courses and rivers.

Mitigation and Management

- All run-off water must be collected, channelled and disposed of in an appropriate manner.
- The site must be visually monitored for occurrences of erosion, which must be recorded and immediately rectified.
- If erosion occurs the necessary changes to the surface drainage management system must be implemented.

Significance Statement

The impact is considered permanent at a scale affecting the study area. The issue is definitely considered severe and of HIGH significance. It is definite that the impact will occur. With mitigation measures in place this impact should be reduced to that of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Definite	HIGH
With Mitigation	Permanent	Study Area	Slight	Unlikely	LOW

Issue 3: Sedimentation of rivers and streams

The project area is drained by the Bitter and Outeep rivers to the north of the Leeuvlei prospecting area. The Outeep River is a tributary of the Bitter River. To the south is the Groen River, which borders the southern extent of the Roode Heuvel prospecting area.

Impact 3.1: Mining activities may cause increased sediment load in the surrounding rivers and streams

Cause and Comment

Mining activities may directly or indirectly lead to an increase in sediment load into the local river systems. The removal of vegetation may lead to an increase in wind-blown sand which in turn may end up in the surrounding rivers and streams.

Mitigation and Management

- Ensure that all stockpiled material (subsoil and topsoil) are appropriately sited and shaped to reduce wind-blown sand. Other mitigation measures include wetting, canvassing or netting down stockpiles, and the construction of wind breaks.

Significance Statement

The impact is considered long term at a scale affecting the study area. The issue is definitely considered moderate and of MODERATE significance. The impact may occur. With mitigation measures in place this impact should be reduced to that of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Study area	Moderate	May occur	**MODERATE**
With Mitigation	Short term	Study area	Slight	Probable	**LOW**

Issue 4: Loss of natural vegetation

Vegetation plays an important role in agriculture, especially livestock farming. Livestock cannot be productive in the absence of natural vegetation.

Vegetation also plays an important role in soil dynamics. It acts as a buffer for surface erosion. Loss of the natural vegetation layer will lead to an increase in soil erodibility.

Impact 4.1: Mining activities will result in various vegetation types being cleared

Cause and Comment

Various natural vegetation types will be removed from the mining site resulting in a permanent loss of these vegetation types in those areas. Proper mitigation will ensure that all the relevant vegetation types are returned to the site during operations after closure of the mine site.

Mitigation and Management

- The upper 10cm of top soil must be stripped and stockpiled prior to commencement of the mining activity. It must be retained for re-spreading over disturbed surfaces during rehabilitation.
- Local seed mixes may be used to aid and speed up the rehabilitation process. Seed mixes must be approved by the ECO.

Significance Statement

The impact is considered permanent at a scale affecting the study area. The issue is definitely considered very severe and of HIGH significance. It is definite that the impact will occur. With mitigation measures in place this impact should be reduced to that of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Very severe	Definite	**HIGH**
With Mitigation	Short term	Localised	Moderate	May occur	**LOW**

Issue 5: Loss of water

Namaqualand has an exceptionally sensitive eco-system which could easily be disturbed by any change in water dynamics. This is because of the semi-arid nature of the Namaqualand, given the low water availability and high temperatures that characterise the local landscape.

Increased water scarcity and livestock loss from heat exhaustion are the primary concerns in the region. In addition, many existing mining companies have scaled down their operations in the area recently, leaving livestock as the principle viable source of income.

Water availability for watering of livestock is the major challenge for sheep farmers in the district. The only available water source for most of these farmers is groundwater, and sometimes rainwater. Groundwater is abstracted through wind pumps and stored in dams or tanks.

Impact 5.1: Loss of water (ground and surface water) as a result of mining activities

Cause and Comment

Reducing the availability of water in this semi-arid landscape could permanently change the landscape into a dry desert, which would negatively impact both livelihoods and biodiversity.

Excessive use of groundwater by the mine could deplete an already scares water source and leave local farmers in the region with less water.

PLEASE NOTE: Groundwater will not be utilised for the proposed development. It was considered in the initiation of the proposed project and thus included in the agricultural assessment. This option has since been deemed unfeasible and this thus considered not to be relevant and has been excluded from the EIR.

iii. Impacts on surface and groundwater resources

Impact 1: Impacts on groundwater of the tailings storage facility and backfill

Cause and Comment

Seawater will be used for mineral processing, and as a result tailings used to backfill mining voids will contain a significant volume of saline seawater. Seepage of seawater from backfill and from the tailings storage facility down to the groundwater table will cause elevated TDS levels in the already brackish groundwater, which may render it unfit for stockwatering, which is currently the predominant use for groundwater in the area. Groundwater modelling indicates that increases in TDS during the 20-year operational lifetime of the mine will occur only in the immediate vicinity of the TSF, and is unlikely to prejudice any activity outside the mining area even after mining ceases.

The severity of the impacts is assessed on the assumption that, after completion of mining, the land will be returned to agriculture, meaning that groundwater will be required for stockwatering as soon as the mined areas have been rehabilitated and revegetated. However, in this context it must be borne in mind that the vegetation specialist assessment recommends that, in order to address the prevailing effects of overgrazing, stock should not be reintroduced until the vegetation is properly established, and then re-introduced at reduced, more sustainable levels.

Given that the groundwater model predicts that salinities in much of the mining area will show increased levels, sufficient to preclude safe stockwatering, only between about 5 and 40 years after the end of mining, the necessity for and nature of mitigation measures will need to be reviewed as mining proceeds, and as mine closure approaches and negotiations begin for the return of the land to some form of post-mining activity.

Mitigation and Management

- Recover seawater from tailings via sumps in paddocks and recycle as process water.
- Optimise the use of slimes mixed with coarser material (co-disposal) to reduce the rate of infiltration and seepage.
- Continuously monitor the salinity of the groundwater in and around the mining area to confirm or otherwise the results of modelling, and continuously update the model to take account of the monitoring results and data from the weather station.
- If necessary, concomitant with the chosen form of post-mining land use, provide alternative sources of water for stockwatering if salinity levels exceed levels appropriate for animal consumption. New boreholes may need to be established outside the mining area to the east and west, and also on the south side of the Groenrivier.

Significance Statement

If the land is to be returned to stock grazing after mining the impact will be permanent, confined to the study area, very severe, and will probably occur: the overall significance will be HIGH negative.

Successful mitigation will reduce the severity to moderate and the likelihood of occurrence to possible: the overall significance will be reduced to MODERATE negative.

If the land is not to be used for stock grazing the impacts will be negligible.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study area	Very Severe	Probable	**HIGH**
With Mitigation	Permanent	Study area	Moderate	Possible	**MODERATE**

Impact 2: Impacts on groundwater of groundwater abstraction

Cause and Comment

Abstraction of groundwater for any mining-related use could lower the groundwater table and reduce yields from local boreholes and wells that are used mainly for livestock watering. Impacts on groundwater levels will almost certainly occur if groundwater is abstracted for use in mineral processing, even if groundwater is used only to supplement seawater, however this is unlikely to occur.

The severity of the impacts is therefore assessed on the assumption that it will probably be necessary to abstract groundwater from boreholes in the Groenrivier valley for construction purposes, and that it may be necessary to maintain these boreholes in working order during the operation of the mine to provide a backup supply of water in the event of electrical, mechanical or process failure of the seawater abstraction, delivery and treatment system. In this scenario it is likely that the borehole(s) will be worked at a delivery rate considerably less than the sustainable yield indicated by the pump tests.

Mitigation and Management

- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- If necessary provide an alternative source of water for stockwatering if abstractions for mining purposes prejudice the yield of existing wells and boreholes used by local population.
- Continuously monitor groundwater levels via observation wells.

Significance Statement

Although the likelihood of the impact occurring will be reduced by implementing mitigation measures, the overall severity of the impact for operation will be LOW negative before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Local	Moderate	Probable	**LOW**
With Mitigation	Long term	Local	Slight	Possible	**LOW**

Impact 3: Impacts on groundwater of pollution by contaminants

Cause and Comment

Groundwater may be polluted by a range of substances that, if not stored, handled and managed properly, may find their way into the aquifer underlying the mine site and permanently contaminate the water. The main contaminants during operation are hydrocarbons such as fuel, oil and other lubricants, paints and solvents, which must be stored, handled and managed to prevent spills and leakage, and measures put in place to rectify incidents immediately they occur.

Mitigation and Management

- All hydrocarbons of all types must be stored on impermeable surfaces with appropriately-sized containment bunds and grease traps. Traps must be regularly cleaned.
- All chemicals of all types must be stored on impermeable surfaces in secure and bunded designated storage areas.
- Vehicle repairs, servicing, refuelling and washing must be done only in designated areas with impermeable surfaces with appropriately-sized containment bunds and grease traps.
- Where it is necessary to service, repair or refuel a vehicle or item of plant in the field drip trays must be used to catch drips, spills and leaks.
- Spill kits must be available at all locations where chemicals of hydrocarbons are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol appropriate to the material in question.

Significance Statement

The operational phase is of much longer duration, and the significance without mitigation is considered to be HIGH negative. Nevertheless, the significance can be reduced to LOW negative by diligent and sustained implementation of mitigation control measures.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	Probable	**HIGH**
With Mitigation	Long Term	Study Area	Moderate	Possible	**LOW**

Impact 4: Impacts on surface water of the tailings storage facility and backfill

Cause and Comment

Groundwater modelling indicates that the saline plume from the TSF and backfilling will reach the northern side of the Groenrivier valley where it borders the southern extent of Roode Heuvel block about 10 to 20 years after mine closure, and that TDS levels in groundwater in the immediate vicinity of the river may increase to 15 000 - 20 000 mg/l. The saline plume is expected to pass beneath the bed of the river channel at around Year 80 (that is, about 60 years after mine closure). The model indicates that the plume will pass beneath the channel, and there will be no net change in groundwater level. The plume will not contribute to flow in the river channel and thence seawards to the estuary. The possibility of ground water levels rising sufficient for the saline plume to contribute to river flow, either as a result of mining or as a result of external influences such as climate change is considered to be extremely unlikely. Even if hydrological connectivity between the seepage plume and the river channel did occur the lower estuarine lagoon is characteristically hypersaline, with a TDS of around 200 000 mg/l, indications of active sulphate reduction, anoxia and methanogenesis, and no significant ecological functioning. Post-mining groundwater TDS levels to the south of the mining area, on the other hand, will peak at approximately 24 000 mg/l and minor flux of such water to the estuarine system, either via river conveyance or groundwater discharge, both of which are confirmed to be improbable, would therefore be unlikely to significantly influence the baseline conditions of the estuarine system. In addition the spring at the head of the estuary lies some 8km downstream at the closest approach of the plume, and extensive mixing and dilution will occur. No water quality impacts on the Groenrivier related to backfilling or the TSF are anticipated.

Mitigation and Management

- Mitigation measures proposed for Impact 1 may result in a reduction of salinity levels of around 5 000 mg/l.
- Having established a pre-mining baseline of the salinity levels in the estuary (SWS 2015), the general biological state of the estuary should be established and monitored at regular intervals thereafter.

Significance Statement

The low probability of the saline seepage from the TSF and backfill contributing to the flow regime of the river and entering the estuary, and the comparative salinities of the seepage (relatively lower) and the water of the lagoon (relatively higher) indicates that, even if the impact did occur, and although it would to all intents and purposes be permanent, it would be localised, with slight severity, and with an overall significance of LOW negative. No mitigation measures are required, but measures recommended (Impact 1) to reduce the salinity of the seepage would also serve to further mitigate this already low impact.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Local	Slight	Unlikely	**LOW**
With Mitigation	Permanent	Local	Slight	Unlikely	**LOW**

Impact 5: Impact on surface water of groundwater abstraction from the Groenrivier valley

Cause and Comment

The 2005 SWS study indicates that there is negligible perennial flow in the Groenrivier system, either at the surface or in the shallow substrate or channel fill, and that the lagoon is sustained by discharge from the spring at the head of the estuary. The spring is fed by a shallow groundwater system in the riparian zone. The discharge from the spring was estimated to be 1 litre per second. The study also showed, by means of hydrochemical fingerprinting, that a direct hydrogeological connection between the general groundwater resources adjacent to the river at the mine site and the spring is highly unlikely. The river and estuary will only be affected in the unlikely event of water being abstracted from the shallow groundwater system in the riparian zone that feeds the spring. Since the discharge from the spring has been observed to be very low (around 1 litre per second in February 2015) compared to the estimated yield of the deeper groundwater system (possibly up to 30 litres per second), there is no intention to abstract water from the riparian groundwater system. Provided no water is abstracted from the groundwater system that feeds the spring no impacts on the river or estuary are anticipated during construction or operation, or in the long-term after mine closure.

Mitigation and Management

- Ensure that water is not abstracted from the shallow groundwater system in the riparian zone

Significance Statement

No impact

Impact 6: Impacts of river crossing infrastructure

Cause and Comment

It will be necessary to upgrade (or possibly even to replace) the existing DR2938 road crossing over the Groenrivier to accommodate increased mine-related traffic. It will also be necessary to construct a pipeline across the river to convey mineral processing water from the seawater intake on the coast south of the mine site to the mine site. A road crossing already exists, and the upgraded / new crossing is not expected to cause additional impacts to the flow regime of river, or to the bed or banks, during mine operation. The seawater pipeline will be constructed across the river at a height sufficient to avoid damage by the occasional high flows in the river.

The existing road crossing is a drift, with no culverts. The structure prevents subsurface flow, when it occurs, which backs up and flows over the road slab[10]**.** The road is impassable during the infrequent high-flow events. The upgraded / new crossing will not result in any impacts on the flow regime of the river that do not already occur. If the upgraded crossing is designed to include culverts it will not obstruct low flows up to the culvert capacity.

Mitigation and Management

Road crossing

- If it is necessary to construct a new crossing, not on the alignment of the existing drift, it should be sited to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- The conditions of the Water Use Licence (or General Authorisation) must be strictly adhered to

Pipe crossing

- Site the crossing to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- As far as possible avoid the construction of structures below the level of the 100-year flood.
- Remove the crossing after closure and decommissioning of the mine.
- The conditions of the Water Use Licence must be strictly adhered to.

Significance Statement

Operational impacts are expected to be of LOW significance.

10 This is evident on the Google Earth images of the road crossing, which are dated 24th September 2013, two days after a flow rate of 1.7m^3/sec was recorded at the Swartdoring gauging station.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Local	Slight	Possible	**LOW**
With Mitigation	Long Term	Local	Slight	Unlikely	**LOW**

iv. *Impacts on the marine environment*

Impact 1: Impingement of organisms

Cause and Comment

The impacts of seawater extraction on marine life can include entrainment and impingement. Entrainment occurs when organisms pass through intake structures and into the process equipment. These may include holoplanktonic organisms (permanent members of the plankton, such as copepods, diatoms and bacteria) and meroplanktonic organisms (temporary members of the plankton, such as juvenile shrimps and the planktonic eggs and larvae of invertebrates and fish). Impingement occurs when larger marine organisms are trapped against intake screens by the velocity of the water flow. These organisms may suffer mortality due to starvation, suffocation or exhaustion (UNEP 2008). Although some hardy species may survive impingement, the 24 h survival rate of less robust species is probably less than 15%. The significance of these impacts is related to the location of an intake. Intake structures should be positioned away from sensitive environments or areas with high species diversity or abundance, like rocky reefs, and should not draw in water from the upper few cm of the water column, as planktonic organisms tend to concentrate in this zone.

Impingement and entrainment can also be mitigated through optimal designs to open water intakes. The horizontal extraction of water should aid in reducing fish entrainment as fish have been shown to avoid rapid changes in horizontal flow. The number of mobile organisms becoming entrained in the intake structure and the ability of larger organisms to escape impingement is dependent on the intake velocity. There is a broadly accepted rule that water extraction velocities should be capped at 0.15 m/s to minimize debris and marine life impingement (ASCE 1982, Fredorenko 1991). However this mitigation measure is only effective for mobile organisms which can swim away and not planktonic organisms, which have little or no mobility and drift passively with currents, or organisms that are incapable of sustained mobility against water flow.

Fish and invertebrate eggs and larvae, algal spores, phytoplankton and zooplankton in the vicinity of the intake structure are thus expected to suffer mortality by entrainment. Plankton species have rapid reproductive cycles and are likely to be widespread and abundant in the coastal waters, and thus their ability to sustain their populations should not be impacted by one intake structure. Furthermore the reproductive strategy of many fish and invertebrates is to produce many eggs and larvae of which a large percentage will suffer mortality by natural causes and only a small percentage will reach maturity (UNEP 2008).

Extracting sea water directly from the sea using a pipeline means that the sea water would not be filtered through sediment and may still contain high numbers of marine biota (larvae, macro/micro – fauna etc.) that may foul plant equipment. Increased particles in the water will require increased use of chemicals and biocides in pre-treatment, resulting in increased backwash volumes/intervals and increased negative environmental contamination. Predicted impacts therefore remain of moderate significance.

Mitigation and Management

It is recommended that the following mitigation measures be taken to avoid or reduce the impingement of mobile organisms at the intake, thus reducing the impact to low significance:

- Having discussed the optimum intake velocity with the engineers it was agreed that the recommended intake flow may not exceed 0.2 m/s through the installation of an appropriate sized intake structure on the base of the foot valve. The intake structure should be directed such that water flows in a 'horizontal' rather than vertical direction;
- The intake pipes must be positioned at least 0.5 m off the seabed to reduce the intake of sediment and benthic organisms (Fredorenko 1991);
- The intake pipes must be positioned at least 1.4 m below the Mean Low Water Spring Tide mark to reduce entrainment of larvae and most other planktonic marine organisms as these are generally concentrated at or near the surface.

The current design considered, indicates that no biocides will be discharged into the marine environment. The seawater will be screened and filtered and all materials used in the system will be selected for robustness to avoid the need for biocides. If fouling occurs and biocides are required the potential impacts of these various options on the water quality and biological communities will need to be assessed and compared. Provided it is mitigated properly, this will not constitute a significant issue.

Significance Statement

The duration of the operational phase impacts will be long term. The extent is localised and the severity of the impact is expected to be severe should mitigation measures not be employed, and slight if mitigation measures are adhered to. As a result the impacts are considered to be MODERATE without mitigation and LOW with mitigation. The likelihood of the impact occurring is probable.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Localised	Severe	Probable	**MODERATE**
With Mitigation	Long term	Localised	Slight	Possible	**LOW**

v. Impacts on flora

This section assesses the impacts associated with the operational phase of the mine, and includes the actual mining operations for the full life of mine.

Issue 1: Loss of Vegetation Type

Impact 1.1: Loss of Strandveld (Namaqualand Strandveld)

Cause and Comment

Strandveld is the dominant vegetation unit in the study area, but it occupies only about 40% of the proposed mining area (1500 ha), and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas. It is also found scattered throughout Sabies, and extends into Leeuvlei. Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld occurs along the southern section of Roode Heuvel. Relatively few SCC are known to occur in true Strandveld, but nevertheless six SCC were recorded in this unit (24% of those in the total study area).

Strandveld is likely to be easier to rehabilitate than Sand Fynbos, as it is adapted to growing on slightly saline soils, whereas Sand Fynbos prefers more acid sands. The primary processing of the mineral sands will be undertaken with seawater, raising the salinity of the sands returned to site, and thus Strandveld is likely to benefit at the expense of Sand Fynbos.

Most of the Strandveld in the mining area has a High botanical sensitivity rating.

Mitigation and Management

The following mitigation actions are required:

- Areas impacted by mining must be rehabilitated as soon as possible after cessation of disturbance;
- Topsoil of at last 300 mm (0.3 m) depth must be harvested from within all development footprints and used for rehabilitation purposes. This is regarded as the minimum depth required in order to include at least 60% of the bulbs (geophytes).
- There must be a north-south corridor at least 300 m wide through the project area at all times. This corridor will be along the eastern side of Roode Heuwel during years 1-5 of mining and along the western edge of the project site once rehabilitation has been completed, for the remainder of the mine life.
- Areas within the project area that are not required during mining should be demarcated as no-go areas and conserved. These areas provide important refugia for birds, reptiles, amphibians and mammals.
- All Very High sensitivity areas outside the approved mining area should be treated as conservation areas and should not be subject to invasive prospecting or mining;
- No livestock should be allowed to graze in the approved mining area nor within a 500 m buffer area (if such an area is located within the permit area) from six months after any authorization up until the mine closure permit is granted. Removal of livestock from the area will significantly enhance seed set and hence rehabilitation.
- Design and implement a Rehabilitation Management Plan.
- Rehabilitation targets must include a measurable element of botanical diversity. In other words the rehabilitation target for Strandveld areas should be to return the mined areas to at least 60% of the pre-mining botanical diversity for this habitat.
- Ongoing, annual alien invasive vegetation management is required in the mined and rehabilitated areas until the mine closure permit is issued.
- East – west oriented wind fences will be required in the rehabilitation areas in order to minimise wind erosion, probably at an interval of every 5 m, as at Namakwa Sands.

Significance Statement

The loss and degradation of up to about 1500 ha of currently natural Strandveld will definitely occur and will have a severe, permanent impact, as ecosystem functioning in these areas will be effectively lost and/or significantly altered. The environmental significance of this impact is HIGH negative, before mitigation, and MODERATE negative after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Severe	Definite	**HIGH**
With Mitigation	Permanent	Study Area	Moderate	Definite	**MODERATE**

Impact 1.2: Loss of Sand Fynbos (Namaqualand Sand Fynbos)

Cause and Comment

Sand Fynbos is the second largest vegetation unit in the study area, and makes up about 60% of the proposed mining area (2,290 ha), and is consequently the most important vegetation type in terms of habitat loss to this project. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei. Sand Fynbos occurs on slightly undulating plains, on fairly acid sands, and is often dominated by restios in the dune slacks (troughs), and asteraceous fynbos or restios on the dune ridges. The vegetation on the dune ridges often includes Strandveld elements. All Sand Fynbos on site has at least a High sensitivity, and due to the fact that all 15 plant SCC recorded from the Sand Fynbos are found in the Northern Sand Fynbos this area has been classified as HIGH sensitivity. Sand Fynbos is currently significantly underconserved on a national basis, and its rehabilitation potential is fairly low when compared to Strandveld.

Mitigation and Management

The following mitigation actions are required:

- Areas impacted by construction that are no longer required during the operational phase must be rehabilitated as soon as possible after cessation of disturbance;
- Topsoil of at last 300 mm (0.3 m) depth must be harvested from within all development footprints and used for rehabilitation purposes. This is regarded as the minimum depth required in order to include at least 60% of the bulbs (geophytes).
- No livestock should be allowed to graze in the approved mining area nor within a 500 m buffer area (if such an area is located within the permit area) from six months after any authorization up until the mine closure permit is granted. Removal of livestock from the area will significantly enhance seed set and hence rehabilitation.
- Design and implement a Rehabilitation Management Plan.
- Rehabilitation targets must include a measurable element of botanical diversity. In other words the rehabilitation target for Sand Fynbos areas should be to return the mined areas to at least 60% of the pre-mining botanical diversity for this habitat.
- Ongoing, annual alien invasive vegetation management is required in the mined and rehabilitated areas until the mine closure permit is issued.
- East – west oriented wind fences will be required in the rehabilitation areas in order to minimise wind erosion, probably at an interval of every 5m, as at Namakwa Sands.
- The majority of the northern Namaqualand Sand Fynbos in the project area (as depicted on the map showing the proposed corridors – refer to conclusions and recommendations in Chapter 11 of this report) (equating to > 2 000 ha) must be set aside as a formal conservation area and managed as such for the duration of the project. It is recommended that discussions are undertaken with the Namaqua National Park with regards to incorporating this section into the Park. This may however, not be a viable option as there are limited linkages between the Park and the proposed project area.

- No livestock should be allowed to graze in the area demarcated as ecological corridors within the Roode Heuwel property, which will be owned by Zirco. It is recognised that it will not be possible to prevent grazing in the ecological corridors of Leeuvlei and Sabies, as Zirco do not own the surface rights to this land. The Roode Heuwel corridor is a critical area as it includes a large amount of Namaqualand Sand Fynbos. It must be managed as a conservation area so that this portion of Sand Fynbos would make a contribution towards the conservation of this important vegetation type. A 4,600 ha biodiversity offset for this project has been recommended, and the ecological corridor would contribute approximately 2,000 ha (43%) towards this target. The figure of 4,600ha has been arrived at by using a 2:1 ratio of conservation: development land, which is the quantum recommended for Least Threatened habitats in the Biodiversity Offsets Guideline (DEADP 2009).
- Suitable high quality areas of Namaqualand Sand Fynbos in the region, adjacent to the Namaqua National Park, have been identified. These could potentially be purchased by the applicant and donated to the appropriate national conservation authorities, or leased to them via contract. This would effectively be a biodiversity offset that would help reduce the significant residual botanical impacts remaining after all the above mitigation has been factored in (Moderate – High negative). Approximately 9000 ha of suitable land has been identified, made up of 11 cadastres, in three main areas (see Figure 9.1). It is recommended that 2,500 ha of this would be required to offset all biodiversity impacts to either moderate or low. It is recommended that consideration be given to purchasing suitable portions and donating them to the Park, within five years of project approval. Given that there are numerous factors that may impact on what land is actually purchased (including landowner willingness) no recommendation is made at this stage in terms of which portions have to be purchased, but it should be within either of these three target areas. If this quantum of land can be added to the National Park then the overall significance of the loss of Sand Fynbos for this project could be reduced to LOW negative.

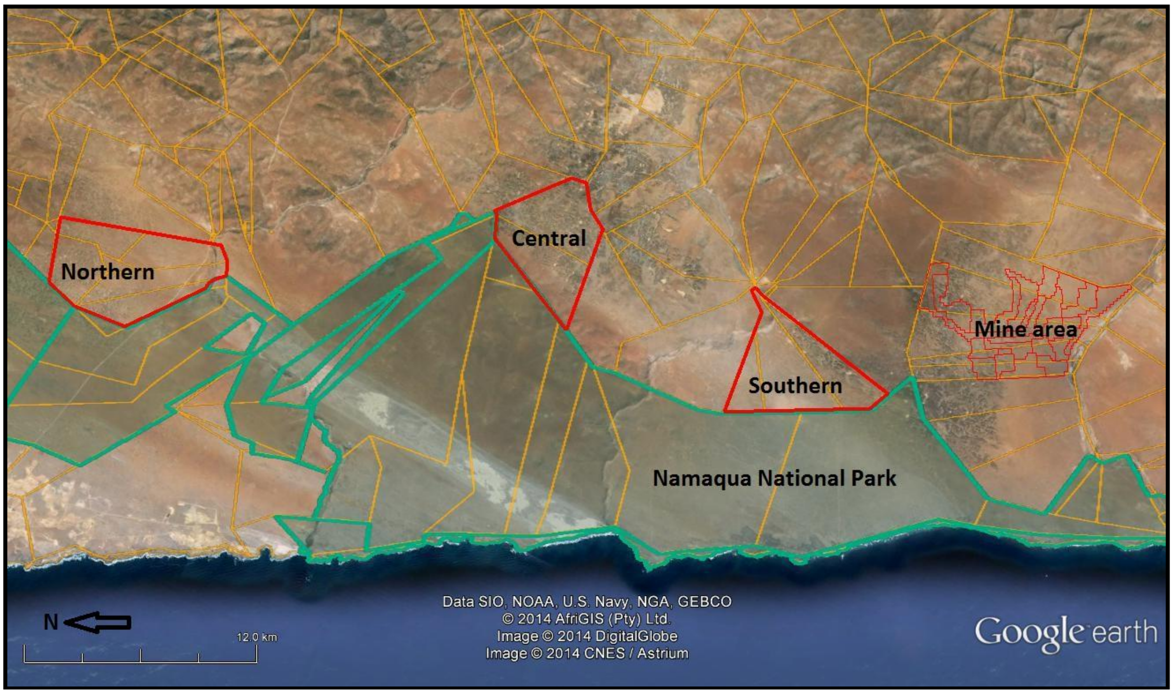


Figure 9.1: Map showing the three best proposed biodiversity offset options (red polygons) adjacent to the Namaqua National Park (green shaded area). Orange lines are cadastres.

Significance Statement

The loss of about 2,290 ha of Sand Fynbos will definitely occur and will have a very severe, permanent impact. The environmental significance of this unmitigated impact will be HIGH negative. This could be reduced to a MODERATE to HIGH negative with mitigation (but without a biodiversity offset). With a suitable offset this could be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Severe	Definite	HIGH
With Mitigation	Permanent	Study Area	Moderate - Severe	Definite	HIGH-MODERATE
With Mitigation and Biodiversity Offset	Permanent	Study Area	Slight	Definite	LOW

Impact 1.3: Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)

Cause and Comment

Heuweltjieveld may be found all along the eastern extent of Leeuvlei, and a large part of north-eastern Sabies. It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld occurs in the south eastern sections of Sabies adjacent to alluvial corridors. This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals. The unit also supports isolated quartz patches, such as along the Outeep River, and these support many plant SCC, including at least two undescribed species new to science, which are not known to occur outside the study area.
The proposed mining footprint does not include any Heuweltjieveld. Prospecting and mining is unlikely to be undertaken to any great degree in this unit as it is not known to support any target minerals, but much of the anticipated impact is associated with possible prospecting in the few quartz patches.

Mitigation and Management

The following mitigation actions are suggested:

- All Very High sensitivity areas (notably quartz patches) outside the proposed mining area should be treated as conservation areas and should not be subject to prospecting or mining;

Significance Statement

The loss of significant areas of Heuweltjieveld is unlikely to occur and prospecting would have a medium temporary to permanent impact. The environmental significance of this unmitigated impact will be MODERATE negative. This could easily be reduced to LOW negative with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary to Permanent	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Temporary to Permanent	Study Area	Low	Definite	**LOW**

Impact 1.4: Loss of Riparian Vegetation (Namaqualand Riviere)

Cause and Comment

Riparian areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also include tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins. The vegetation varies from *Acacia* thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species and are classified as areas of high sensitivity. The only impact on this vegetation type will be due to the routing of the main aboveground seawater pipeline (and probably an associated service track) across the Groen River, but impacts are likely to be limited to less than 2 ha, and are covered under the construction phase impacts.

Mitigation and Management

No specific mitigation required for this habitat in terms of mining, as it will not be impacted by mining.

Significance Statement

Very minor loss of riparian vegetation is likely (construction phase). The environmental significance of this impact will thus be LOW negative, before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Minor	Probable	**LOW**
With Mitigation	Temporary	Study Area	Minor	Probable	**LOW**

Impact 1.5: Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)

Cause and Comment

Klipkop Shrubland vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies. No SCC is likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively.

Mitigation and Management

No specific mitigation required for this habitat in terms of the operational phase, as it will not be impacted by mining.

Significance Statement

No loss of the Klipkop Shrubland is likely to occur. The environmental significance of this impact will thus be LOW negative, before and after mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Temporary	Study Area	Minor	Unlikely	**LOW**
With Mitigation	Temporary	Study Area	Minor	Unlikely	**LOW**

Impact 1.6: Loss of Seashore Dunes

Cause and Comment

Seashore Dunes occur as a belt along the coastline, above the high tide water mark, and on the seaward side of the Coastal Duneveld. Essentially it consists of Namaqualand Seashore Vegetation, but also includes transition zones of seashore vegetation occurring on white dune sands, which have taller shrubs, but are not considered part of the Coastal Duneveld. No mining will occur in this habitat, and loss would be caused by the installation of the seawater pump, pipe and associated facility, which would probably occupy less than 0.01 ha. This is a construction phase impact and is covered under that section of the report.

Mitigation and Management

No specific mitigation required for this habitat in terms of the operational phase, as it will not be impacted by mining (operational phase).

Significance Statement

The loss of Seashore Dune habitat will definitely occur and will have a minor, permanent impact. The environmental significance of this unmitigated impact will be LOW to MODERATE negative. With mitigation measures this can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Definite	**LOW TO MODERATE**
With Mitigation	Permanent	Study Area	Low	Definite	**LOW**

Impact 7: Loss of Coastal Duneveld

Cause and Comment

Coastal Duneveld is situated on the inland side of the Seashore Dunes, and gradually merges with Strandveld further inland. No SCC was recorded in this unit. The main seawater pipeline and associated access track will cross this habitat type, along with the Namaqualand Strandveld and the riverine habitat, but the routing thereof has not yet been finalised. Total habitat loss is likely to be <5 ha, but this will largely be at the construction phase. No mining (operational phase) will occur in this habitat.

Mitigation and Management

No specific mitigation required for this habitat in terms of the operational phase, as it will not be impacted by mining.

Significance Statement

The loss of the Coastal Duneveld will definitely occur and will have a low - moderate, permanent impact. The environmental significance of this unmitigated impact will be LOW to MODERATE negative. With mitigation measures this can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Low - Moderate	Definite	**LOW TO MODERATE**
With Mitigation	Permanent	Study Area	Low	Definite	**LOW**

Issue 2: Loss of Species of Conservation Concern

Impact 2.1: Loss of Species of Conservation Concern

Cause and Comment

Mining activities and the associated infrastructure will result in the loss of portions of the local subpopulations of at least 17 plant Species of Conservation Concern (SCC), as well as other species that are important to ecosystem functioning. Prospecting in the greater project area could potentially impact on a further six SCC, although the likelihood of this impact is much lower. Appendix 2 in the vegetation assessment lists the SCC likely to be impacted by the proposed mining footprint, and in the possible prospecting areas, and the significance thereof for each species. Three species are of particular concern – *Lachenalia* sp nov (*arenicola* MS), *Agathosma elata* and *Lampranthus procumbens*.

Mitigation and Management

The following mitigation actions are suggested:

- All bulbs (geophytes) of Conservation Concern in the mining area (notably Lachenalia sp nov/arenicola) should be subject to Search and Rescue in the winter to spring season (June – September) preceding any mining. These plants should be located by suitably qualified staff or consultants who can identify the species. The plants should be immediately translocated to a similar, suitable receiving environment that will not be disturbed by mining activities at any stage in the future.
- All succulents of Conservation Concern in the mining area (notably Lampranthus procumbens) should be subject to Search and Rescue in the autumn (April – May) preceding any mining. These plants should be located by suitably qualified staff or consultants who can identify the species. The plants should be immediately translocated to a similar, suitable receiving environment that will not be disturbed by mining activities at any stage in the future.

- A nursery should be set up in the project area to propagate all possible SCC from within the mining area, and the propagated plants should be returned to the post mining landscape about three years after initial rehabilitation has been completed. Planting out should take place after the first good winter rains, typically in May or June. Material for propagation should be sourced from the pre mining areas.
- The applicant should set aside undisturbed habitat that conserves at least 30% of the project area populations of all SCC recorded from the project area. Key areas in this regard include the ecological corridors (defined in the conclusions and recommendations in Chapter 11 of this report). These areas should be managed as conservation areas.
- A suitable biodiversity offset should be implemented within 5 years of any project approval, whereby at least 2500 ha of natural habitat known to support the SCC is purchased by the applicant and added to the Namaqua National Park (either by donation or contract). The offset should be located within one of the three priority areas identified in Figure 9.1.

Significance Statement

The mining activities will definitely result in the loss of portions of local subpopulations of up to 17 plant SCC and this will have a severe permanent impact. The environmental significance of this unmitigated impact would be HIGH negative. Standard mitigation measures may reduce this to a MODERATE - HIGH negative impact, and if combined with the implementation of a suitable biodiversity offset this impact could be further reduced to LOW - MODERATE negative.

Impact	**Effect**			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	**Spatial Scale**	**Severity of Impact**		
Without Mitigation	Permanent	Study Area	Severe	Definite	**HIGH**
With Mitigation	Permanent	Study Area	Moderate	Probable	**HIGH-MODERATE**
With Mitigation and Biodiversity Offset	Permanent	Study Area	Moderate	Probable	**LOW-MODERATE**

Impact 2.2: Fragmentation of vegetation and edge effects

Cause and Comment

Habitat fragmentation is potentially one of the most important impacts on the vegetation, and this also has knock on effects on the associated fauna. Fragmentation occurs wherever previously continuous vegetation is lost or degraded, and results in a reduction in the total gene pool and a decrease in species richness and diversity. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced movement due to the absence of ecological corridors. The site is currently unfragmented in about 90% of the area, with partial fragmentation due to clearing of agricultural lands and heavy grazing in about 10% of the total area. Many of these agricultural lands have been fallow for over a decade and are now partly rehabilitated (although most are heavily grazed, which reduces their rehabilitation potential). Edge effects relate to the proximity of natural vegetation to disturbed or mined areas, and these edges are often invaded by alien species, and may also be impacted by windblown dust, etc. It is acknowledged that less than 300 ha will be mined at any one time, and that the remainder of the mining area blocks will either thus be undergoing rehabilitation or standing undisturbed, depending on the project phase, which will help reduce overall fragmentation of the site.

Mitigation and Management

The following mitigation actions are suggested:

- Ongoing alien invasive vegetation management in the mining and project area for the duration of life of mine.
- Setting aside key representative portions of each vegetation type as conservation areas (as depicted in the proposed corridor map, included in the conclusion and recommendations in Chapter 11 of this report) within the project area.
- There must be a north-south corridor at least 300 m wide through the project area at all times. This corridor will be along the eastern side of Roode Heuwel during years 1-5 of mining and along the western edge of the project site once rehabilitation has been completed, for the remainder of the mine life.
- Best practise rehabilitation of mined areas as soon as feasible after cessation of mining of each block.
- Mining of only one block at a time (all blocks <300 ha in extent), with concurrent rehabilitation of any previously mined blocks, and no disturbance of blocks that will only be mined in the future.

Significance Statement

The mining activities will definitely result in habitat fragmentation and edge effects and this will have a severe permanent impact. The environmental significance of this unmitigated impact would be HIGH negative. This will be reduced to MODERATE negative with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Severe	Definite	**HIGH**
With Mitigation	Permanent	Study Area	Moderate	Definite	**MODERATE**

Impact 2.3: Increased dust levels on vegetation

Cause and Comment

Increased dust levels are common during construction and bush clearance and are also a major consequence of vehicular traffic, even on paved surfaces. Dust settling on adjacent vegetation can block plant photosynthesis, respiration and transpiration, in addition to causing physical injuries to plants (Farmer, 1993), but its most important impact probably relates to smothering of the anthers and stigmas of flowering plants and the consequent reduction in pollination success and seed set. Dust from road surfaces can also transport chemical pollutants to adjacent regions, thus affecting riparian ecosystems via impacts on water quality.

Mitigation and Management

The following mitigation actions are suggested:

- Haul roads and the heavy use areas around the main plant should be compacted and treated with dust inhibitors.
- Heavy vehicle speed limits on unpaved roads on site should be 40km/h.

- Wind fences should be erected at suitable intervals (probably every 5 m) on all recently mined and rehabilitated areas.
- Only single blocks should be mined at any one time, with no block being bigger than 300 ha.

Significance Statement

Dust levels will be raised during the operation of the mine and will definitely have a moderate, long term impact. The environmental significance of this unmitigated impact would be MODERATE negative. Mitigation measures will reduce the impact to a LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Short Term	Study Area	Slight	Probable	**LOW**

Impact 2.4: Invasion of alien species

Cause and Comment

The removal of existing vegetation creates 'open' habitats that will inevitably be colonised by pioneer plant species. While this is part of a natural process of regeneration, which would ultimately lead to the re-establishment of a secondary vegetation cover, it also favours the establishment of undesirable species in the area. These species are introduced along transport lines, and by human and animal movements in the area. Once established, these species are typically very difficult to eradicate and may then invade, posing a threat to neighbouring habitats. The primary invasive alien species are likely to be *Atriplex lindleyi* ssp *inflata* (blasiebrak) and *Salsola kali* (Russian tolbos), both already present in the area.

Mitigation and Management

The following mitigation actions are suggested:

- Prepare an Alien Management Plan, with ongoing, annual alien vegetation management throughout the project area, and in the mining area and along roads in particular.
- Eradicate alien invasive plants as they appear. Alien invasive plants should be stockpiled and burnt to destroy their seeds.
- Do not use any alien grasses (eg. *Lolium* - ryegrass) for rehabilitation purposes.
- Do not allow livestock on the mining site during the life of mine and for at least 10 years after mine closure, as livestock grazing will selectively remove the palatable species and leave the unpalatable species. The latter are typically the common, weedy species that dominate most disturbed areas, and once established are difficult to remove.
- Put in place environmentally acceptable procedures for waste management.
- Monitor the project area for any new invasive plant species, and remove them as they appear.

Significance Statement

The mining activities will very probably result in the proliferation of alien invasive plants in the mining and project area, which will have a moderate, permanent impact. The environmental significance of this unmitigated impact would be MODERATE negative. Mitigation measures could reduce the impact to a LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Very Probable	**MODERATE**
With Mitigation	Permanent	Study Area	Slight	Probable	**LOW**

vi. Impacts on fauna

Issue 1: Loss of Biodiversity

Impact 1.1: Loss of faunal biodiversity

Cause and Comment

Impacts of the proposed developments on the surviving fauna will vary for the different groups. Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics due to stormwater flow. However, most frogs in the region are widespread and have rapid colonizing abilities. The reptile fauna comprises some species relatively tolerant of agricultural development. Birds are by far the most speciose vertebrate component in the region, but many species are tolerant of low to medium disturbance. The remaining mammal diversity in the region consists of small mammals. With the exception of introduced rodents and bats, most mammals in the region are poor colonizers and require protected habitats to maintain viable population levels. Due to disturbance resulting from habitat loss there will also be an increase in animal mortality as animals move away from the region.

Mitigation and Management

- Mitigation of the impact entails protection and where necessary, rehabilitation of adjacent habitats as a possible environmental offset particularly temporary wetland and riparian habitats, and the rocky habitats in the east of Sabies.
- Avoid clearing or damaging temporary wetlands, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas.
- Maintenance of water quality and flow dynamics.
- Protect abiotic habitats, such as rock outcrops, which shelter many reptile and mammal species.
- Prohibit exploitation of SCC e.g. tortoises and chameleons, by mine employees.
- Educate mine staff about the necessity of faunal groups such as snakes.

Significance Statement

The duration of the operational phase impacts will be medium term. The extent is considered to be limited to the study area and the severity of the impact is expected to be moderate should mitigation measures not be employed, and will remain moderate if mitigation measures are adhered to. As a result the impact is considered to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Moderate	Probable	**LOW**

Impact 1.2: Loss of Species of Conservation Concern

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 1.5).

Significance Statement

The duration of the operational phase impacts will be long term. The extent is considered to be regional and the severity of the impact is expected to be severe should mitigation measures not be employed, and can be reduced to moderate if mitigation measures are adhered to. As a result the impact is considered to be HIGH without mitigation and MODERATE with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Regional	Severe	Definite	**HIGH**
With Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**

Impact 1.3: Introduction of alien fauna

Cause and Comment

The threat presented by alien invasive fauna is limited – the biggest threat is usually in the form of alien fish that affect the population of indigenous and endemic species, as has happened in the Oliphant's-Doring River System to the south of the project area.

Developments such as mines and their associated roads create suitable corridors for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as mining villages. These species generally tend to survive alongside human habitation, and don't spread in natural areas.

The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) which is now distributed almost worldwide. In addition, the European Starling (*Sturnus vulgaris*) is also an abundant introduced resident avian species. Both the House Sparrow and European Starling were recorded on site. The most recent and active bird invasive in the region is the House Crow (*Corvus splendens*), which are actively expanding their ranges.

Mitigation and Management

- The deliberate introduction of alien species should be prohibited, unless a full environmental assessment is undertaken and control methods for escapees detailed.
- Eradication programs of problem animals should be undertaken in consultation with conservation authorities.

Significance Statement

The duration of the operational phase impacts will be medium term. The extent is considered to be localised and the severity of the impact is expected to be moderate should mitigation measures not be employed, and can be reduced to slight if mitigation measures are adhered to. As a result the impact is considered to be LOW without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Localised	Moderate	Probable	**LOW**
With Mitigation	Medium term	Localised	Slight	Unlikely	**LOW**

Issue 2: Habitat impacts

Impact 2.1: Impacts on fauna due to habitat fragmentation and habitat loss

Cause and Comment

Habitat fragmentation can have diverse consequences for ecosystems and their fauna and flora (Saunders, et al., 1991). Habitat loss is rarely uniform and usually occurs piecemeal, leaving a mosaic of habitat fragments that may serve as refugia for the surviving fauna. Intervening unsuitable habitat, however, creates artificial barriers to normal migration and prevents or inhibits genetic interchange between the isolated populations. Tolerance of habitat fragmentation depends on numerous factors and will thus affect different faunal groups differently.

Mitigation and Management

- Where possible the planning of the roads and the location of buildings should ensure minimal fragmentation of sensitive habitats.
- Road designs should incorporate, where possible, underpasses and culverts that allow the movement of animals. This is of particular importance along drainage lines, which form natural corridors for faunal movements.
- Ecological corridors of sufficient width should be established to facilitate faunal (especially reptiles and small mammals) movement.

Significance Statement:

The duration of the operational phase impacts will be medium term. The extent is considered to be limited to the study area and the severity of the impact is expected to be moderate should mitigation measures not be employed, and will remain moderate if mitigation measures are adhered to. As a result the impact is considered to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Moderate	Probable	**LOW**

Issue 3: Additional operational impacts on fauna

A variety of impacts are likely to result from the operation of the various components of the mine, both during the construction and operational phases. Operation of the various facilities, including dry mining, transport of heavy mineral concentrates and general associated operations (e.g. transport, fuel dumps, administration facilities, etc.) may cause chemical pollution, raise dust levels, increase noise and light levels and lead to changes in water hydrodynamics.

A significant and extensive impact results from increased transport in the region. Roads are known to alter physical characteristics of the environment, namely: soil density, temperature, soil water content, light penetration, dust production, surface water flow, run-off pattern and sedimentation. As a result roads affect ecosystems, biological communities and species in numerous and different ways. The significance of these effects is determined largely by the location, density, and distribution of roads across the landscape (Hourdequin, 2000). Generally roads have negative effects on the biotic integrity in both terrestrial and aquatic ecosystems and these effects can be classified under various categories (Trombulak and Frissell, 2000): increased mortality from road construction and vehicle collisions; modification of animal behaviour, particularly movement patterns; alteration of the physical environment; and chemical environment; spread of exotic species; and increased alteration and use of habitats by humans.

Impact 3.1: Increased Dust Levels

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 3.1).

Significance Statement

The duration of the operational phase impacts will be medium term. The extent is considered to be limited to the study area and the severity of the impact is expected to be moderate should mitigation measures not be employed, and will remain moderate if mitigation measures are adhered to. As a result the impact is considered to be MODERATE without mitigation and LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Moderate	Probable	**LOW**

Impact 3.2: Noise Pollution

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 3.2).

Significance Statement

The duration of the operational phase impacts will be medium term. The extent is considered to be limited to the study area and the severity of the impact is expected to be severe should mitigation measures not be employed, and will be reduced to moderate if mitigation measures are adhered to. As a result the impact is considered to be LOW without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Severe	Definite	**LOW**
With Mitigation	Medium term	Study Area	Moderate	Definite	**LOW**

Impact 3.3: Pollution and Contamination

Cause and Comment

Many faunal groups are sensitive to pollutants. Lead concentrations are higher in small terrestrial mammals collected alongside roads than in bats caught in the same areas (Clark, 1979). Frog diversity in ponds affected by pollution from road run-off is depressed (Hecnar and Mcloskey, 1996) and the accumulation of herbicides and their residues in adjacent wetlands can lead to developmental abnormalities in tadpoles and metamorphosing froglets (Osano et al., 2002) and also masculinization of female frogs (Dalton, 2002).

Pollution may result from periodic accidents, or from a slow, ongoing contamination. Operation of the mine particularly in relation to the use of inflammable liquids such as diesel will probably result in periodic accidents. Heavy vehicle traffic is also associated with increased local pollution resulting from exhaust fumes, oil spillage and accumulation of rubber compounds from tyre wear. These pollutants can cause localised impacts. Sensitive wetlands or patches of threatened vegetation may need protection from road surface water run-off containing such pollutants and the application of herbicides to control plant growth alongside roads and around buildings should be monitored.

Mitigation and Management

- Storage facilities for chemicals, particularly diesel, should not be situated in regions subject to flooding.
- They should be bunded so that in the event of spillage their contents run immediately into large catchments for decontamination.
- The use of insecticides and herbicides should be closely monitored and dosages and application detailed in the EMP.
- A waste management plan must be developed and all recommendations contained in the plan must be adhered to.

Significance Statement

The duration of the operational phase impacts will be medium term. The extent is considered to be limited to the study area and the severity of the impact is expected to be moderate should mitigation measures not be employed, and will remain moderate if mitigation measures are adhered to. As a result the impact is considered to be MODERATE without mitigation and will remain LOW with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Localised	Moderate	Probable	**LOW**

Issue 4: Impacts from product transport and increased vehicle movements in the area

Impact 4.1: Threats to Animal Movements

Cause and Comment

Linear developments, such as access roads and above-surface pipelines, disrupt the movement of species within their normal home ranges or the seasonal movements of migratory species. Habitat fragmentation may require species to make long movements between patches of suitable habitat in search of mates, breeding sites or food. At such times they may suffer increased mortality, either directly by road vehicles, or from their natural predators due to increased exposure.

Reptiles and amphibians do not undertake long distance migrations, but both groups may undertake short seasonal movements. Many snakes undertake movements between winter hibernation sites and their summer foraging areas. Amphibians are known to experience the highest levels of mortalities associated with the presence of roads among vertebrates (Glinta *et al.* 2007). This is mainly attributed to *en masse* seasonal migrations to and from their breeding sites. Some amphibians, particularly toads, are explosive breeders, and move *en masse* to the breeding ponds. At such times they may suffer heavy casualties whilst crossing roads.

Impacts on animal movements will be significant for all faunal groups. For amphibians this impact will be greatest where the road runs adjacent to wetlands suitable for breeding. It is an impact of high probability that will be negative due to increased mortality. It will be localised and occur over the long-term.

Mitigation and Management

- Mitigation depends firstly on ongoing assessment of the significance of animal road mortalities, levels of which should be monitored during the construction and operational phases.
- The design of project infrastructure and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines and temporary wetlands.
- Road designs should incorporate, where possible, underpasses and culverts that allow the movement of animals. This is of particular importance along drainage lines, which form natural corridors for faunal movements.
- Where possible the road traffic on site should be limited after dark, as much of the terrestrial fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc. Or lower speeds limits must be enforced at night-time on site. These recommendations will help reduce night driving impacts. Limit the transport of product from and to site at night-time as far as possible on the main provincial road, as this will dramatically reduce the impact on all faunal groups.
- Vehicle speed on site should be limited to the lowest possible, and should not exceed 40km/h.

- Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.

Significance Statement

The duration of the operational phase impacts will be long term. The extent is considered to be limited to be regional and the severity of the impact is expected to be severe should mitigation measures not be employed, and will be reduced to moderate if mitigation measures are adhered to. As a result the impact is considered to be HIGH without mitigation and will remain MODERATE with mitigation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Regional	Severe	Definite	**HIGH**
With Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**

vii. Visual impacts

Impact 1: Impact of introducing highly visible mine infrastructure into a rural, undeveloped landscape.

Cause and Comment

The relatively large buildings with straight edges and smooth surfaces are likely to stand out in contrast to the surrounding, undeveloped nature of the area. The passage of large vehicles and the influx of people associated with the mine will have an impact on the sense of remoteness of the region. Dust from mining activity is likely to increase the severity of the visual impact.

The landscape is mildly transformed by agricultural activities, but by South African standards, is very remote and rural, with limited infrastructure development. Telephone lines run to most farms, but none are connected to the Eskom grid. The nearby Namaqua Park is valued by tourists as a remote and calm getaway destination, with campsites available along the coast, and as a destination during the flower season. As such, this area can be considered rather sensitive to the development of such a mine.

Mitigation and Management

The following mitigation measures are proposed:

- Maintain as much natural vegetation as possible between the mine buildings and the edge of the mine area.
- Non-reflective paint should be used on all buildings and roofs of buildings. Galvanised steel structures should be darkened to prevent glare.
- Rehabilitate areas that have been cleared of vegetation during the construction phase.
- Treat roads to reduce dust emissions.
- Light fixtures installed should not spill light beyond the mine area, where they are needed for 24 hour mine operation. Direct the light beams downwards, and use blinds as necessary.

- Use timer switches or motion detectors to provide light in areas where light is not needed continuously.

Significance Statement

The duration of the impact will be Permanent. The extent is Study Area due to the visibility and size of the project. The severity of the impact is expected to be MODERATE since the landscape has a moderate sensitivity to the development type. The likelihood of surrounding farmers and the National Park being negatively impacted by dust generation and bright lighting is May occur if mitigation measures are not employed. If mitigation measures are employed, the effect of these impacts will be reduced to Unlikely.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	May occur	**MODERATE**
With Mitigation	Permanent	Study Area	Moderate	Unlikely	**LOW**

Impact 2: Impact of mine operation in light of the Department of Environmental Affairs' Strategy on Buffer Zones for National Parks

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vii, impact 2).

9.1.5 Impacts that may result from the decommissioning phase

i. Impacts on topography and geology

Rehabilitation and therefore backfilling and sloping will be undertaken progressively and therefore minimal disturbance will occur during the decommissioning of the mine. The impact on topography and geology is therefore negligible.

ii. Impacts on soils and agriculture

Issue 1: Rehabilitation of soil

Impact 1.1: Incorrect or insufficient rehabilitation of soil will result in a decrease of agricultural ability

Cause and Comment

If topsoil becomes buried, or subsoil material that is less suitable for root growth remains at the surface, the agricultural suitability of the soil, that will become available for agriculture again after rehabilitation of mined and developed areas after decommissioning of the mine, will be reduced.

Mitigation and Management

- Develop and implement a Rehabilitation and Monitoring Plan to monitor rehabilitated areas.
- Implement measures such as wind-breaks, swales and watering to aid the initial growth of primary vegetation.

Significance Statement

The duration of the impact will be short term. The extent is the study area. The severity of the impact is expected to be moderate and the overall significance LOW. With the implementation of mitigation measures the impact will remain of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Moderate	Definite	**LOW**
With Mitigation	Short term	Study Area	Slight	Unlikely	**LOW**

iii. Impacts on surface and groundwater resources

Impact 1: Impacts on groundwater of the tailings storage facility and backfill

Cause and Comment

Seawater will be used for mineral processing, and as a result tailings used to backfill mining voids will contain a significant volume of saline seawater. Seepage of seawater from backfill and from the tailings storage facility down to the groundwater table will cause elevated TDS levels in the already brackish groundwater, which may render it unfit for stockwatering, which is currently the predominant use for groundwater in the area. The results of groundwater modelling indicate that the potential plume of saline seepage from backfill and the TSF will continue to be mobile for many years after the cessation of mining, and that the TDS levels in some locations in the southern half of the Roode Heuvel block (an area of about 30km^2) and for about 750m westward of its boundary, will rise to levels well above 13 000mg/l, which is considered unsuitable for animal consumption.

The severity of the impacts is assessed on the assumption that, after completion of mining, the land will be returned to agriculture, meaning that groundwater will be required for stockwatering as soon as the mined areas have been rehabilitated and revegetated. However, in this context it must be borne in mind that the vegetation specialist assessment recommends that, in order to address the prevailing effects of overgrazing, stock should not be reintroduced until the vegetation is properly established, and then re-introduced at reduced, more sustainable levels.

Given that the groundwater model predicts that salinities in much of the mining area will show increased levels, sufficient to preclude safe stockwatering, only between about 5 and 40 years after the end of mining, the necessity for and nature of mitigation measures will need to be reviewed as mining proceeds, and as mine closure approaches and negotiations begin for the return of the land to some form of post-mining activity.

Mitigation and Management

- Recover seawater from tailings via sumps in paddocks and recycle as process water.
- Optimise the use of slimes mixed with coarser material (co-disposal) to reduce the rate of infiltration and seepage.
- Continuously monitor the salinity of the groundwater in and around the mining area to confirm or otherwise the results of modelling, and continuously update the model to take account of the monitoring results and data from the weather station.

- If necessary, concomitant with the chosen form of post-mining land use, provide alternative sources of water for stockwatering if salinity levels exceed levels appropriate for animal consumption. New boreholes may need to be established outside the mining area to the east and west, and also on the south side of the Groenrivier.

Significance Statement

If the land is to be returned to stock grazing after mining the impact will be permanent, confined to the study area, very severe, and will probably occur: the overall significance will be HIGH negative.

Successful mitigation will reduce the severity to moderate and the likelihood of occurrence to possible: the overall significance will be reduced to MODERATE negative.

If the land is not to be used for stock grazing the impacts will be negligible.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Very Severe	Probable	HIGH
With Mitigation	Permanent	Study Area	Moderate	Possible	LOW

Impact 2: Impacts on surface water of the tailings storage facility and backfill

Cause and Comment

Groundwater modelling indicates that the saline plume from the TSF and backfilling will reach the northern side of the Groenrivier valley where it borders the southern extent of Roode Heuvel about 10 to 20 years after mine closure, and that TDS levels in groundwater in the immediate vicinity of the river may increase to 15 000 - 20 000 mg/l. The saline plume is expected to pass beneath the bed of the river channel at around Year 80 (that is, about 60 years after mine closure). The model indicates that the plume will pass beneath the channel, and there will be no net change in groundwater level. The plume will not contribute to flow in the river channel and thence seawards to the estuary. The possibility of ground water levels rising sufficient for the saline plume to contribute to river flow, either as a result of mining or as a result of external influences such as climate change is considered to be extremely unlikely. Even if hydrological connectivity between the seepage plume and the river channel did occur the lower estuarine lagoon is characteristically hypersaline, with a TDS of around 200 000 mg/l, an order of magnitude higher than the plume. This, together with indications of active sulphate reduction, anoxia and methanogenesis suggest that there will be no significant effect on ecological functioning. Post-mining groundwater TDS levels to the south of the mining area, on the other hand, will peak at approximately 24 000 mg/l. and minor flux of such water to the estuarine system, either via river conveyance or groundwater discharge, both of which are confirmed to be improbable, would therefore be unlikely to significantly influence the baseline conditions of the estuarine system. In addition the spring at the head of the estuary lies some 8km downstream at the closest approach of the plume, and extensive mixing and dilution will occur. No water quality impacts on the Groenrivier related to backfilling or the TSF are anticipated.

Mitigation and Management

- Mitigation measures proposed for Impact 1 may result in a reduction of salinity levels of around 5 000 mg/l.
- Having established a pre-mining baseline of the salinity levels in the estuary (SWS 2015), the general biological state of the estuary should be established and monitored at regular intervals thereafter.

Significance Statement

The low probability of the saline seepage from the TSF and backfill contributing to the flow regime of the river and entering the estuary, and the comparative salinities of the seepage (relatively lower) and the water of the lagoon (relatively higher) indicates that, even if the impact did occur, and although it would to all intents and purposes be permanent, it would be localised, with slight severity, and with an overall significance of LOW negative. No mitigation measures are required, but measures recommended (Impact 1) to reduce the salinity of the seepage would also serve to further mitigate this already low impact.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Local	Slight	Unlikely	**LOW**
With Mitigation	Permanent	Local	Slight	Unlikely	**LOW**

iv. Impacts on the marine environment

It is anticipated that impacts 2, 3 and 4 outlined in the construction phase (Section 9.1.3 no. iv) are likely to be repeated during the decommissioning phase. The same mitigation procedures should be adhered to in order to mitigate as far as possible for any of the impacts discussed previously.

v. Impacts on flora

The decommissioning of the project could have a positive impact on the natural vegetation in the mining area, if the areas are restored to a near-natural state.

However, rehabilitating disturbed areas to a natural or near-natural condition may not meet the livelihood requirements of the project-affected communities, whose needs may be better served by allowing the area to be used for small stock grazing. In this case the decommissioning phase will probably result in a net loss of plant diversity, as natural vegetation will be altered by mining, followed by rehabilitation and grazing (further altering the natural species composition in favour of less palatable species), and thus this would be considered to be a negative ecological impact.

It is strongly recommended that livestock not be introduced into the mined and rehabilitated areas for at least ten years after initial rehabilitation has been completed on the last block to be mined. Removal of livestock will dramatically improve rehabilitation by allowing flowering and seed set for the more palatable species. It is recommended that the area be stocked with limited numbers of range appropriate game, and the possibility of tourist accommodation could be explored.

vi. Impacts on fauna

Issue 1: General Decommissioning Impacts on Fauna

A variety of impacts are likely to result from the decommissioning of the various components of the mine. General decommissioning operations (e.g. transport, fuel dumps, administration facilities, etc.) may cause chemical pollution, raise dust levels, increase noise and light levels and lead to changes in water hydrodynamics and fire regimes.

Impact 1.1: Increased Dust Levels

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 3.1).

Significance Statement

The duration of the impact will be short term. The extent is the study area. The severity of the impact is expected to be slight and the overall significance LOW. With the implementation of mitigation measures the impact will remain of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Slight	Definite	**LOW**
With Mitigation	Short term	Localised	Slight	Probable	**LOW**

Impact 1.2: Pollution and Contamination

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 3.3).

Impact 1.3: Noise Pollution

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.1.3, no. vi, impact 3.2).

Significance Statement

The duration of the impact will be medium term. The extent is the study area. The severity of the impact is expected to be severe and the overall significance MODERATE. With the implementation of mitigation measures the impact will remain of MODERATE significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Severe	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**

vii. Visual impacts

This impact is considered to be the same for the construction phase as listed above for the construction phase (Section 9.1.3, no. vii, impact 1 and 2).

9.2 SOCIAL-ECONOMIC IMPACTS

9.2.1 Planning and Design Phase Impacts

Activities associated with the design and pre construction phase pertains mostly to exploration. As the project has an exploration license impacts associated with exploration and the mitigation of these impacts were included in the Exploration EMP compiled to obtain this license and will therefore not be repeated in this section. Other activities associated with the design and pre construction phase will not have impacts on the socio-economic environment as this phase consists of planning and design of the proposed development, and is done at a desktop level. In some cases site visits need to take place but the impact of these visits is negligible, if any, e.g. photographs, botanical and other field surveys, etc.

9.2.2 Impacts resulting from the existing land use / no-go options

The proposed mining area and pipeline servitude are comprised of seven farms subdivided into 15 separate farm portions. The majority of the farms are run by the owners, and a few by the lessees of the land. Most of the farms affected by the project range from 4.5ha to 6420ha in size, with a mean of 1,196ha. Many of these farms have been in the same family since the early or middle 1900s, and many of the farmers therefore feel a strong social connection to the land from a heritage perspective. The farms are sparsely populated with generally only one or two residential buildings. Many farmers do not live on these farms and few farm labourers are employed (some on a casual basis). Most workers are sourced from Stofkraal and Molsvlei to the south of the project area and have dormitory accommodation on the farms (normally between one and five workers), whereas some return to their homes on a daily basis.

The impacts on existing land-use include affecting farmers' place attachment, as well as the economic viability of the remaining unaffected land portions after land acquisition for the mine. Firstly, as most farms are held in families, farm-owners' place attachment is significant and farm-owners might become sentimental over their land once the mine is being established, as this will result in them visualising the mine's impact. Moreover, several farm-owners were dismayed about the prospects of land acquisition, maintaining that it would alter the landscape. A possible scenario is that some farmers who permanently live on an adjacent farm remain on this land, but have to sell a farm portion to Zirco. In this scenario, one issue is a fear that their remaining portions would not be economically viable. This issue appears to be especially applicable to smaller farms that have been subdivided in the past. However, from an economic viability perspective, affected owners will be compensated for the land above the average market value. Therefore, owners could affectively invest financially in their remaining farms, or acquire new ones. This reduces the severity of this impact from an economic perspective, as farm owners would be able to invest more capital in their farms, or invest this elsewhere.

9.2.3 Impacts that may result from the construction phase

<u>Issue 1: Influx of Job Seekers and Outside Workers</u>

The Zandkopsdrift Mine is being planned near the Kamiesberg Project. As the study area's residents are poorly educated, more educated and skilled labour will certainly be needed from other areas. The mining developments in the area will therefore cause an influx (in-migration, i.e. people coming into the area) of job-seekers and contractual workers into the area.

The impacts of this issue can be significant, especially since it might increase the burden on the municipality to delivery basic services (such as housing delivery and service delivery). Moreover, many key informants also voiced concern that such an influx might cause local conflict between outsiders and locals, whilst increasing and worsening already existing social pathologies. The latter predominantly relate to substance-abuse, sex work, risky sexual behaviours and teenage pregnancies. Although an influx is considered outside the control of project developers, the IFC guidelines on project-induced in-migration (i.e. people flocking into communities) suggest that an influx can threaten 'project security' and that it should be managed as a project threat (cf. IFC, 2009).

It should be noted that, as with most social impacts, in-migration may also have a positive impact in terms of providing locals with small business opportunities due to an increased demand for local produce and other goods, as well as opportunities for cultural exchange.

The following issues are discussed under this section:

- Community expansions and increased burdens on service delivery and cost of living;
- Increased community conflicts due to differential benefits or between local labour and outside workers; and
- Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)

Impact 1.1: Community expansions and increased burdens on service delivery and cost of living:

Cause and Comment

The consultant is confident that the cumulative developments in the area will expand some of the communities studied. Although the KLM has assigned a piece of land in Garies for labour-related housing developments, there is a strong possibility that other smaller communities might also experience expansion as optimistic job-seekers move to Garies in the hope of obtaining work.

The KLM is a small municipality and funds are limited to cater for rapid community expansions. As the KLM already expressed concern over a service delivery backlog in the area, such expansions might increase the burdens on service delivery. Some of the following service delivery challenges could be experienced with rapid community expansions:

- Providing more healthcare facilities (clinics, for example);
- Water shortages and the need for more boreholes and possibly a desalination plant;
- Connection to the electricity grid, especially since the KLM is currently exceeding its electricity allowance from Eskom and would need to apply for a larger off take;
- Increased burdens on the communities' sewage and refuse systems; and
- An increased demand for houses.

Lastly, in CES' experience, as development projects often attract more incomers, it is not uncommon for local food prices to inflate. The degree to which this might be felt is difficult to ascertain, although it is an important aspect to consider with an influx of people.

Mitigation and Management

The following mitigation and/or enhancement measures should be adopted:

- The mine's SLP should be implemented and annually updated. Sections of relevance in the SLP are the HRDP (and labour compliance targets), as well as its Preferential Procurement Policy.
- The proponent should develop a Recruitment and Influx Management Plan. The following guidelines can be used in developing such a plan:
    - *Information dissemination*: Employment opportunities need to be advertised, however the procurement procedures for employment need to be made available to the public. Regular briefings with regard to recruitment and procurement to the wider public are necessary;
    - *Recruitment and supply chain transparency*: Recruitment and procurement rules and opportunities have to be transparent and, most importantly, accessible to the public. This will be the responsibility of the Community Liaison Officer (CLO), as well as the Human Resource Manager (HRM); and
    - *Influx management and security arrangements must be underpinned by a code of conduct signed with a private security company (explained shortly).*

Although the mine is not in close proximity to surrounding communities, the project will still create an influx of job-seekers into the surrounding communities, especially the town of Garies. Therefore, the proponent should develop a Recruitment and Influx Management Plan and a Stakeholder Engagement Plan (SEP).

Significance Statement

Should no mitigation measures be implemented by the proponent to safeguard communities from rapid expansion and assist the municipality with new incomers, the overall significance of this impact during the construction phase should be MODERATE negative.

With proper mitigation measures, during the mine's construction phase, the project should have a positive impact on the surrounding communities. The reason for this is that the mine could stimulate the local skills base, and limit (as far as possible) the number of outside workers that will be required.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Short Term	Study Area	Slightly Beneficial	Probable	**MODERATE**

Impact 1.2: Increased community conflicts due to differential benefits between local labour and outside workers

Cause and Comment

Community member and key informant interviewees revealed a general concern that conflict might be stirred between the local residents and potential new incomers. Such conflicts could result from tension over the use of existing social services, housing demands or even perceived preferential treatment (for example, where local residents feel that outside workers who now live in their community receive unfair benefits from the mine).

Another reason for possible conflict could be the creation of 'poverty gaps', such as inequalities in terms of income and wealth accumulation between locals and outside workers.

This situation might be worsened by the fact that many residents complained about the local police station's limited capacity to deal with such issues, as most stations are far from the rural towns. Lastly (but not least), other reasons for increased conflict might be related to the disruption of the host communities' social dynamics. For example, conflicts could increase amongst men and women over expenditure of household incomes.

Conflicts can be stirred as a result of many other factors. Some of these include (but are not limited to):

- An increase in economic disparities between those with jobs and those without;
- Changes in values and changes in 'way of life' of those with jobs;
- Changes in power relations between employed youth and elders;
- Perceived unfair recruitment strategies; and/or
- Perceived preferential procurement strategies;

Mitigation and Management

The following mitigation and/or enhancement measures should be adopted:

- The proponent should develop a Corporate Social Responsibility (CSR) Programme aimed at identifying and developing particular projects that could alleviate possible future conflicts and strengthen community values. It is suggested that a needs analysis be conducted amongst the PACs, which should aid in the development of such a programme. The following CSR projects could possibly be considered in the programme:
    - Assisting particular schools with education programmes aimed at teaching children the affects and consequences of crime and drug/alcohol abuse;
    - Sport programmes or the upgrading of particular sport fields;
    - The upgrading of sport facilities or safe playgrounds;
    - Supporting schools or the KML with youth empowerment programmes; or
    - Support the KLM with community out-reach programmes to deal with issues related to unsafe sexual practices, sex work, teenage pregnancies and sexual (gender) violence.

Significance Statement

Without any mitigation measures, the consultant believes that the overall significance of this impact would be HIGH negative during the construction phase. Should appropriate mitigation measures be adopted, the overall significance of this impact should be LOW negative during the construction phase. With any development, a degree of community tension would be expected. This cannot change into a positive impact, which is why it remains LOW negative, even when mitigation measures are adopted.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	Probable	**HIGH**
With Mitigation	Short Term	Study Area	Slight	May Occur	**LOW**

Impact 1.3: Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)

Cause and Comment

Throughout the report, issues of substance-abuse have been raised. Substance abuse (alcohol- and drug-use) reinforces and accounts for a range of social pathologies, such as intra-household violence, women abuse, rape, teenage pregnancies and crime. Several South Africa studies have confirmed such direct linkages with substance-abuse (cf. Meade et al., 2012; King et al., 2004 and Bhatt, 1998).

Many residents feared that new comers could potentially worsen substance-abuse, especially if they introduce new drug trades. Apart from substance-abuse, many also fear that an influx could elevate levels of crime. At present, few residents complained about high crime rates. However, many believe that the youth might learn such behaviour from outsiders. It should also be noted that some farmers have been cautiously raising concern that an increase in labour in the area might exacerbate farm-related crime. The latter includes general theft, as well as stock theft.

A concern regarding a possible increase in crime has mostly been expressed by community members and the Garies Police Station. For example, Warrant Officer Mr Spogter, of the Garies Police Service confirmed, from his experience in the area, that some outside workers do cause a rise in crime levels as local residents are taught how to steel. Moreover, it is expected that there might be an increase in risky sexual behaviours.

The latter typically refers to unsafe sex especially between incomers and existing residents. This may not necessarily be related to sex work or prostitution. Although many community members did confirm that prostitution is already a problem in the area, what is typically more common in these rural communities is unsafe sexual practices.

A concern has also been expressed by Ms Vottering, Principal of the Garies High School, regarding an increase in teenage pregnancies. There is reason to believe that this might worsen with an influx of job-seekers if no mitigation measure is implemented.

Many of the above-mentioned concerns have been noted in previous post mining project evaluation studies conducted by CES (cf. CES, 2011)11. Such concerns are thus well-grounded in reality, especially since youth members are often attracted to outside workers who come with employment and hence money.

Mitigation and Management

Mitigation measures are the same as listed for Impacts 1.1 and 1.2 above.

Significance Statement

Without any mitigation measures, the consultant believes that the overall significance of this impact would be HIGH negative during the construction phase. The reason for this high rating is that the severity of this impact is very severe and the likelihood definite.

Should appropriate mitigation measures be adopted, the overall significance of this impact should be low negative during the construction phase. Changing social pathological behaviours is extremely difficult, as it involves changing attitudes and community values. At

[11] CES conducted a social monitoring study of Kenmare Moma Mining Ltd. in Mozambique. The findings indicated a spike in sex work and risky sexual behaviours subsequent to the development of the mine.

most, such impacts can be controlled, but never eliminated.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Very Severe	May Occur	**HIGH**
With Mitigation	Short Term	Study Area	Severe	Probable	**LOW**

Issue 2: The use of security personnel

Impact 2.1: The use of security personnel for mine access control

Cause and Comment

Security personnel will be used for monitoring access to the mine. The recruitment of a security company could have an effect on the adjacent farm-owners. Should particular farm-owners enter into an agreement with the proponent to have their title deeds amended to allow them to remain living in their house on their farms (as one possible scenario), the following impacts could be experienced:

- Feeling threatened by security personnel;
- Feeling that access is being denied to areas which farm-owners normally had access to before the mine's construction started; and
- Experiencing tension or conflict that could be stirred as a result of any of the above-mentioned impacts.

However, it should be noted that the entire mining area would be fenced-off. No farm-owners would have access to the mining area, which means that this impact should not have a significant direct effect on those residents living in the area.

Mitigation and Management

The following mitigation and/or enhancement measures should be adopted:

- The proponent should establish a Grievance Mechanism to allow the PAF-owners and PAC members to lodge any complaints. Management feedback should be provided to claimants within two weeks of claimants submitting formal complaints. The socio-economic assessment provides a general procedural outline for establishing such a mechanism;
- As far as possible, the proponent should comply with IFC PS 4 on the use of security personnel. Such compliance could be ensured by signing an agreement with the private security company. Such an agreement should include the following:
    - Security personnel need to be properly trained in the use of force and, most importantly, appropriate conduct towards farm-owners and farm labour;
    - Security personnel should not have been part of any past abuses or theft;
    - The above-mentioned code of conduct must be consistent with the United Nation's (UN) Code of Conduct for Law Enforcement Officials, and the UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials; and
    - All the PAF-owners need to be informed about the roles and responsibilities of the security personnel.

- As part of the CLO's duties, a separate security liaison sub-committee should be established. Through this committee, the CLO could allow PAF-owners and PAC members to voice any issues and/or concerns to the proponent in relation to security issues and/or concerns. Affected farmers should volunteer and nominate farmers to act on this committee. This forum could also be used as a liaison body between the affected farmers and security personnel, through which security arrangements are discussed with affected farmers.

Significance Statement

This could potentially be a LOW negative impact of the usage of security personnel. The reason for this is that it could result in fractious relationships between the proponent and the affected farm-owners. This could especially be the case if adjacent farm-owners start to feel a sense of threat from the security personnel. In the most serious case, farm-owners might even be subject to violent attacks from security guards, although there is no reason to suspect this at such an early stage.

With an appropriate code of conduct for the usage of a security company, the impact of security personnel should not have any effect on the surrounding residents.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	May Occur	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Issue 3: Provision of basic social services

Many aspects of the proposed project should be viewed in a positive light as the proponent would be able to assist the KLM with basic social services. As explained throughout the SIA, it is envisaged that some communities might experience impacts related to in-migration. Concerns that this might compound the existing backlog in basic social services, such as water provision, sewage and refuse and above all, housing were expressed. Through the mine's SLP, the KLM will be supported through various programmes, including the mine's measures to address housing and living conditions of its own employees.

Impact 3.1: Assisting with housing requirements in Garies

Cause and Comment

At present, the KLM does not have a Housing Plan. Discussions with the municipality also alluded to the fact that the municipality has a backlog in housing delivery. For example, in the KLM's IDP (2013), the number of families on the municipality's housing waiting list is 337.

The municipality also confirmed that their capacity to provide housing is limited, and that support would be welcomed from the private sector. In the SLP, measures will be implemented to assist the municipality with mine labour housing in the town of Garies. For example, the SLP refers to using the services of external companies that specialise in developing and managing staff housing schemes. In summary, it is envisaged that the mine will assist its labour force with their housing requirements. Proper measures and systems should be in place, however, to ensure that housing development is fair to all employees, and that no form of discrimination is introduced.

Mitigation and Management

The following mitigation and/or enhancement measures should be adopted:

- As per Section 4.7 in the mine's SLP (Measures to address housing and living conditions), a Housing and Living Conditions Plan (for staff only) should be drafted by the proponent, which should be aligned with the KLM's IDP and their own housing plan;
- The proponent should implement its housing and living condition measures as per its SLP; and
- Fair and transparent measures should be adopted with assistance with housing development and related services, in accordance with Section 4.9 of the mine's SLP (Procurement Progression Plan).

Significance Statement:

If no assistance is provided for staff housing, informal settlements might become established. However, this is unlikely as the conditions of mining will dictate that suitable staff accommodation is provided. Should no measures or procedures be in place to ensure a fair and transparent process, conflict might be stirred in the communities regarding perceived unfair housing provision. The overall significance for household development would therefore only be MODERATE positive.

Should procedures and measures be put in place to ensure that assistance with housing is done in a fair and transparent manner, the overall significance should be HIGH positive during the construction phase.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Slightly Beneficial	Probable	MODERATE +ve
With Mitigation	Long Term	Localised	Very Beneficial	Probable	HIGH +ve

Impact 3.2: Assisting with local economic development

Cause and Comment

In South Africa, the MPRDA (2002) and the Broad-Based Socio-Economic Empowerment Charter for the South African Mining and Minerals Industry (or the Mining Charter) of 2010 require mining developments to invest in LED projects within the local municipality.

Several projects have been proposed in the client's SLP aimed at supporting the municipality with projects which could assist the town of Garies to strengthen its infrastructure and provide services to its residents. These project proposals have been based on several engagements with the municipality in 2013 and 2014, undertaken during the development of the SLP (CES, 2014).

Local economic development, through the SLP, would be a significant boost for communities and municipalities. However concerns are often raised regarding the sustainability of community projects. Many community members did express concern over the long-term sustainability of the client's community investment. Therefore, a strong emphasis of such programmes should be to develop skills and establish SMMEs that can be sustainably operated in the future without mining support. Proper and continuous community and stakeholder engagement is also a vital ingredient in this process.

Mitigation and Management

The following mitigation and/or enhancement measures should be adopted:

- The proponent should draft and implement an SEP;
- Community members should be regularly informed about any proposed LED plans and should be able to provide input in the development of such projects;
- Monitoring and evaluation would be required for LED projects that could have a significant impact on employment provision or service delivery. Monitoring and evaluation could be used to identify shortfalls in programmes, using such data to adjust programmes as needed and in accordance with the needs of the communities; and
- As per legislation, the client's SLP (and hence LED programmes) should be reviewed annually and adapted or revised as necessary.

Significance Statement

Should the proponent invest in LED without ensuring that sufficient project enhancement measures and appropriate community and stakeholder engagements have been undertaken, any investment would probably only have a MODERATE positive impact.

Should mitigation (or rather enhancement) measures be implement, the mine's LED investment in the KLM could have an overall HIGH positive significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Study Area	Moderately Beneficial	Probable	MODERATE +ve
With Mitigation	Medium Term	Study Area	Very Beneficial	Probable	HIGH +ve

Impact 3.3: Upgrading of roads

Cause and Comment

Generally, the conditions of the existing road is construed as inadequate by many, who feel comforted by knowing that the mine will upgrade the existing gravel road from Garies to the mine site. According to the proponent, any new road will be constructed either on land held by the company or in a registered servitude along the proposed pipeline. Upgrading of the road from Garies to the mine would have a positive impact on the remaining farm-owners and their farms' operations. However, some farmers expressed concern over the possibility that road upgrades could increase theft in the area, in particular stock theft. However, such an impact cannot really be substantiated with any evidence, as it might simply be some farm-owners' own fear of how the mine might change the area.

The road between Garies and the mine site is a public road, and hence access cannot be restricted. Therefore, there is no mitigation against a possible concern that such an upgrade could increase theft in the area. Overall this should be considered as a positive impact, as it might improve existing farm operations.

Mitigation and Management

No suggested enhancement measures

Significance Statement

It is believed that upgrading some road networks will have a general positive impact on the area's population. Therefore, this impact (as a project enhancement measure) has been rated as a 'low positive'.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Slight Beneficial	Definite	LOW +ve
With Mitigation	Long Term	Study Area	Slightly Beneficial	Unlikely	LOW +ve

Issue 4: Land acquisition for mining

Many farmers are still uncertain as to how their farms will be affected. In consequence, several issues still need to be clarified with regard to land acquisition. This includes the status of farmer land ownership, continued farm use and remaining farm portion economic viabilities, as well as the need for household resettlement. Depending on these clarifications, some farm owners raised concerns over the economic viability of farm portions, should particular portions be excluded from land acquisition at the request of farmers not wanting to relocate. Moreover, another concern which is discussed under this issue relates to the possibility that existing farm labour will be reduced. This impact was raised by community members.

The process for land acquisition by Zirco will be as follows: Offers will be made to purchase the surface rights affected by the planned initial 20 year life of mine, encompassing all of Roode Heuvel. All properties will be professionally assessed and valued by independent valuers registered as professional valuers with the South African Institute of Valuers and the South African Council for Property Valuers and professionals working for Agri Land Projects (Pty) Ltd. Agricultural valuations encompass area, agricultural potential and capital improvements. This is the estimated value if the land were to change hands on the open market as agricultural land. Each property is then given a mining value encompassing the market value, valuation based on recent sale of farms to mining right holders, and inconvenience and relocation. Total valuations are significantly higher than the market value. Valuations, and the process to achieve them, will be shared with the landowners and will form the basis for on-going negotiations with them.

Thus, within the 20 year mining area encompassing all of Roode Heuvel, no farmers will be able to remain resident.

Impact 4.1: Economic viability of remaining unaffected land

Cause and Comment

A possible scenario is that some farmers who permanently live on an adjacent farm remain on this land, but have to sell a farm portion to Zirco. In this scenario, one issue is a fear their remaining portions would not be economically viable. This issue appears to be especially applicable to smaller farms that have been subdivided in the past. However, from an economic viability perspective, affected owners will be compensated for the land above the average market value. Therefore, such owners could affectively invest financially in their remaining farms, or acquire new ones. This reduces the severity of this impact from an economic perspective, as farm owners would be able to invest more capital in their farms, or invest this elsewhere.

Mitigation and Management

Mitigation and/or enhancement measures would not be applicable for this impact, as the proponent will compensate for land acquisition.

Significance Statement

It is believed that compensation for land will have a moderate positive impact on the affected farmers and their households.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	N/A	N/A	N/A	N/A	**N/A**
With Mitigation	Long Term	Study Area	Slight	May Occur	**MODERATE +ve**

Issue 5: Stimulation of Economic Growth

One of the major positive impacts of the project is the fact that a significant number of employment opportunities will be generated, together with skills development and bursary opportunities for the youth. The cumulative development of mines in the area would afford even more opportunities.

However, appropriate mitigation and project enhancement measures are needed to ensure that employment remains a positive impact and that all the benefits can be maintained or enhanced. The following impacts are discussed below:

- Employment of local labour;
- Developing and supporting local businesses; and
- Skills training and further training opportunities.

Impact 5.1: Employing local labour

Cause and Comment

Many residents of this area used to work on mines which have closed in recent years. In view of this, many seem excited about the prospect of having more mines opening in the area. One issue raised by some members is that mining skills are being lost to the older generation, as the youth are not familiar with this industry and have never had the opportunity to receive mining-related skills. It is believed that local employment provision and adequate skills transfer programmes could allow the youth to regain such skills.

The importance of employing local residents cannot be overstated. Employment provides an income to households that have none, in addition to other benefits that could include:

- Reducing rates of crime;
- Reducing rates of alcohol and drug-abuse; and
- Reducing intra-household violence.

The reason behind these benefits, is that employment stimulates residents and preoccupies the youth. As some plainly stated, at the end of a work day, a tired employee does not engage in alternative, illegal ways to obtain an income.

Similarly, intra-household violence and especially women abuse are believed to be coupled with income-related arguments and worsened by substance-abuse. With a more steady income flowing into households, many believe that such violence could be controlled.

The mine will need highly skilled workers and graduates, and staff with experience in mining. However, a large number of the tasks can be performed by local labour, and the proponent is encouraged to increase such opportunities as far as reasonably possible, in accordance with its HRDP and recruitment policies contained in its SLP.

Employing local labour will also, to some extent, curtail an influx of job seekers into the area, as would be job seekers realise that the employment strategy is biased towards local people.

Mitigation and Management

The following mitigation and enhancement measures are proposed.

- The proponent should be held responsible and accountable for implementing its HRDP in its SLP (Section 3). Some of the mine's own commitments in this regard include:
    - The provision of ABET programmes to community members and employees;
    - Core business training to suitable employees;
    - Learnership programmes for the mine's labour force and community members (for suitable members);
    - Portable skills training opportunities for the mine's labour force and community members (for suitable members); and
    - Community bursaries and internships (for suitable members).
- Employment should be managed by selecting suitable employees according to a selection system that ensures recruitment from local, impacted communities. This should ensure a fair recruitment process.
- The proponent should implement its SLP's Employment Equity Plan (Section 3.5 under the SLP), thus providing equal opportunities to members from all the possible labour-sending communities;
- The client's Procurement Progression Plan (Section 4.9 of the SLP) should be implemented to ensure that local suppliers are used. Moreover, local suppliers and SMMEs should be invited to list their businesses on a database managed by the proponent, possibly through the KLM;
- Appropriate HR policies and procedures, including a labour desk/employment committee should be established to design and implement the SLP's labour recruitment policies and Career Progression Plan. This should ensure that recruitment is done in a fair and transparent way, and that job creation opportunities are maximised;
- The recommendations contained in IFC PS 2 (Labour and Working Conditions) must be adhered to in developing the labour policy and operational guidelines (much of this has been included in the SLP already). These include:
    - Developing appropriate HR policies and procedures (Nr 8);
    - Establishing appropriate working conditions (Nr 10);

  - Ensuring non-discrimination and providing equal opportunities (Nr 15);
  - Establishing a Grievance Mechanism for labour issues (Nr 20);
  - Protecting the work force (Nr 21-22); and
  - Occupational Health and Safety (Nr 23).
- The following ILO conventions must be adhered to:
  - ILO Convention 87 on freedom of association and protection of the right to organise;
  - ILO Convention 98 on the right to organise and collective bargaining;
  - ILO Convention 29 on forced labour;
  - ILO Convention 105 on the abolition of forced labour;
  - ILO Convention 138 on the minimum age of employment;
  - ILO Convention 182 on child labour;
  - ILO Convention 100 on equal remuneration; and
  - ILO Convention 111 on discrimination.
- As far as possible, those labourers involved in the construction phase should be incorporated in the permanent staff for the operational phase; and
- Attention should be paid to employment opportunities for women and disabled persons.

Significance Statement

Without proper labour practices (especially to recruit local labour), this would only be a low positive impact on the local population during the construction phase, as the project could potentially source too many outsider workers.

This is a very significant impact which could, if managed properly, have a high positive overall impact on the population during the construction phase, with mitigation measures in place.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Slightly Beneficial	May Occur	LOW +ve
With Mitigation	Short Term	Study Area	Very Beneficial	Probable	HIGH +ve

Impact 5.2: Developing and supporting local businesses

Cause and Comment

Many local residents called upon the mine to invest in their communities and especially to stimulate the development of SMMEs. Some residents recalled past experiences of mines that have closed and allegedly left their communities without any sustainable income generation opportunities. In this way, some call upon the proponent to invest in sustainable income-generating opportunities that could sustain their communities in the future when the mine has closed.

Through the client's Procurement Progression Plan in its SLP, commitment has been expressed to stimulate and develop local businesses. Moreover, through this SLP, the local economy of the municipality will be supported and stimulated through several community development programmes that are currently being considered by the client. Each programme is being designed with a strong emphasis on stimulating and supporting local business development.

There is a general concern that, should the mine not support local businesses, insufficient opportunities would be created for the communities to become self-sustainable after mine closure. The area might become dependent on outside workers or outside businesses that enter the communities without any skills transfers for the location population.

Mitigation and Management

The SLP should be implemented and annually reviewed.

Significance Statement

Should local SMMEs not be supported and their development not stimulated, the overall significance of the project would only be low positive during the construction phase.

Should appropriate mitigation and enhancement measures be in place, the overall significance of this impact would be high positive during the construction phase. The reason for this is the fact that many SMMEs could be supported, especially during the construction phase when different skills in the general building industry might be required. This would be an ideal opportunity to stimulate local businesses that could provide services in other sectors.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Regional	Slightly Beneficial	May Occur	LOW +ve
With Mitigation	Short Term	Regional	Very Beneficial	Definite	HIGH +ve

Impact 5.3: Skills training and further training opportunities

Cause and Comment

The mine will need highly skilled workers and graduates, and staff with experience in mining. Although many older community members do have this experience, a concern was raised that much of this knowledge has been lost and not passed onto the younger generation.

Sufficient skills and further training opportunities should be developed by the mine for several reasons. The first reason is that this should be seen by the proponent as an investment for the mine itself. Training youth in mine-related skills would ensure that the mine has a steady labour supply in the future. In addition, youth members who have not completed matric should be supported through ABET programmes to obtain appropriate certificates that would allow them to be employed and progress through the mine's internal employee ranks. Another reason is that more local skilled residents could be absorbed in the mine, reducing the need for outside workers.

The consultant is confident that the mine's SLP does address these issues adequately in its SLP, in particular as such measures are required by the Department of Energy (DoE) for issuing a mining license in accordance with the MPRDA (2002). Should such measures not be implemented, there is concern that the mine would not create sustainable jobs and that more outside workers would be required. This would have add-on affects related to many of the impacts already discussed, such as an influx of job-seekers (refer to Issue 1).

Mitigation and Management

Since the implementation of an SLP is mandatory, no mitigation and/or project enhancement measures have been included under this section.

Significance Statement

By implementing its HRDP in its SLP, the mine should have a high positive overall significant impact on the communities. This impact would be HIGH positive for the construction phase of the proposed development.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	N/A	N/A	N/A	N/A	**N/A**
With Mitigation	Medium Term	Regional	Beneficial	Definite	**HIGH +ve**

Issue 6: Altering the landscape

The proposed project might alter the landscape in several ways. Two possible impacts are discussed under this issue which are very closely related, but each issue is dealt with individually:

- Effects on farm-owners' place attachment; and
- Effects on the area's tourism industry.

Impact 6.1: Effects on farm-owners' place attachment

Cause and Comment

Place attachment was defined in the SIA as the bonding that occurs between individuals and their meaningful environments. Three aspects (or dimensions) of place attachment were considered, namely attachment from a personal or group perspective, through a psychological process, and from a physical place attraction. The analysis indicated a mixed and highly complicated relationship between the various variables. For example, place attachment is affected by:

- How long a farm has been in a family;
- The farm-owners' personal or family experience on the land, land memory and knowledge;
- Their social and physical attraction to the land and its natural, but also built environment; and
- The effect that the land has on them, such as instilling a sense of pride, love or memories.

As most farms are held in families, farm-owners' place attachment is significant when analysing it in terms of the above indicators. Although few farmers seemed to be attached to the land from a cultural and social perspective, others contradicted this sentiment by reflecting upon the fact that farm-owners are not familiar with mines and how these alter landscapes. In this view, some warned that farm-owners might become sentimental over their land once the mine is being established, as this will then force them to visualise the mine's impact. Moreover, several farm-owners were dismayed about the prospects of land acquisition, maintaining that it would alter the landscape and acquire land from families. Some are of the opinion that they have spent years to accumulate sufficient resources to acquire the land.

It should be noted that the effect of place attachment would apply differently to each affected farmer, and the type of land acquisition discussed between the proponent and the affected farmer. For example, surrounding landowners whose land will not be acquired, but who would remain living in the area, might have a strong place attachment to the area, and the development of the mine could have an effect on the way they perceive the surrounding environment. Directly affected farm-owners who receive compensation for their land, might decide to voluntary relocate and will be less affected. Assessing the impact of place attachment is therefore very difficult, as the assessment should be applied to different scenarios.

Taking the perspective that place attachment would not be a significant impact for farm-owners who leave the area, this impact has been assessed in terms of those neighbouring farmers who will remain in the area. These farmers will witness the changing landscape, and might perceive such change in relation to how they have known and value the area in the past.

<u>Mitigation and Management</u>

There are no mitigation measures to guard against place attachment values.

<u>Significance Statement</u>

It is assumed that this would be a high negative impact, for those farmers who move off their land. This high negative impact therefore takes place during the construction phase, and is a direct impact on Roode Heuvel farmers required to vacate their land. However, these directly affected farm-owners will benefit in terms of compensation.

Remaining farmers in the area have a strong place attachment, principally since many owned their farms for generations. It should be expected that those farm-owners who chose to remain on their farms would be indirectly affected in terms of place attachment. These farmers regard the changes brought about by a mine as constituting a major and long-term change to their environment which results in severe effects, and hence this is rated as high negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	Definite	**HIGH**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

<u>Impact 6.2: Effects on the area’s tourism industry</u>

<u>Cause and Comment</u>

For purposes of this EIA and in the context of this project, tourism can be divided into eco- or business tourism. Ecotourism can be defined as an influx of people to the area specifically drawn to the area for its natural beauty and flower season. It is one form of tourism that usually attracts people to the area’s fragile, yet pristine and relatively undisturbed natural areas. This is in stark contrast to mass tourism (related to leisure tourism, site of cultural significance or holiday destinations), which this area does not experience significantly. A business tourist, alternatively, can be defined as someone who is drawn to a specific place for business or professional reasons.

From an ecotourism perspective, some expressed concern that the mine would change the area’s landscape and would fail to attract tourists in the future. However, from discussions with the KLM, as well as the communities and some of the affected farm-owners, some agree that the mine should not really affect the area’s tourism industry significantly. As claimed by many, people are not attracted to the farming areas, but prefer to visit the Namakwa NP and areas known for their flower displays around the town of Garies.

According to Mr van Lente (SANParks), the development of the mining industry could in fact stimulate and increase the area’s tourism potential. It is believed that more guesthouses might mushroom to cater for the mine’s needs. The same guesthouses might also be able to cater for more tourists. However, the latter could only be achieved if resources are allocated to promoting the area’s biodiversity and conservation importance.

Lastly, considering business tourism, it is anticipated that the mining development will increase business tourism, as more opportunities will be created for accommodation in the area. This, in return, will have a positive add-on (or spill-over) effect on other sectors as well (such as the food industry).

Mitigation and Management

The following mitigation and enhancement measures are proposed:

- As part of the proponent’s CSR Programme, local tourism initiatives could be supported and promoted.

Significance Statement

With and without mitigation measures in place, it is anticipated that the project will have a LOW positive impact on the tourism industry in the general area.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Localised	Slight Beneficial	Probable	**LOW +ve**
With Mitigation	Medium Term	Localised	Slight Beneficial	Probable	**LOW +ve**

Issue 7: Health related impacts

Impact 7.1: EHA #2: Acute respiratory infections and respiratory effects from housing

Cause and Comment

The project has the potential to attract outsiders and returning families. Population influx has the potential to contribute to the prevalence of respiratory problems in two ways. First, newcomers may carry strains of respiratory diseases (e.g. seasonal influenza viruses) to which the local population has limited resistance due to a lack of previous exposure. Second, in the absence of adequate and affordable housing, newcomers may settle in informal settlements without services such as water, electricity, etc. This may force them to rely on wood fires for cooking and indoor heating.

Mitigation and Management

- Social management measures should include measures to discourage uncontrolled influx of job-seekers and proliferation of informal settlements.

Significance Statement

The impact is considered to occur over the medium term at a regional scale. The likelihood of the impact is definite and considered to be severe. Thus the impact is considered to be of HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Regional	Severe	Definite	**HIGH**
With Mitigation	Medium Term	Regional	Moderate Beneficial	May Occur	**MODERATE +ve**

Impact 7.2: EHA #4: Sexually-Transmitted Infections, Including HIV/AIDS

Cause and Comment

HIV/AIDS and STI are significant existing public health challenges nationally and within the proposed project area. STIs, if present and untreated, have been found to increase the risk of transmission of HIV, if one partner is infected.

The potential influx and movement of labour (including contract workforce) into the area may pose an increased risk for STIs. There may be more disposable income either as a direct or indirect consequence of the project. Commercial sex workers are more likely to establish in Garies, but may also be attracted to the immediate proposed project area and surrounding communities such as Molsvlei and Stofkraal, where local community may be vulnerable to opportunistic sexual liaisons. The probable effect of the Project employing a number of relatively well-paid employees may also increase the risk for transactional sex, especially if they are away from their normal family unit. Economic upliftment and settlement in the proposed project area may also lead to the adoption of “urban” values and lifestyle changes, which may also play a role in casual sexual engagement.

Women and young girls are extremely vulnerable and have limited negotiating power for safe practices and family planning. Gender based sexual violence is common and there is not much support for victims.

HIV/AIDS should be considered a major risk for the project and the community and interventions should be implemented on a broad base in the workforce and the community.

Mitigation and Management

- Develop a HIV/AIDS policy that incorporates both the workplace and community considerations;
- Support the local health authorities in extending care and treatment programs in the area. Support the local health authorities with the establishment of Voluntary Counselling and Testing (VCT) centres in the area;

- Support community based condom distribution centres;
- Providing women and young people with basic HIV/AIDS education;
- Collaborate with local schools as schools are a well-established point of contact through which young people can receive AIDS education;
- Use the media as it is a powerful way of reaching large numbers of people with HIV and AIDS information and prevention messages
- Support information campaigns and community based peer educator programs in both the workforce and community. These need to use locally acceptable tools and based on the finding of the Knowledge, Attitude and Practices (KAP) study;
- Support equal employment opportunities for women and support livelihood programs to reduce risk for opportunistic sexual encounters. This will enable them to be financially independent;
- Support community based information campaigns related to TB symptoms and the need to seek care. The campaign should address the risk of co-infection between HIV and TB. This can be managed through community-based peer health educators;
- Develop partnerships to support the community based TB control programs in conjunction with the authorities and any agencies/NGO;
- Support the health management information system and collect longitudinal (spatial/ over time) data on key TB indicators. This will require health systems strengthening to get this essential data; and
- Support NGO groups active in area on gender-based sexual violence.

Significance Statement

The impact is considered to be permanent at a regional scale. The likelihood of the impact is definite and considered to be very severe. Thus the impact is considered to be of VERY HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Regional	Very Severe	Definite	**VERY HIGH**
With Mitigation	Permanent	Regional	Moderate Beneficial	May Occur	**MODERATE +ve**

Impact 7.3: EHA #5: Soil-, water- and waste-related diseases

Cause and Comment

The communities in the proposed project area have good access to clean or improved water supplies. There is a heavy reliance on non-protected wells as a primary source of drinking water.

Influx may also play a role in availability of water due to increased demand, which may ultimately negatively affect water quality. Pressure on existing limited services in terms of water supply and sanitation could dramatically increase the risk of water related diseases. Water-borne diseases such as diarrhoea were noted during KIIs and are linked to contaminated water and poor sanitary conditions.

There is little data on basic water and sanitation practices or burden of disease linked to specific water and sanitation indicators. There is the potential for the proposed project to be accused of polluting the water bodies in the surrounding communities from plant or domestic water and thus it is important to establish firm baselines for mitigation. Water and sanitation are significant existing needs in the community and if Zirco supports any initiatives they should be linked to specific indicators to measure impact.

Mitigation and Management

- The quality of groundwater and surface water must be monitored to ensure that the proposed project does not have any detrimental effects on community water sources;
- Influx management;
- Restrict access to project created water bodies;
- Perform end user analysis of water quality. This serves as an indicator for monitoring water quality where it is consumed and determines the level of general sanitation and hygiene even if water is collected from clean sources;
- Ensure proper disposal of human waste that is generated from the project; and
- Ensure proper waste management from project generated waste according to waste management principles.

Significance Statement

The impact is considered to be medium term at a regional scale. The likelihood of the impact is definite and considered to be severe. Thus the impact is considered to be of HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Regional	Severe	Definite	HIGH
With Mitigation	Permanent	Regional	Moderate Beneficial	May Occur	MODERATE +ve

Impact 7.4: EHA #6: Food- and nutrition-related issues

Cause and Comment

The possible influx of people into the proposed project area may result in a reduction to agricultural yields as well as space available for grazing livestock. Inflation could reduce food security in a situation of already high food prices that communities cannot afford.

Changes in practices also need to be considered over the medium term. The community may start buying more food in the form of refined products as a result of economic upliftment. A reduction in physical exertion may also result as a result of changing livelihoods. Ironically, the final result could be an increased incidence in obesity.

Mitigation and Management

- Support sustainable livelihood programs through increased use of agriculture. The financial benefit of farming over other practices will be essential to support. An example of this could be community gardens;
- Support maternal and child health programs; and
- Favour local procurement of food items in combination with incentives to increase local production.

Significance Statement

The impact is considered to be medium term at a scale restricted to the study area. The likelihood of the impact is probable and considered to be severe. Thus the impact is considered to be of MODERATE significance. With mitigation measures in place the impact is considered to be LOW beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Study Area	Severe	Probable	MODERATE
With Mitigation	Medium Term	Study Area	Moderate Beneficial	Unlikely	LOW +ve

Impact 7.5: EHA#7: Accidents/Injuries

Cause and Comment

The proposed project may lead to increased traffic loads on primary and access roads and has thus the potential to increase the number of traffic accidents. Some community members may be relatively naïve to risks from road traffic accidents and the larger volumes of traffic may increase their exposure risk. This is especially relevant for small children.

The risks and impacts related to project-generated traffic during construction of the mine were identified as:

- Increased traffic on DR2938;
- Increased risk of vehicle collisions and personal injuries;
- Increased dust generation;
- Increased traffic noise; and
- Increased traffic and disruption of traffic flows on the N7 highway and provincial roads between the N7 and the port at Saldanha.

The health facilities within the communities have very limited capacity to respond and manage any form of complex trauma or multiple casualty situations. In addition, there are limited emergency services so delays to care can be significant and inappropriate movement has the potential to exacerbate injuries.

Mitigation and Management

- Improving road safety by collaborating with the district road-safety unit to establish and maintain pictorial road-safety signage near the site in local language (Afrikaans) and English language (if needed);
- Clearly demarcated pedestrian crossings in appropriate places etc. This could be achieved by establishing and implementing a Traffic Management Plan;
- Develop and implement an Emergency Preparedness and Response Plan for construction and operation, including provisions to deal with traffic accidents, particularly accidents involving personal injuries. All drivers must be made aware of the procedures to be followed;

- Develop community security and safety management structures (such as the Security Community Liaison Forum – a liaison body between the affected farmers and security personnel, through which security arrangements are discussed with affected farmers) for the project related to the different activities. This should include emergency response plans for both community related accidents and also for the workplace. This must include a fire, rescue and chemical spill response capability, as well as medical emergency response strategies;
- Conduct a traffic impact assessment to assess the impact of increased traffic within the proposed project area (this has been completed and forms part of the Specialist Volume);
- Develop a clear policy for the management of emergencies or accidents in the community as a direct result of the projects activities; and
- Support with local safety and security as addressed in the specialist studies.

Significance Statement

The impact is considered to be long term at a scale restricted to the study area. The likelihood of the impact is probable and considered to be severe. Thus the impact is considered to be of HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	Probable	HIGH
With Mitigation	Long Term	Study Area	Moderate Beneficial	May Occur	MODERATE +ve

Impact 7.6 EHA #8: Exposure to potentially hazardous materials, noise and malodours

Cause and Comment

Radiation

Heavy mineral sands will be concentrated through the production of the HMC and may therefore be considered to be above the naturally background radiation levels. In addition, certain scrap types may be contaminated with radionuclide-containing ore/product (Naturally-Occurring Radioactive Materials (NORM)). Used vehicle tyres together with components from the processing plants such as metal sheets, rubber-lined parts of the process and fibreglass trays, are particularly prone to this type of contamination. As such, radiation levels should be assessed, and if necessary, monitored (a radiation assessment has been completed and included in the Specialist Volume, in addition to this, radiation impacts are discussed separately below (Section 9.4) for all phases of the project).

In the absence of adequate mitigation, radiation exposure resulting from project activities constitutes one of the most significant potential health impacts of the project. Any living tissue in the human body can be damaged by radiation in a unique manner. The body attempts to repair the damage, but sometimes the damage is of a nature that cannot be repaired or it is too severe or widespread to be repaired. Also mistakes made in the natural repair process can lead to cancerous cells. The most common forms of ionizing radiation are alpha and beta particles, or gamma and X-rays.

In general, the amount and duration of radiation exposure affects the severity or type of health effect. There are two broad categories of health effects: stochastic and non-stochastic.

Stochastic Health Effects: Stochastic effects are associated with long-term, low-level (chronic) exposure to radiation. ("Stochastic" refers to the likelihood that something will happen.) Increased levels of exposure make these health effects more likely to occur, but do not influence the type or severity of the effect. Cancer is considered by most people the primary health effect from radiation exposure.

Non-Stochastic Health Effects: Non-stochastic effects appear in cases of exposure to high levels of radiation, and become more severe as the exposure increases. Short-term, high-level exposure is referred to as 'acute' exposure. Many non-cancerous health effects of radiation are non-stochastic. Unlike cancer, health effects from 'acute' exposure to radiation usually appear quickly. Acute health effects include burns and radiation sickness. Radiation sickness is also called 'radiation poisoning.' It can cause premature aging or even death. If the dose is fatal, death usually occurs within two months. The symptoms of radiation sickness include: nausea, weakness, hair loss, skin burns or diminished organ function.

Solid Waste (General and Hazardous)

Waste streams likely to be produced during the construction phase will include both general (non-hazardous) and hazardous wastes and are expected to be similar in composition to the non-process wastes or co-products produced during the operational phase. The domestic waste stream will be comprised predominantly of non-hazardous waste types including paper, plastic, cloth and some food waste. In addition, relatively insignificant quantities of hazardous wastes may be included in this waste stream, including batteries, empty containers for cleaning chemicals, fluorescent light tubes, pesticide aerosol cans, medical / clinic wastes etc.

The construction and rehabilitation activities will also result in the generation of hazardous wastes including chemicals associated with machine and vehicle maintenance, oily rags and filters, empty containers for hazardous chemicals (paints, solvents, lubricants, herbicides, pesticides / herbicides) and electrical and electronic equipment.

The clinic or first aid station that will be located at the mine will most likely generate some medical waste (bio-hazards). Medical waste is classified as Hazard Rating 1 or Extreme hazard waste and must be incinerated before disposal at a landfill. Alternative methods for disposal are pre-treatment by sterilisation, direct irradiation or micro-waving to render inactive, prior to its final disposal by landfilling at a hazardous waste landfill site.

Air pollution, Water, Noise and Mal-odours

Exposures and environmental health determinants as a result of the project will be covered in a number of specialist reports (refer to Specialist Volume). These include air quality, water, noise and soil studies.

Noise is also a factor to consider and the health impacts of noise are well described at both a physical and psychosocial level. The noise related to transport and use of equipment will also need to be assessed (a noise assessment has been completed and is included in the Specialist Volume).

Air quality and odours have been addressed in detail in the air quality report. Dust generation was highlighted as a potential impact especially in operations. The pollutant of concern under the current land-use would be particulates that would result in elevated levels of dustfall, as well as elevated PM_{10} and $PM_{2.5}$ concentrations. The likely emissions sources would be wind erosion of areas where vegetation cover is limited and vehicle entrainment of particulates from the unpaved district and farm roads.

Available information in regards to water quality indicates that project activities will not have any appreciable adverse impact on the quantity and quality of potable groundwater (a surface and groundwater report has been completed and is available in the Specialist Volume).

Mitigation and Management

- Implement mitigation measures as specified in the radiation and air quality assessment reports;
- The quality of groundwater and surface water must be monitored to ensure that the proposed project does not have any detrimental effects on community water sources;
- Evaluate and manage air, water and noise issues as part of the environmental impact assessment and environmental management plan requirements. Human health considerations should be considered based on results of the surveillance activity.

Significance Statement

The impact is considered to be permanent at a scale restricted to the study area. The likelihood of the impact is probable and considered to be moderate. Thus the impact is considered to be of MODERATE significance. With mitigation measures in place the impact is considered to be LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium Term	Study Area	Moderate	Unlikely	**LOW**

Impact 7.7: EHA #9: Social determinants of health (gender-based violence, alcohol and drugs)

Cause and Comment

Gender-based violence occurs commonly and is often related to substance abuse. Women and young girls are often the most vulnerable.

Drug and alcohol abuse are currently a major problem in the local study area, and these have the potential to increase during the lifespan of the proposed Project. The SIA confirms this through the discussion of substance abuse (alcohol- and drug-use), and how this reinforces and accounts for a range of social pathologies, such as intra-household violence, women abuse, rape, teenage pregnancies and crime. This would be due to the increase in income and mobility, affording individuals who previously could not afford these 'luxuries', to now indulge.

Mitigation and Management

- Social management plans and recommendations as part of the social impact assessment; and
- Gender empowerment should be considered.

Significance Statement

The impact is considered to be medium term at a scale restricted to the study area. The likelihood of the impact is probable and considered to be severe. Thus the impact is considered to be of MODERATE significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Study Area	Severe	Probable	**MODERATE**
With Mitigation	Medium Term	Study Area	Moderate Beneficial	May Occur	**MODERATE +ve**

Impact 7.8: EHA #9: Social determinants of health (social cohesion and well-being)

Cause and Comment

Influx into the proposed project area will play a major role in lifestyle and perceptions of wellbeing.

Employment is a major need in the proposed project area. The SIA highlights the potential benefits that the proposed project may bring for employment opportunities. There are distinct direct and indirect health benefits related to this.

Education is also a major existing need in the community. The level of education in the proposed project area is described as low. It was cited as a priority developmental need in the community. Women’s literacy is extremely important to enhance health needs in the family unit as they are the gatekeepers to health.

There is a lot of mining expertise in the area such as former diamond, copper and base metal miners. Zirco expects to employ numerous local skilled and unskilled labour. Zirco will also make use of skilled workers from outside the KLM. Once the mine becomes operational, several permanent jobs will be created, constituting of skilled, semi-skilled and unskilled labourers. Many of the highly-skilled workers may come from outside of the proposed project area which may result in community tension and a reduced sense of well-being.

Mitigation and Management

- Gender empowerment and equity, this should include programs as well as employment opportunities;
- Supporting education programs with a gender equity focus;
- Support cultural activities and sports especially in schools;
- Support vulnerable groups; and
- Support graduate training programs for the youth in the community.

Significance Statement

The impact is considered to be medium term at a regional scale. The likelihood of the impact is probable and considered to be severe. Thus the impact is considered to be of HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Regional	Severe	Probable	HIGH
With Mitigation	Medium Term	Regional	Moderate Beneficial	Probable	MODERATE +ve

Impact 7.9: EHA #12: Non-Communicable Diseases

Cause and Comment

These diseases are poorly described in the country and district. This is due to the high burden of communicable diseases in the country that have focussed the human and economic resources to this sector.

NCD may play a major role in the economics of the country as it is well recognised that poor adult health negatively effects economic well-being at an individual and household level, but also at a macro level. Labour productivity will fall, and the social and medical costs of managing chronic diseases as well as an ageing population, will increase.

The proposed project will in all likelihood enhance the socio-economic conditions in the area either from direct or cumulative benefits. As the Project starts to uplift health programs in the area through direct or indirect means, it will hopefully increase the life expectancy in the area and also the productive time of breadwinners. The short term effects may be an increased spending ability and adoption of more western sedentary lifestyle and diet. With prosperity and organised settlement may come a degree of urbanism with associated changes in values and behaviour, which predisposes the community to an increase in lifestyle related diseases such as obesity, hypertension, diabetes, and some forms of cancers. This may place an additional burden on the local health care facilities that may not have an ability to diagnose and appropriately manage these conditions.

The proposed project will employ a number of permanent and temporary workers. Diet and lifestyle will need to be monitored in this sector as they will have access to increased incomes and potentially free meals on the project site. This is a workplace health as well as a community health concern.

In terms of the significance of the proposed project on the communities the following can be considered:

- Social and environmental factors that increase stress and unhealthy behaviours; and
- Increase pressure on existing health care facilities that only practice limited preventive health care.

These conditions are chronic in nature and difficult to predict at the local level. The cumulative impacts of the economic upliftment of the region will need to be considered and such the impacts cannot solely be ascribed to the project. Mitigation and management at the local level is however important.

Mitigation and Management

- Collect indicator data on NCD in area. Focus on hypertension and diabetes as most common conditions;
- Support the local health care personnel with training on disease management programs and the recognition of NCD symptoms and associated management; and
- Support health education programs as part of a community based peer health educator program. These should focus on lifestyle risk factors such as diet, exercise, smoking and alcohol consumption.

Significance Statement

The impact is considered to be long term at a regional scale. The likelihood of the impact is probable and considered to be severe. Thus the impact is considered to be of HIGH significance. With mitigation measures in place the impact is considered to be moderately beneficial.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Severe	Probable	HIGH
With Mitigation	Long Term	Regional	Moderate Beneficial	May Occur	MODERATE +ve

Issue 8: Economic Impacts

Impact 8.1: Impact on tourism

Cause and Comment

The economic assessment took into account negative impacts on tourism associated with visual impacts, impacts related to noise and dust, impacts on freshwater and marine environments and the loss of conservation worthy land and biodiversity offsets. In addition it also considered the benefits that may arise from the proposed development, including improved access to the NNP via the upgrading of the road and an increase in business tourism. A consolidated consideration of the risks and opportunities are assessed below.

Mitigation and Management

- Serious consideration should be given to funding tourism enhancement projects in collaboration with local tourism stakeholders as part of the mine's future Social and Labour Plan (SLP) contributions. There is a particular need given limited concerted efforts in the local area. Assistance could, for example, encompass tourism planning, promotion, capacity building, enterprise development and the provision of tourist facilities.
- With regard to rehabilitation, if one takes a sample of mines throughout South Africa, it is clear that rehabilitation effort and success can be highly variable even if all mines are required to abide by the same regulations (see van Zyl et al., 2012). This variability can be seen when comparing both operating and closed mines. It therefore stands to reason that, with regards to minimising impacts, much will depend not only on how the applicants EMP is conceived, but critically how it is implemented in

partnership with the relevant authorities and other stakeholders. Rehabilitation needs to be rigorously applied and adequately funded both concurrently and at closure, especially to minimise visual scarring and other tourism risks. The fact that the costs of rehabilitation have been determined, and allowances for this made in the financial model, indicates that this is the current thinking.

- The biodiversity offset recommended by the botanical specialist would have particular potential to compensate for tourism risks. The initial location options for the offset recommended by the botanical specialist are adjacent to the NNP allowing for new areas to be added to the NNP. Ideally, further choices among these options should be made with NNP tourism development in mind so that the areas chosen can enhance tourism. Such an offset could reduce overall tourism risks to a low significance if appropriately chosen, and successfully integrated into the NNP in conjunction with other mitigation and rehabilitation measures.

Significance Statement

Some disturbance and nuisance would be experienced during construction. This would include the potential for increased dust and noise. Impacts should, however, be low provided the construction phase is well managed and the mitigation measures suggested by the other specialist studies forming part of this EIA are implemented.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Short Term	Study Area	Slight	Probable	**LOW**

Impact 8.2: Impact on landowners

Cause and Comment

The economic assessment took into account impacts on landowners associated with visual impacts and sense of place, impacts associated with noise, and impacts on freshwater and marine environments. In addition it also considered the benefits that may arise for the proposed development, including the upgrading of the district road. A consolidated consideration of the risks and opportunities are assessed below.

Mitigation and Management

- Mitigation measures are the same as those listed for Impact 8.1 above.

Significance Statement

Some disturbance and nuisance would be experienced during construction. This would include the potential for increased dust and noise as well as increased risk of the emergence of “social ills" associated with the presence of the construction workforce. Impacts should, however, be low provided the construction phase is well managed and the mitigation measures suggested by the other specialist studies forming part of this EIA are implemented.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Moderate	Probable	MODERATE
With Mitigation	Short Term	Study Area	Slight	Probable	LOW

Impact 8.3: Impact of project related expenditure

Cause and Comment

Construction expenditure would constitute a positive injection of new investment. Preliminary estimates indicate that a total of between R1.4 billion and R2.15 billion would be spent on all aspects of construction.

Mitigation and Management

The applicants procurement processes, hiring and training of staff and social and labour plan (SLP) projects should act as departure points when considering benefit enhancement measures. Among other things, this plan deals with giving preference to local and historically disadvantaged individuals and companies.

Mitigation in the form of benefit enhancement should focus on three areas:

- Targets should preferably be set for how much local labour should be used based on the needs of the applicant and the availability of existing skills and people that are willing to undergo training. Opportunities for the training of unskilled and skilled workers from local communities should be maximized.
- Local sub-contractors should be used where possible and contractors from outside the local area that tender for work should also be required to meet targets for how many locals are given employment.
- The applicant should explore ways to enhance local community benefits with a focus on well-conceived SLP projects that are clearly aligned with local needs as outlined in the Kamiesberg Municipality IDP. (Please note this has been completed and forms part of the accepted SLP).

The social specialist study (CES, 2014a) also provides more details on appropriate benefit enhancement measures.

Significance Statement

An assessment of the significance of the combined impacts of project-related expenditure based on the findings above is presented in the table below. Impacts with mitigation should be of a MODERATE significance during construction.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Regional	Moderately Beneficial	Definite	MODERATE +ve
With Mitigation	Short Term	Regional	Moderately Beneficial	Definite	MODERATE +ve

9.2.4 Impacts that may result from the operational phase

Issue 1: Influx of Job Seekers and Outside Workers

Impact 1.1: Community expansions and increased burdens on service delivery and cost of living:

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 1, impact 1.1).

Significance Statement

Should no mitigation measures be implemented by the proponent to safeguard communities from rapid expansion and assist the municipality with new incomers, the overall significance of this impact during the operational phase should be MODERATE negative.

With proper mitigation measures, during the mine's operational phase, the project should have a positive impact on the surrounding communities. The reason for this is that the mine could stimulate the local skills base, and limit (as far as possible) the number of outside workers that will be required.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long-term	Study Area	Moderate	May Occur	MODERATE
With Mitigation	Long-term	Study Area	Slightly Beneficial	Probable	MODERATE +ve

Impact 1.2: Increased community conflicts due to differential benefits between local labour and outside workers

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 1, impact 1.2).

Significance Statement

Without any mitigation measures, the consultant believes that the overall significance of this impact would be MODERATE negative during the operational phase as the influx of job-seekers might potentially level-off. Should appropriate mitigation measures be adopted, the overall significance of this impact should be low negative during the operational phase. With any development, a degree of community tension would be expected. This cannot change into a positive impact, which is why it remains low negative, even when mitigation measures are adopted.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long-term	Study Area	Slight	May Occur	MODERATE
With Mitigation	Long-term	Study Area	Slight	Unlikely	LOW

Impact 1.3: Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 1, impact 1.3).

Significance Statement

Without any mitigation measures, the consultant believes that the overall significance of this impact would be HIGH negative during the operational phase. The reason for this high rate is that the severity of this impact is very severe and the likelihood definite.

Should appropriate mitigation measures be adopted, the overall significance of this impact should be LOW negative during the operational phase. Changing social pathological behaviours is extremely difficult, as it involves changing attitudes and community values. At most, such impacts can be controlled, but never eliminated.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Very Severe	Definite	**HIGH**
With Mitigation	Long Term	Study Area	Moderate	May Occur	**LOW**

Issue 2: The use of security personnel

Impact 2.1: The use of security personnel for mine access control

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 2, impact 2.1).

Significance Statement

This could potentially be a MODERATE negative impact of the usage of security personnel. The reason for this is that it could result in fractious relationships between the proponent and the affected farm-owners. This could especially be the case if adjacent farm-owners start to feel a sense of threat from the security personnel. In the most serious case, farm-owners might even be subject to violent attacks from security guards, although there is no reason to suspect this at such an early stage.

With an appropriate code of conduct for the usage of a security company, the impact of security personnel should not have any effect on the surrounding residents.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	May Occur	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Issue 3: Provision of basic social services

Impact 3.1: Assisting with housing requirements in Garies

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 3, impact 3.1).

Significance Statement:

If no assistance is provided for staff housing, informal settlements might become established. However, this is unlikely as the conditions of mining will dictate that suitable staff accommodation is provided. Should no measures or procedures be in place to ensure a fair and transparent process, conflict might be stirred in the communities regarding perceived unfair housing provision. The overall significance for household development would therefore only be MODERATE positive.

Should procedures and measures be put in place to ensure that assistance with housing is done in a fair and transparent manner, the overall significance should be HIGH positive during the operational phase.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Slightly Beneficial	Probable	**MODERATE +ve**
With Mitigation	Long Term	Localised	Very Beneficial	Probable	**HIGH +ve**

Impact 3.2: Assisting with local economic development

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 3, impact 3.2).

Significance Statement

Should the proponent invest in LED without ensuring that sufficient project enhancement measures and appropriate community and stakeholder engagements have been undertaken, any investment would probably only have a MODERATE positive impact.

Should mitigation (or rather enhancement) measures be implement, the mine's LED investment in the KLM could have an overall HIGH positive significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Study Area	Moderately Beneficial	Probable	**MODERATE**
With Mitigation	Medium Term	Study Area	Very Beneficial	Probable	**HIGH**

Impact 3.3: Upgrading of roads

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 3, impact 3.3).

Significance Statement

It is believed that upgrading some road networks will have a general positive impact on the area's population. Therefore, this impact (as a project enhancement measure) has been rated as a 'low positive'.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Slighty Beneficial	Definite	**LOW +ve**
With Mitigation	Long Term	Study Area	Slightly Beneficial	Unlikely	**LOW +ve**

Issue 4: Land acquisition for mining

Impact 4.1: Economic viability of remaining unaffected land

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 4, impact 4.1).

Significance Statement

It is believed that compensation for land will have a moderate positive impact on the affected farmers and their households.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	N/A	N/A	N/A	N/A	**N/A**
With Mitigation	Long Term	Study Area	Slight	May Occur	**MODERATE +ve**

Issue 5: Stimulation of Economic Growth

Impact 5.1: Employing local labour

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 5, impact 5.1).

Significance Statement

Without proper labour practices (especially to recruit local labour), this would only be a low positive impact on the local population during the operational phase, as the project could potentially source too many outsider workers.

This is a very significant impact which could, if managed properly, have a very high positive impact during the operational phase. During the operational phase, it is anticipated that, together with the cumulative developments of other mines in the area, the spatial scale would become regional.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Slightly Beneficial	May Occur	LOW +ve
With Mitigation	Long Term	Regional	Very Beneficial	Probable	HIGH +ve

Impact 5.2: Developing and supporting local businesses

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 5, impact 5.2).

Significance Statement

Should local SMMEs not be supported and their development not stimulated, the overall significance of the project would only be low positive during the operational phase.

Should appropriate mitigation and enhancement measures be in place, the overall significance of this impact would be high positive during the operational phase. The reason for this is the fact that many SMMEs could be supported, when different skills in the general building industry might be required. This would be an ideal opportunity to stimulate local businesses that could provide services in other sectors.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Slightly Beneficial	May Occur	LOW +ve
With Mitigation	Long Term	Regional	Beneficial	Probable	HIGH +ve

Impact 5.3: Skills training and further training opportunities

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 5, impact 5.3).

Significance Statement

By implementing its HRDP in its SLP, the mine should have a high positive overall significant impact on the communities. This impact would be HIGH positive for the operational phase of the proposed development.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	N/A	N/A	N/A	N/A	**N/A**
With Mitigation	Long Term	Regional	Beneficial	Definite	HIGH +ve

Issue 6: Altering the landscape

Impact 6.1: Effects on farm-owners' place attachment

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 6, impact 6.1).

Significance Statement

Remaining farmers in the area have a strong place attachment, principally since many owned their farms for generations. It should be expected that those farm-owners who chose to remain on their farms would be indirectly affected in terms of place attachment. These farmers regard the changes brought about by a mine as constituting a major and long-term change to their environment which results in severe effects, and hence this is rated as high negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Severe	Definite	**HIGH**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Impact 6.2: Effects on the area's tourism industry

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.2.3, issue 6, impact 6.2).

Significance Statement

With and without mitigation measures in place, it is anticipated that the project will have a LOW positive impact on the tourism industry in the general area.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Localised	Slight Beneficial	Probable	**LOW +ve**
With Mitigation	Long Term	Localised	Slight Beneficial	Probable	**LOW +ve**

Issue 7: Health related impacts

The majority of health related impacts as a result of the project can be ascribed to the influx of job seekers into the overall area. As discussed previously this impact usually occurs through all phases of the project life, thus the project related health impacts for the operational phase will be the same as those listed for the construction phase.

Issue 8: Economic Impacts

Impact 8.1: Impact on tourism

The cause and comment and mitigation measures related to this operational phase impact are identical to the impact discussed for the construction phase (Section 9.2.3) and not repeated here.

Significance Statement

Un-mitigated impacts on tourism have been given a MODERATE to HIGH negative significance rating during operations. It should, however, be possible to reduce these impacts to a MODERATE level of significance provided that appropriate mitigation measures are put in place. Note that it should be possible to reduce this significance further to a LOW rating provided a biodiversity offset is chosen that adds to the tourism potential of the NNP to an adequate degree.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderate to Severe	Probable	HIGH-MODERATE
With Mitigation	Long Term	Study Area	Moderate	Probable	MODERATE
With Biodiversity Offset	Long Term	Study Area	Slight	Probable	LOW

Impact 8.2: Impact on landowners

The cause and comment and mitigation measures related to this operational phase impact are identical to the impact discussed for the construction phase (Section 9.2.3) and not repeated here.

Significance Statement

Un-mitigated impacts on nearby land owners have been given a MODERATE to HIGH negative significance rating during operations without mitigation (see table below). These impacts could, however, be reduced to a MODERATE significance provided that appropriate mitigation measures are put in place. Bear in mind that the key driver of this impact rating are the risks predicted to affect local residents living nearby the DR2938.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderate to Severe	Probable	HIGH-MODERATE
With Mitigation	Long Term	Study Area	Moderate	Probable	MODERATE

Impact 8.3: Impact of project related expenditure

Cause and Comment

The key operational phase impacts associated with the project would flow from expenditure on operations at the mine and plant. Once the mine is fully operational, expenditure should be between R546 million and R819 million per annum over 20 years of operation.

Mitigation and Management

Mitigation is the same as for impact 8.3 (Section 9.2.3).

Significance Statement

An assessment of the significance of the combined impacts of project-related expenditure based on the findings above is presented in the table below. Impacts during operations would have a HIGH positive significance rating with mitigation given the size of the expenditure injection and the number of potential employment opportunities involved.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Moderately Beneficial	Definite	**MODERATE +ve**
With Mitigation	Long Term	Regional	Substantially Beneficial	Definite	**HIGH+ve**

Impact 8.4: Macro-economic impacts

Cause and Comment

The scale of the project and its export orientation should ensure that it makes a significant contribution in terms of macro-economic benefits. Key variables for the measurement of these benefits are foreign exchange earnings, company taxes and mineral royalties. Estimates of benefits in this regard are provided in the table below based on inputs from the applicant. They indicate that:

- Foreign exchange earnings would average between R861 million and R1,290 million per year during mining. The present value of these benefits would be between R12 billion and R18 billion using a 4% discount rate. Note that these benefits would be offset by imports. However, these would not make up a particularly significant portion of mining costs as mining equipment would largely be available locally.
- Company tax contributions would average between R75 million and R112 million per year during mining. The present value of these benefits would be between R950 million and R1,400 million using a 4% discount rate.
- Mining royalties would average between R41 million and R61 million per year during mining. The present value of these benefits would be between R570 million and R850 million using a 4% discount rate.

Mitigation and Management

None recommended

Significance Statement

An assessment of the significance of the combined macro-economic impacts of the project based on the findings above is presented in the table below. Impacts would be high positive with no mitigation recommended.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	National	Substantially Beneficial	Definite	HIGH +ve
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

9.2.5 Impacts that may result from the decommissioning phase

Issue 1: Loss of social services

Cause and Comment

During the decommissioning of the mine various social projects initiated during the various phases of the proposed project such as educational projects, agricultural projects, etc. may be lost.

Mitigation and Management

The project proponent should ensure that these projects are undertaken in a sustainable manner so that they can continue within the region post mine closure, i.e. should include basic business training.

Significance Statement

This impact is considered to be of MODERATE negative significance and will remain moderately negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Severe	May Occur	**MODERATE**
With Mitigation	Permanent	Study Area	Severe	Unlikely	**MODERATE**

Issue 2: Retrenchment

Cause and Comment

During the decommissioning phase of the proposed project the majority of staff previously employed will be retrenched as all mining activities has ceased.

Mitigation and Management

A retrenchment policy has to be in place prior to any retrenchment activities being undertaken.

Should the proposed project continue to Phase 2, employees appointed for Phase 1 of the development should be maintained for the second phase which would reduce the amount of staff to be retrenched.

Significance Statement

This impact is considered to be of VERY HIGH negative significance but can be reduced to moderately negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Very Severe	Definite	VERY HIGH
With Mitigation	Permanent	Study Area	Moderate	May Occur	MODERATE

Issue 3: Health related impacts

The majority of health related impacts as a result of the project can be ascribed to the influx of job seekers into the overall area. As discussed previously this impact usually occurs through all phases of the project life, thus the project related health impacts for the decommissioning phase will be the same as those listed for the construction phase.

9.3 CULTURAL HERITAGE IMPACTS

9.3.1 Planning and Design Phase Impacts

Activities associated with the design and pre construction phase pertains mostly to exploration. As the project has an exploration license impacts associated with exploration and the mitigation of these impacts were included in the Exploration EMP compiled to obtain this license and will therefore not be repeated in this section. Other activities associated with the design and pre construction phase will not have impacts on the cultural heritage of the area as this phase consists of planning and design of the proposed development, and is done at a desktop level. In some cases site visits need to take place but the impact of these visits is negligible, if any, e.g. photographs, botanical and other field surveys, etc.

9.3.2 Impacts resulting from the existing land use / no-go options

Existing impacts on cultural heritage are more visible at the coast. Existing heritage (i.e. shell scatters and middens) is quite resilient, and the current impacts are mainly related to natural processes such as wind erosion. Anthropogenic activities such as past illegal camping, digging of rubbish pits and toilets, illegal 4 x 4 tracks, parking, and other recreational activities (playing on the dunes for example) has also had a severe negative impact on the archaeological heritage. Archaeological sites on the coast have been severely compromised and many have been destroyed by the above activities. Evidence shows that these impacts are currently ongoing. For example, there are some middens on the dunes near the parking area at Island Point which are slowly eroding away. This is caused by trampling and the construction of informal access roads. Please note that any damage or disturbance to archaeological sites is an offence under the NHRA (but this is impossible to police).

Existing impacts on the heritage environment inland of the coast (in the application area) are clearly not as severe, but are difficult to quantify/measure. Removing objects from sites (e.g. the Stone Age campsites in the wind deflated dunes) will impact negatively on the integrity and scientific value of these sites, but unless one specifically asks the farmers/landowner there is no way of knowing/proving this has taken place. In addition to this, the road built to the top of the Brandkop (on Roode Heuvel) has impacted negatively on the archaeological site (Site 086), and if local residents continue to access this area this will continue to undermine this site and others in the surrounding area. Other than this, however, indications are that there is little currently impacting on the heritage environment in the application area (Roode Heuvel & Leeuvlei).

9.3.3 Impacts that may result from the construction phase

Cause and Comment

The main construction phase impact on cultural heritage during the construction phase of the project will be as a result of the construction of the proposed pipeline and associated infrastructure. Archaeological remains are extremely rich at the coast. Typically, these comprise scatters of shellfish dominated by limpets and Black Mussel. A few stone flakes, some ostrich eggshell and pottery was also found. Shell scatters are essentially the remains of processing sites where meat was extracted, cooked in pots, or even dried like biltong for transport to campsites further inland. Some of these sites may have to be removed and/or will be impacted on by the proposed development.

Mitigation and Management

Proposed seawater intake, pump station and pipeline – Kmm5

- Shellfish deposits (Site 095) at the sea water intake must be sampled. This should take the form of a series of 1m x 1m excavations in order to test the significance and extent of the archaeological deposits. Shellfish and bone must also be collected for dating. Should significant sub-surface deposits be encountered during test excavations, a larger sample will need to be rescued.
- Scatters of shellfish (Sites 096-103 & Sites 105-115) in the pipeline route, and between the sea water intake and the pump station (Sites 277-279, Sites 283-286 and Site 296) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i. e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.
- Scatter of tools (Site 136) in the wind deflated site in the pipeline route south of the Groenrivier must be mapped on a grid system. Sand must also be sieved for the presence of sub-surface material. All the remains must be collected, curated and written up and a report presented to SAHRA. No archaeological material may be collected or damaged without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.
- Outcropping of quartz (sites 138 and 139) alongside the pipeline must be investigated. This will entail more detailed visual recording, mapping and collection. The material must be written up and a report presented to SAHRA. No archaeological material may be collected without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.
- Should any unmarked human remains or ostrich eggshell caches be uncovered or exposed during excavations for the pump station for example, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Att: Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Proposed seawater intake, pump station and pipeline – Kmm4

- Scatters of shellfish (Site 273, Sites 233, 236 and 237, Sites 244 and 245, Sites 250-255 and Site 261) in the pipeline route, and scatters of shellfish between the sea water intake and the pump station (Site 229 and Site 272) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i. e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.

Significance Statement

Impacts on cultural heritage during the construction phase is considered to be long term, severe and limited to the study site. This will result in a MODERATE negative impact. With mitigation measures in place the impact can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	Definite	**MODERATE**
With Mitigation	N/A	Localised	Low	May Occur	**LOW**

9.3.4 Impacts that may result from the operational phase

Cause and Comment

Due to the establishment of ecological corridors, the number of cultural heritage sites that will be impacted on by the proposed operation of the mine have been reduced to 9 (refer to Figure 9.2 below). These include sites 010, 033, 037, 041 and 088 on Leeuvlei, and sites 090, 091, 092 and 328 on Roode Heuvel.

Mitigation and Management

- Site 010, 033, 037, 041 and 088: These sites are outcroppings of quartz that was probably a source of raw material. Mitigation Measures include a buffer of 5 m and/or fencing of the site.
- Site 090: This site consists of 15-20 pieces of ostrich eggshell and a large piece of Ferrecrete in a wind deflated hollow. The archeological remains should be collected and sands should be sieved for the presence of subsurface material.
- Site 091: This consists of a quartz flake, round core and 3 quartz chunks in a deflated hollow. The archeological remains should be collected and sands should be sieved for the presence of subsurface material.
- Site 092: This consists of a low density scatter of tools, including 2 chunks, 4-5 flakes, chips, core, 3-4 manuports together, flaked chunk, large flake and round core – all in quartz. The archeological remains should be collected and sands should be sieved for the presence of subsurface material.
- Site 328: Consists of a wind deflated hollow/dune blow out on the high upper slopes overlooking the district road. This comprises a scatter of tools dominated by quartz flakes, blade and chunks, 2 round cores, small round crystal, quartzite manuport, 2 utilised silcrete flakes, quartzite hammerstone, quartzite chunk, and fragments of weathered limpet (*S. argenvillei*), including 1 whole *S. argenvillei*. Also includes a small fragment of coarse tempered pottery. The archeological remains should be collected and sands should be sieved for the presence of subsurface material.
- Should any unmarked human remains, or ostrich eggshell caches for example, be uncovered or exposed during mining or associated activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

- A Heritage Management Plan (HMP) must be implemented in order to protect important archaeological sites that fall within `non-mining areas', during the Construction and Operational Phase of the project. The HMP must be included as part of the Environmental Management Plan (EMP) for the proposed project. The HMP must be submitted to SAHRA for approval.
- No archaeological material may be collected or damaged without a permit issued by SAHRA.

Significance Statement

Impacts on cultural heritage during the operational phase is considered to be long term, severe and limited to the study site. This will result in a MODERATE negative impact. With mitigation measures in place the impact can be reduced to LOW negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Severe	Definite	**MODERATE**
With Mitigation	N/A	Localised	Low	May Occur	**LOW**

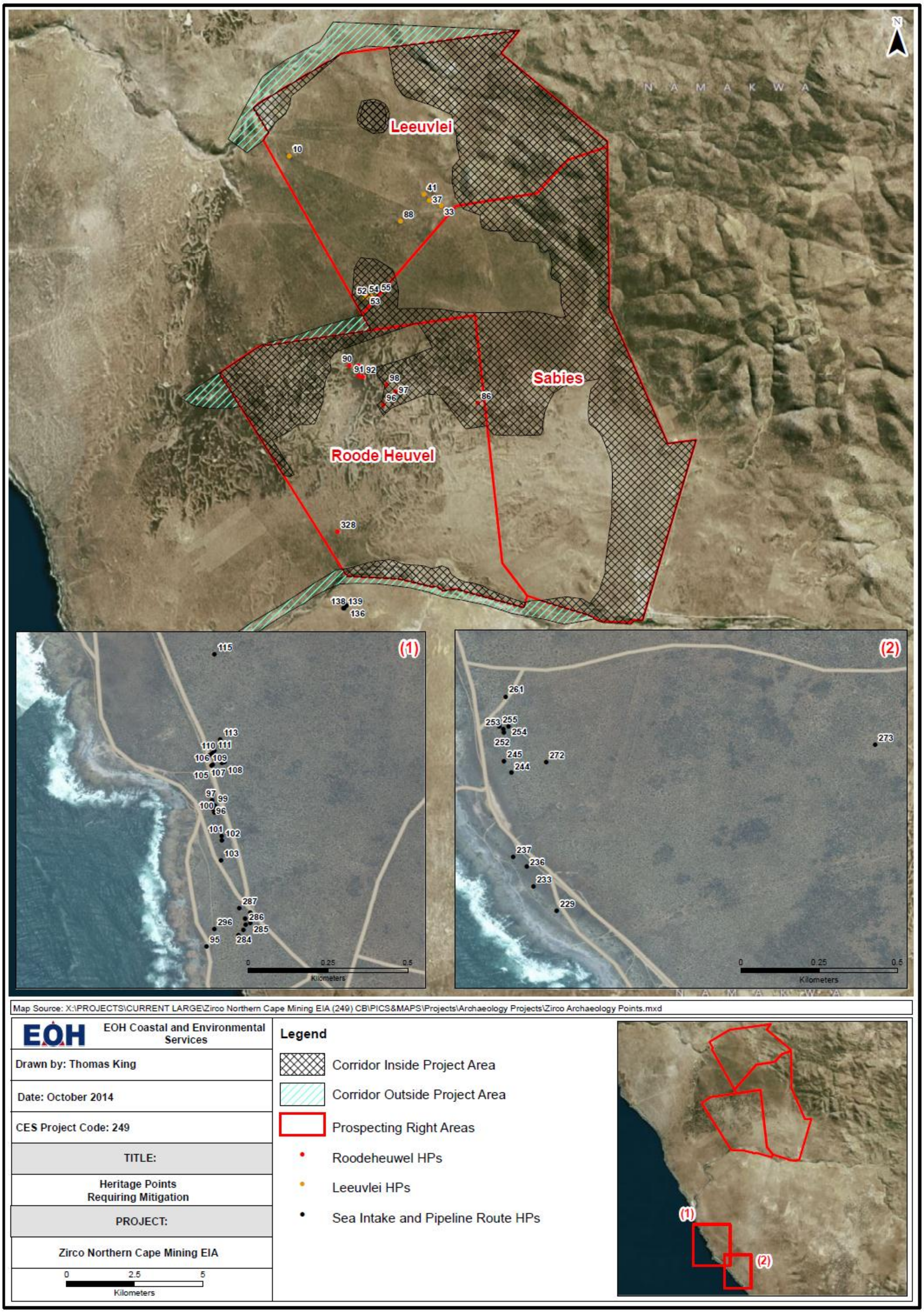


Figure 9.2: Heritage resources that require mitigation in and outside the project affected area

9.3.5 Impacts that may result from the decommissioning phase

Due to the fact that significant site of cultural heritage value that will be impacted on by the proposed development will be removed prior to construction and/mining, no impacts are anticipated for the decommissioning phase.

9.4 WASTE AND INFRASTRUCTURE RELATED IMPACTS

Activities associated with the design and pre construction phase pertains mostly to exploration. As the project has an exploration license impacts associated with exploration and the mitigation of these impacts were included in the Exploration EMP compiled to obtain this license and will therefore not be repeated in this section. Other activities associated with the design and pre construction phase will not result in waste being produced as this phase consists of planning and design of the proposed development, and is done at a desktop level. In some cases site visits need to take place but the impact of these visits is negligible, if any, e.g. photographs, botanical and other field surveys, etc.

9.4.1 Impacts resulting from the existing land use / no-go options

i. Impacts associated with waste

The EIA regulations require the consideration of the no-go alternative, even when the no-go alternative appears not to be a feasible or reasonable option. The evaluation of this alternative must include a discussion on the resulting impacts, both locally and regionally, should no development occur. This forms the baseline study for comparison against the impacts resulting from the proposed activity and alternatives. Should the mining development not occur, the no-go option would mean no negative impact resulting from waste on the environment would occur. The no-go option would also result in none of the positive impacts such as the improved waste management practice since the locality is relatively very poor and the knowledge amongst local community members of the implementation of the National Waste Management Strategy (DEA, 2011) is limited.

ii. Impacts related to air quality

In order to contextualise the potential impacts of the proposed mining and processing project, the status quo (i.e. baseline) ambient air quality should be considered. This baseline can then be used to compare against the project specific impacts.

Cause and Comment

The pollutant of concern under the current land-use would be particulates that would result in elevated levels of dustfall, as well as elevated PM_{10} and $PM_{2.5}$ concentrations. The likely emissions sources would be wind erosion of areas where vegetation cover is limited and vehicle entrainment of particulates from the unpaved district and farm roads.

Significance Statement

Due to the dominance of coarse particles in the surface soils, windblown dust will probably impact dustfall rates within the study area only during high wind speed events. The temporal scale of the impact is permanent as a result of the climate of the area. Vehicle entrainment emissions are likely to be localised in the short term, as a result of the very low population density of the area and associated infrequency of vehicles travelling on the district road. The overall significance is LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	Study Area	Moderate	Probable	**LOW**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

iii. Impacts related to noise

There are currently no impacts related to this issue.

iv. Impacts related to radiation

Refer to Chapter 8, section 8.13

v. Impacts related to traffic and transport

District Road (DR) 2938

DR 2938 runs from the N7 highway at a point some 22km south of the town of Garies for a distance of about 63km to the coast at Groenriviermond. The road is used for access to the 21 farmsteads and other buildings along the road and also by recreational visitors to Groenriviermond in the Namaqua National Park. Vehicular traffic is mainly bakkies and cars, with the occasional medium-heavy or heavy delivery vehicle. Current volumes of traffic are very low, and pedestrian use is infrequent. The condition of the existing unpaved road, which is constructed from local gravel sources, is adequate for current levels of traffic.

N7 highway

The N7 is the main north-south road link between Cape Town and the Vioolsdrif border post into Namibia. Traffic data for two counting stations on the N7 for 2011 provides average daily traffic (ADT) of approximately 1 000 vehicles, approximately 25% of which is truck traffic. SANRAL considers these figures to be low compared to the national average for highways similar to the N7. Allowing for reasonable growth in traffic volumes since 2011 it is evident that the road is not trafficked at its design capacity.

Provincial roads

No measured traffic data could be found for the provincial roads between the N7 and the port at Saldanha. The roads are already trafficked by heavy goods vehicles, but it is evident that they are adequately sized to take heavy vehicles, and they appear to be in good condition.

Conclusion:

The roads in the vicinity of the mine and between the mine and the point of product export that will be used by mine traffic are adequately sized for their present utilisation, and there is no indication that current levels of traffic are resulting in negative impacts on their condition.

9.4.2 Impacts that may result from the construction phase

i. Impacts associated with waste

Issue 1: Management of non-process general and hazardous wastes

Impact 1.1: Pollution of land and water

Cause and Comment

Inappropriate storage of wastes, particularly those exhibiting harmful properties (i.e. hazardous wastes), can result in the contamination of land and water resources. As a result of rainfall events, leachate may be formed as water percolates through the solid waste, and this leachate may contain nutrients and a variety of toxic compounds, including metals. As such, it could result in the contamination of water and land. In extreme cases, release of large quantities of nutrients to a water body can result in eutrophication. The presence of certain toxic compounds in water as a result of pollution by wastes may have significant long-term negative impacts on the aquatic ecosystems and render the water unsuitable for certain applications including human consumption.

Mitigation and Management (General wastes)

- An Integrated Waste Management Plan must be developed for the mine;
- All wastes must be managed according to the requirements of South African legislation and, preferably, the requirements of the IFC General EHS Guidelines (2007);
- As far as practicable, the philosophy of the waste management hierarchy should be applied to the management of all waste streams in accordance with the Waste Classification and Management Regulations, Government Notice R634 of 2013;
- All general wastes that cannot be reused or recycled should be stored in a dedicated area and then transported regularly to the proposed landfill for disposal;
- The proposed general landfill site must be sited, designed and operated to international standards in order to isolate the wastes and prevent environmental contamination, particularly groundwater contamination (EHS Guidelines for Waste Management Facilities 2007 and EPA 2000) and must be licenced by the developer early in the construction phase. Until such time as this facility is fully operational, all general waste produced during the construction phase must be stored on site in a secure access control area, in a legally-compliant manner that minimises environmental impacts;
- It will be essential to implement a ground water monitoring system in the vicinity of the constructed landfill site in order to detect any changes to the quality of sub-surface water;
- All bins for temporary storage of waste that are located outdoors should be covered to prevent ingress of water and access by animals;
- A comprehensive Integrated Waste Management Plan should be developed for the site and it should include Key Performance Indicators (KPIs) against which the management of wastes can be audited;
- All employees, contractors and visitors to the site must be informed of correct waste management procedures, including separation of general and hazardous waste at source;
- Waste storage and disposal areas must be located at least 100m from surface water resources or important drainage lines.

Mitigation and Management (Hazardous wastes)

- The Integrated Waste Management Plan for the facility must cover the management of all hazardous waste types;
- Prior to safe disposal, all hazardous wastes must be temporarily stored at the hazardous waste storage facility. This facility should be designed to include secondary containment lined and covered to protect the contents from weather (sunlight and rain). If wastes are corrosive, the base of the storage facility should be lined with an acid-resistant coating;
- Where possible, empty containers for hazardous chemicals will be returned to suppliers. Where empty containers for hazardous chemicals (hydrocarbons, pesticides, laboratory chemicals, degreasing agents etc.) cannot be returned to the suppliers, they must be triple-rinsed, punctured and stored in a secure area until such time as they can be disposed of safely. Rinse water may not be discharged directly to the environment;
- Empty pesticide containers should be disposed of according to the Food and Agricultural Organisation's (FAO) Guidelines on Management Options for Empty Pesticide Containers (2008);
- As per the FOA (2008) guidelines, burning of empty pesticide containers should be strongly discouraged. Specific guidance on the management of empty pesticide containers is provided by the FAO (2008);
- A Hydrocarbon Management Operating Procedure should be designed and implemented. Copies of this document should be made available at designated facilities where hydrocarbons are used or stored. The purpose of this procedure is to provide for the proper storage and handling of hydrocarbons, including waste hydrocarbons, on site and hence prevent any form of contamination;
- It is recommended that soil contaminated with hydrocarbon should be immediately removed and disposed of at a soil bioremediation facility on site or else disposed of as hazardous waste;
- MSDS for all chemicals must be readily available on site and the precautions stipulated in these must be adhered to at all times. All staff must be trained on the correct management of bunded facilities, including the discharge of collected liquids;
- Spill kits must be readily available at strategic points throughout the site and staff must be trained on the correct use of these kits;
- No hazardous wastes should be disposed of into drains as this may impact negatively on the performance of the septic tanks;
- There are two potential disposal options for medical waste which must be managed according to the management procedure described in Annex 3 of the ICRC Medical Waste Management (2011) and the requirements of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 3rd ed. (DWAF, 2005a). The first would be to transport this material to the Joe Slovo clinic for safe disposal. The second would be to incinerate the material on site to render it harmless and then dispose of it at the on-site landfill.

Significance Statement (General wastes)

Impacts associated with the management of general (non-hazardous) solid waste may occur and the impacts are potentially long-term. The extent of the impacts (excluding potential impacts to water resources which are assumed to be covered in the sections above) are likely to be limited to the study area. Without mitigation the impacts will definitely occur and should probably be regarded as moderately severe. With the recommended mitigation the severity could be reduced to slight. The overall significance of the impact without mitigation would be MODERATE but with mitigation would be LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Study area	Moderately Severe	Probable	**MODERATE**
With Mitigation	Long term	Study area	Slight	May Occur	**LOW**

Significance Statement (Hazardous wastes)

Based on the most likely nature of non-process hazardous wastes, impacts may occur and, due to the potential for certain hazardous substances to accumulate in the environment, are potentially permanent. Due to potential transport of these substances into water, their impact may be of significance to the district. Without mitigation the impacts will definitely occur and would probably be regarded as very severe and of HIGH significance. However, with mitigation the severity could be reduced to moderate and the overall significance of the impact would be MODERATE.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Permanent	District	Very Severe	Definite	**HIGH**
With Mitigation	Permanent	District	Moderate	May Occur	**MODERATE**

Impact 1.2: Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)

Cause and comment

The uncontrolled storage of solid waste, in particular food waste, can attract vermin and pests including rodents, birds and flies. These vermin / pests may pose a nuisance to adjacent farms and communities and may act as vectors for disease. The uncontrolled storage of solid waste can result in the release of unpleasant odours which may be regarded as a nuisance to adjacent land-users, particularly that down-wind of the material. Odorous compounds are also released from relatively well-managed solid waste disposal facilities. The presence of large quantities of litter around the facility or at the proposed landfill may constitute a visual impact to employees and local communities.

Mitigation and Management

Refer to mitigation measures for Impact 1.1 (above).

Significance Statement

Nuisance impacts associated with the management of solid waste will probably occur and the impacts are potentially long-term but limited to the study area. Without mitigation the impacts should probably be regarded as moderately severe but with mitigation the severity could be reduced to slight. The overall significance of the impact without mitigation would be MODERATE but with mitigation would be LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	Probably	**MODERATE**
With Mitigation	Long Term	Study Area	Slight	Probably	**LOW**

Issue 2: Disposal of domestic wastewater, brine and sewage sludge

Impact 2.1: Pollution of soil and water

Cause and Comment

Domestic sewage is characterised by a high concentration of nutrients, high organic matter and a variety of pathogens. As such, it must be properly treated prior to discharge to the environment to avoid negative impacts to human health and the environment. If untreated sewage is discharged to the environment, the high nutrient concentration could lead to eutrophication of surface water resources and subsequent disruption of ecological function within the aquatic environment. The sewage sludge from sanitary treatment facilities would have to be removed periodically. The sewage sludge would have to be treated and disposed of as described in section 5.3.2 of the Waste Assessment. Sewage sludge also contains high concentrations of nutrients and may have a similar impact on water resources if not stored and disposed of in a manner that minimises the likelihood of migration of contaminants from the sludge to water resources. The brine and other liquid wastes from desalination plants will contain high salt concentrations and chemicals used during de-fouling of plant equipment and pre-treatment which may contaminate the environment when released. The management of the brine water from the desalination plant is described in section 5.3.2 of the Waste Assessment.

Mitigation and Management

- All domestic wash water and sewage from all sites must be diverted to the septic tanks or packaged sewage treatment plants for treatment and discharge from these facilities must meet the local and international discharge standards prior to its release into the process water pond;
- Sewage effluent from sanitary facilities should be manage as described in the Guidelines for the Utilization and Disposal of Wastewater Sludge (Vol.1 to 5) (DWAF, 2006) as well as the EHS Guidelines for Water and Sanitation (2007c);
- Sewage sludge management requires stabilization and drying of the sludge before either disposal at the proposed landfill or alternatively, applied as a soil conditioner during rehabilitation of the mine, provided that levels of toxic constituents are sufficiently low. If soil application is adopted, soil contamination should be avoided and the soil standard prescribed by the AfDB and DWAF (2006) should be adhered to;
- The pre-treatment of oil and grease containing effluents from canteens by the use of a grease trap prior to discharge into sewage treatment facilities;
- Chemical toilets should not be used during the construction period unless the contents can be disposed of in a manner that does not pose a threat to the environment. Instead, alternatives such as VIPs, composting toilets or similar should be considered as preferred alternatives;
- If VIPs are used, they must be lined, maintained and sited in a way that minimises the risk of contamination of surface and sub-surface water resources;

- All sewage treatment facilities should be well maintained. To this end, at least one employee on site must be trained to maintain the system(s);
- The performance of the sewage treatment systems must be monitored regularly. Where a system is found to be performing poorly, the cause of the poor performance must be investigated timeously and remediation measures put in place to restore performance;
- The environmental monitoring programme for the facility must incorporate monitoring points that are able to detect a negative impact on the environment associated with the discharge of treated sewage;
- The management of brine water from the desalination plant should be in accordance with IFC EHS Guidelines for Water and Sanitation (2007c).

Significance Statement

Environmental impacts associated with the disposal of sewage will definitely occur. As the proposed project will be operational for approximately 20 years, impacts associated with the release of untreated effluent and poor sludge management are potentially long-term and may affect the study area. Without mitigation the impacts on soil and water would probably be moderately severe and of MODERATE significance. However, with implementation of the recommended mitigation measures the severity of the impacts would be slight and of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	Definite	**MODERATE**
With Mitigation	Long term	Study Area	Slight	Unlikely	**LOW**

Impact 2.2: Health impacts to employees and communities

Cause and Comment

Sewage and sewage sludge is normally characterised by high concentrations of pathogenic microorganisms (viruses and bacteria) and helminths. Exposure to untreated effluent, either directly or through contaminated water resources, can result in the spread of numerous diseases including cholera.

Mitigation and Management

Refer to mitigation measures for Impact 2.1 above. In addition, the following mitigation measures are applicable:

- Any employees tasked with management of sewage and sanitation systems should be vaccinated against key diseases associated with these waste streams.

Significance Statement

Pathogenic microorganisms are commonly found in untreated sewage and release of these organisms to water bodies used for irrigation, drinking, recreation or fishing can result in the spread of disease such as cholera. The health impacts associated with the release of untreated sewage effluent and poor sludge management are potentially long-term and may affect the district. Without mitigation the associated health impacts would probably be severe and of HIGH significance. However, with implementation of the recommended mitigation measures the impacts would be of slight severity and of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	District	Severe	Probable	**MODERATE**
With Mitigation	Long Term	District	Slight	Unlikely	**LOW**

Impact 2.3: Nuisance impacts (odour and flies)

Cause and Comment

Raw sewage, sewage sludge and sewage treatment facilities are frequently associated with the release of unpleasant odours and may attract large numbers of insect pests such as flies. The persistent odours and presence of insect pests would most likely be regarded as a nuisance to employees and local community members. If sewage is managed correctly, the level of these nuisance factors can normally be reduced significantly.

Mitigation and Management

Refer to mitigation measures for Impact 2.1 above.

Significance Statement

The management of sewage will definitely be associated with odours and insect pests and, due to the influence of wind, the impact on any one receptor would probably be short-term. The treatment plant will, however be relatively small and so the impact is likely to be confined to the study area. There are also currently no communities in the immediate vicinity of the mine. Without mitigation the impacts would probably be Moderately Severe and of MODERATE significance. However, with implementation of the recommended mitigation measures the impacts would probably be of slight severity and of LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Moderately Severe	Probable	**MODERATE**
With Mitigation	Short Term	Localised	Slight	Unlikely	**LOW**

Issue 3: Disposal of run-off / storm water

Impact 3.1: Pollution of land and water

Cause and Comment

Run-off water is likely to be generated on site as a result of the rainfall, washing of machinery (including vehicles) and, possibly, dust suppression activities. As this water migrates across the site it has the potential to pick up various pollutants such as hydrocarbons and small solid particles. Furthermore, the run-off from machine washing activities is also likely to contain hydrocarbons. If this water is discharged without treatment, chemicals (hydrocarbons, pesticides etc.) and sediment could be transported into surface and sub-surface water bodies, resulting in ecological disruption.

Mitigation and Management

- The management of all run-off must comply, as a minimum, with the requirements of South African legislation but preferably with the requirements of the IFC's General EHS Guidelines (2007a);
- A Storm Water Management Plan must be developed for the mine and it should incorporate measures to divert clean storm water away from stockpiles, waste storage and disposal areas and other operation areas;
- Mitigation measures should be aimed at reducing contact between storm water and hazardous chemicals. This needs to be considered during the planning of the storm water drainage system for the mine facilities;
- In terms of minimising discharge of pollutants and run-off quantity requiring treatment, all storm water run-off must be properly segregating and clean water run-off diverted to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release;
- All run-off from machine wash areas must pass through an oil trap and should be treated as hazardous due to the presence of hydrocarbon. All other run-off water must pass through a sediment trap to remove the majority of suspended solids prior to discharge to the environment. All settled material must be disposed of at the landfill; and
- The quality of all liquid waste streams discharged from the site, including storm water, must be monitored regularly to ensure compliance with the requirements of relevant legislation and standards.

Significance Statement

Impacts associated with the disposal of run-off may occur and the impacts are possibly Long-term and, considering the relatively dry climate, impacts may be of significance to the study area. Without mitigation the impacts should be regarded as moderately severe but with mitigation the severity could be reduced to slight. The overall significance of the impact without mitigation would be MODERATE but with mitigation would be LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	May Occur	**MODERATE**
With Mitigation	Long Term	Study Area	Slight	Unlikely	**LOW**

Issue 4: Management and disposal of obsolete equipment, scrap and tyres

The proposed mining development is likely to result in the generation of significant quantities of scrap over its life, including obsolete equipment and waste tyres. While much of this may simply be bulky, some may be associated with potentially hazardous materials and must therefore be managed appropriately in order to minimise threats to human and environmental health.

Obsolete equipment, including mechanical components from the processing plant or vehicles, may be stored on site until such time as they can be reused or disposed of. This scrap may contain lubricants (including hydrocarbon-based lubricants), hydraulic fluid(s) or other potentially hazardous substances that if released to the environment could lead to negative impacts.

In addition, certain scrap types may be contaminated with radionuclide-containing ore / product (Naturally-Occurring Radioactive Materials (NORM)). Used vehicles tyres together with components from the processing plants such as metal sheets, rubber-lined parts of the process and fibreglass trays, are particularly prone to this type of contamination. As such, radiation levels should be checked and, if necessary, scrap items should be washed and then assessed to ensure that the level of surface radiation complies with international clearance standards of the International Atomic Energy Agency (IAEA) or the Commission of European Communities prior to recycling or disposal. These clearance standards refer to levels whereby wastes may be released to the public or, where the materials remain slightly contaminated, they may be recycled usually via smelting. Further details regarding the clearance limits are provided in the Selby (2013). The disposal of those items that cannot be cleaned to acceptable standards would be managed by an officially authorised entity, whether government or private. As the resulting wash water may contain radioactive suspended particulates, it should be treated (settled) prior to release to the environment. Inappropriate management of contaminated scrap items can result in significant impacts to human health and the environment. The impacts related to the management of scrap items with elevated levels of radiation are discussed below and so will not be covered here.

Impact 4.1: Pollution of soil and water

Cause and Comment

The proposed development is likely to result in the generation of scrap over its life, including obsolete equipment and waste tyres. While much of this may simply be bulky, some may be associated with potentially hazardous materials, such as hydrocarbons, and must therefore be managed appropriately in order to minimise threats to human and environmental health.

Mitigation and Management

- The Integrated Waste Management Plan or waste management procedure for the facility should address the management of scrap and obsolete equipment, including tyres;
- All scrap or obsolete equipment that may potentially be contaminated with elevated levels of radionuclides (NORM) should be managed and disposed of according to international best practice;
- All scrap must be stored in designated areas, preferably a safe distance from any surface water features;
- As far as possible, storm water must be diverted around the scrap storage areas;
- Good house-keeping must be employed at the scrap storage area at all times;

- Unauthorised individuals must be prevented from removing scrap from the site and the scrap area should be secured;
- Where scrap is likely to contain hazardous liquids, including lubricants or hydraulic fluids, these items must be stored in such a way as to minimise pollution of soil and water;
- The scrap storage area must be inspected regularly for signs of soil pollution and where this is detected, remediation measures must be implemented immediately;
- Where scrap items are likely to release hydrocarbons or other hazardous chemicals, they must be stored on an impermeable surface to minimise the risk of contamination of soil and water;
- Where ever possible, all scrap metals including waste tyres that have been cleared of contaminants including NORM should be returned to the suppliers or certified recycling companies for recycling;
- All scrap, including waste tyres, must be stored in such a way so as to minimise the formation of stagnant water that will facilitate breeding of mosquitoes;

Significance Statement

There will probably be exposure of the environment to hydrocarbon contamination associated with the disposal of hydrocarbon contaminated equipment and structural materials and the impacts are potentially Long-term and may be of significance to the study area. Without mitigation the impacts should possibly be regarded as moderately severe and of MODERATE significance. However, with mitigation the severity could be reduced to slight and the significance to LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Moderately Severe	Probable	**MODERATE**
With Mitigation	Long Term	Study Area	Slight	Unlikely	**LOW**

ii. Impacts related to air quality

Cause and Comment

Disturbance of the surface soils during the construction of the mine and processing plant is likely to result in particulate emissions from the following sources: materials handling, cleared areas awaiting infrastructure construction, and vehicle movement. Gaseous emissions are likely from the exhaust emissions. The spatial impact of the construction phase is likely to be within the study area. These impacts are expected to be restricted to the short-term.

Mitigation and Management

Dust control measures which may be implemented during the construction phase are outlined below. Control techniques for fugitive dust sources generally involve watering, chemical stabilization, and the reduction of surface wind speed though the use of windbreaks and source enclosures.

- *Debris handling*: Wet suppression (hourly watering recommended)
- *Truck transport and road dust entrainment*:

- Wet suppression (hourly watering recommended) or chemical stabilization of unpaved roads;
- Haul trucks to be restricted to specified haul roads using the most direct route; Reduction in traffic if possible; and
- Strict on site speed control (i.e. 40 km/hr for haul trucks).

- *Materials storage, handling and transfer operations*: Wet suppression where feasible, possibly using continuous sprays.
- *Earthmoving operations*: Wet suppression (hourly watering recommended) where feasible.
- *Open areas (wind-blown emissions)*:
  - Reduction of extent of open areas in order to minimise the time between clearing and infrastructure construction, and/or use wind breaks and water suppression to reduce emissions from open areas;
  - Restriction of disturbance to periods of low wind speeds (less than 5m/s);
  - Stabilisation (chemical, rock cladding or vegetation) of disturbed soil; and
  - Re-vegetation of cleared areas as soon as practically feasible.

Significance Statement

The short duration of the construction activities will probably result in a LOW negative impact on the concentration of particulate, SO_2 and NO_X within the study area.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	Probable	**LOW**
With Mitigation	Short Term	Study Area	Moderate	Probable	**LOW**

iii. Impacts related to noise

Impacts 1: Impact of the vehicle noise on the residents along the transport routes during construction

Cause and Comment

Noise impacts during the construction phase, would result mainly from the use of large construction vehicle on the existing road network, which may impact on residences in close proximity to existing roads.

Mitigation and Management

- All trucks must adhere to designated speed limits.

Significance Statement

The short duration of the construction activities will probably result in a LOW negative impact in regards to noise during the construction phase of the project.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Local	Moderate	Probable	**MODERATE**
With Mitigation	Short Term	Local	Slight	Probable	**LOW**

iv. Impacts related to radiation

Refer to Chapter 8, section 8.13

v. Impacts related to traffic and transport

Issue 1: Increased volume of construction traffic on DR2938

Population density in the predominantly rural Kamiesberg LM area is about one person per square kilometre, and is similarly low in the project area. Mining activities will directly affect 11 landowners on seven farms, each farm typically comprising the home / homes to the resident land owners and one or two families of resident farm workers. The DR2398 is used for access by the 21 farmsteads and other buildings along the road, five of which are less than 50m from the road. The road is also used by recreational visitors to Groenriviermond. Vehicular traffic is mainly bakkies and cars, with the occasional medium-heavy or heavy delivery vehicle. Current volumes of traffic are very low, and pedestrian use is infrequent. The condition of the existing unpaved road is adequate for current levels of traffic.

Anticipated impacts relate to:

- Increased likelihood of vehicle collisions resulting in personal injuries.
- Increased generation of traffic-related dust.

The impacts are closely related, since fugitive dust from vehicle wheels decreases visibility and increases the likelihood of collisions on a heavily trafficked road.

Impact 1.1: Increased risk of vehicle collisions and personal injuries

Cause and Comment

The addition of an estimated 28 trips per day by heavy and medium goods vehicles during the peak of construction activity, and an estimated 20 light vehicle trips per day to the existing low levels of local traffic has the potential to increase the incidence of vehicle-to-vehicle and vehicle-to-pedestrian collisions, with the possibility of personal injuries, if appropriate mitigations measures are not implemented.

Mitigation and Management

- The road must be upgraded to ensure that it is wide enough to allow two heavy vehicles to pass safely. The carriageway may need to be widened in places, and realigned at sharp bends (particularly where the road crosses the Groenrivier). Construction work on the road upgrade must be done in such a way as to minimise disruption to local traffic.
- A speed limit appropriate to the design and construction factors and characteristics of the road (such as width, horizontal and vertical alignment, grade, sightlines and

surfacing material) must be specified for all construction vehicles, and strictly enforced. Signage must be erected at frequent intervals along the road.

- Warning signage must be erected at all intersections, including at the intersections with farm access roads.
- Heavy vehicles should not travel the road between 10pm and 6am unless it is absolutely unavoidable. Vehicle trips of any kind between 10pm and 6am should be minimised, concomitant with operational requirements.
- Deliveries by heavy vehicles must, as far as possible, be scheduled to avoid the formation of convoys. Sufficient distance must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- A Construction Traffic Management Plan must be developed and implemented.
- The Construction Emergency Preparedness and Response Plan must include provisions to deal with traffic accidents, particularly accidents involving personal injuries, and all drivers must be made aware of the procedures to be followed.
- Communication with the local community and individuals must provide regular information on the volumes of traffic particularly heavy vehicles, anticipated on the road during the construction period.

Significance Statement

This impact is considered to be of HIGH negative significance but can be reduced to moderately negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	Probable	**HIGH**
With Mitigation	Short Term	Study Area	Severe	May Occur	**MODERATE**

Impact 1.2: Increased dust generation

Cause and Comment

The generation of fugitive dust from vehicle wheels depends, among other things, on the speed of the vehicle and the nature of the road surface. The extent to which dust is distributed beyond the road corridor depends on wind speed.

Construction traffic will generate considerable volumes of dust, particularly from multi-axle heavy vehicles, which will reduce visibility and increase the risk of vehicle collisions, and will also create a nuisance for the several residences that are situated close to the road.

Mitigation and Management

- The upgrade of the road must include measures to reduce the generation of fugitive dust, preferably by means of a bituminous / aggregate sealing / wearing course, but otherwise by regular and frequent application of dust suppressant, including water if it is available in sufficient quantities.

Significance Statement

This impact is considered to be of MODERATE negative significance but can be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Severe	Definite	MODERATE
With Mitigation	Short Term	Study Area	Slight	May Occur	LOW

Issue 2: Increased construction traffic on the N7 highway

Impact 2.1: Disruption of traffic flows on the N7

Cause and Comment

The N7 highway is designed for larger volumes of traffic than were recorded by the traffic counts undertaken by SANRAL in 2011, when traffic volumes were noted as being low in comparison to similar highways.

Estimates of the volumes of heavy vehicles indicate that 24 trips a day by construction traffic will increase the average daily truck traffic (ADTT) measured in 2011 by approximately 10%. Total volumes of all types of construction traffic on the N7 may increase total average daily traffic (ADT) volumes measured in 2011 by about 5%. It is unlikely that construction traffic will significantly prejudice the free-flow traffic capacity of the N7.

The South African National Roads Agency will require the N7 / DR2938 to be upgraded to accommodate the anticipated volumes of heavy vehicles turning onto and from the N7, which may include the construction of an auxiliary acceleration lane on the N7 south of the intersection, and alterations to the DR2938 bellmouth entrance from the south.

Mitigation and Management

The impacts of construction traffic on the N7 should be managed by:

- Upgrade the N7 at its intersection with DR2938 as required by SANRAL, which may include the construction of an auxiliary acceleration lane south from the intersection, and upgrading the DR2938 bellmouth entrance.
- Schedule heavy vehicle deliveries and vehicle returns to avoid, as far as possible, morning and evening periods in urban areas (where the N7 passes through Piketburg) and stretches of the N7 known to carry large volumes of morning and evening traffic.
- Extreme care must be exercised when travelling through urban areas, especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- Avoid the formation of convoys.
- Maintain sufficient distances between heavy vehicles to allow light vehicles to overtake safely.
- Develop and implement an Emergency Preparedness and Response Plan to deal with accidents and incidents en route.

Significance Statement

This impact is considered to be of LOW negative significance and will remain LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Regional	Slight	May occur	LOW
With Mitigation	Short Term	Regional	Slight	Unlikely	LOW

Issue 3: Increased construction traffic on provincial roads

Impact 3.1: Disruption of traffic flows on provincial roads

Cause and Comment

It is possible that some materials and equipment will be delivered by road from the port at Saldanha Bay. The urban areas through which vehicles will travel en route (will carry commuter traffic during morning and evening periods. The roads are already trafficked by heavy vehicles, but additional heavy goods vehicles will result in some impacts on existing traffic flows.

Mitigation and Management

- Heavy vehicle deliveries and vehicle returns should be scheduled to avoid, as far as possible, morning and evening periods in urban areas (Moorreesburg, Hopefield) and stretches of the provincial roads that carry significant volumes of morning and evening traffic.
- Extreme care must be exercised when travelling through urban areas, especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- The formation of convoys must be avoided.
- Sufficient distances must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- An Emergency Preparedness and Response Plan must be in place to deal with incidents en route.

Significance Statement

This impact is considered to be of MODERATE negative significance and will be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Regional	Moderate	May occur	MODERATE
With Mitigation	Short Term	Regional	Slight	May occur	LOW

Issue 4: Abnormal loads

Impact 4.1: Disruption of traffic flows on the N7 and provincial roads

Cause and Comment

It is probable that some items of off-site fabricated equipment such as transformers and storage tanks will be sufficiently large to require delivery vehicles that exceed the limits specified in the National Road Traffic Regulations, 1999, and will constitute abnormal loads. The traffic authorities usually require guard vehicles to precede and follow such vehicles to warn other motorists of their approach, and often specify times when large, slow-moving vehicles should travel.

Mitigation and Management

- Arrangements must be made with the provincial traffic authorities – Western Cape and Northern Cape - for abnormal loads, and their requirements strictly adhered to.
- Speed limits must be strictly observed.
- As far as possible deliveries of abnormal loads should be scheduled to avoid periods when significant volumes of construction traffic are making deliveries to site.

Significance Statement

This impact is considered to be of MODERATE negative significance and will be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Very Short Term	Regional	Moderate	May occur	**MODERATE**
With Mitigation	Very Short Term	Regional	Low	May occur	**LOW**

9.4.3 Impacts that may result from the operational phase

i. Impacts associated with waste

Issue 1: Disposal of tailings (Operational phase)

Tailings are expected to be generated throughout the 20 years mining operation. This will lead to two possible process waste impacts:

(i) Impacts associated with the Destabilisation of the TSF; and
(ii) Impacts associated with exposure to radionuclides in tailings.

According to Selby (2013), preliminary results show that the radionuclide contents of the HMC are on the high side at ~8 Bq/gm, when compared with other southern African deposits. The impacts associated with the possible exposure to radionuclides are discussed in the sections below and thus only the impact associated with the destabilisation of the TSF is discussed here.

Impact 1.1: Health and safety of employees and local communities

Cause and Comment

A TSF management plan has been developed for the Kamiesberg Project and should conform to the requirements of the IFC's EHS Guidelines for Mining (IFC, 2007b). The TSF will be built by an independent recognised expert in tailings dam design and will be managed according to international best practice. However, several farms are within the footprint of the project site and in the highly unlikely event of a TSF failure, unstable tailings material could pose a risk to these farms as well as mine employees. But these risks would normally be managed along with other routine occupational health and safety risks

Mitigation and Management

- The management of the TSF will conform to the requirements of the IFC's EHS Guidelines for Mining (IFC, 2007);
- As far as practical, the TSF must be sited in a location such that in the event of failure, pollution of soil and water as well as physical risk to farms, including communities is minimised;
- The integrity of the TSF must be inspected regularly by suitably qualified personnel throughout the life of the mine;
- Access to the TSF should be restricted as far as practical and all local communities including farms should be informed of the potential risks associated with these facilities through site notices and community meetings.

Significance Statement

A long term impact may occur within the study area and due to the potential for harm to individuals, including possible fatalities the severity of the impact is regarded as high. Without mitigation, significance will be HIGH and with mitigation, this could be reduced to LOW significance.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Localized	Severe	May Occur	**MODERATE**
With Mitigation	Short Term	Localized	Slight	Unlikely	**LOW**

Issue 2: Storage of effluent in the process water pond

The process water pond (decant system) containing the process water effluent will serve as the collection point for the decant water from the TSF. It is anticipated that the re-circulated water in the process water pond will contain at least low concentrations potentially harmful substances such as radionuclides. Over time, the re-circulation and evaporation may result in an increase in the concentration of potentially harmful substances. The presence of a large pond containing process water containing potentially harmful substances could pose a threat to environmental contamination, particularly if the pond was to overflow after a period of heavy rainfall.

Impact 2.1: Pollution of soil and water resources

Cause and Comment

In the event that the pond overflows or is otherwise compromised, the accidental release of stored process water and associated sediment, could lead to pollution of water resources and soil and an increase in the turbidity of nearby water bodies. The potential consequences of increased turbidity include reduced light penetration and growth of aquatic plants. This could have subsequent, long-term negative impacts on local ecosystems and human health.

Mitigation and Management

- The process water storage pond will be fenced off with appropriate signage to limit unauthorised access;
- Flotation devices will be readily available around the facility;
- The Health & Safety induction training should incorporate these risks;
- The integrity of the TSF must be inspected regularly by an independent and suitably qualified and experienced engineer;
- The operation of the facility must ensure sufficient freeboard to ensure that the pond does not overflow;
- The quality of the stored process water should be monitored so that in the event of accidental discharge, the contaminants released into the environment are known.
- Warning notices should be placed around such facilities.

Significance Statement

The impact of the pond water released into the ecosystem without mitigation was considered to be very severe with a MODERATE significance and with mitigation it was considered to be LOW with a slight severity.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Localized	Very Severe	Unlikely	**MODERATE**
With Mitigation	Short Term	Localized	Slight	Unlikely	**LOW**

Impact 2.2: Risk to Health and Safety of Employees

Cause and Comment

Water from the TSF will be captured in a pond prior to blending with the input process water to the plant. The presence of a large pond containing process water which contains potentially harmful substances such as radionuclides will pose a threat to the health and safety of employees. Access to the pond by individuals who are not able to swim may result in drowning.

Mitigation and Management

Refer to mitigation measures for Impact 2.1 above.

Significance Statement

It is possible that without mitigation, an employee could fall into the TSF/pond and drown. As such, the impact to human health and safety without mitigation was considered to be very severe with a MODERATE significance. The likelihood of the impact occurring could be reduced through implementation of mitigation measures. With mitigation, the overall significance of the impact is expected to be LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium Term	Localized	Very Severe	Unlikely	**MODERATE**
With Mitigation	Medium Term	Localized	Slight	Unlikely	**LOW**

Issue 3: Management of non-process general and hazardous wastes

Impact 3.1: Pollution of land and water

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 1.1).

Impact 3.2: Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 1.2).

Issue 4: Disposal of domestic wastewater, brine and sewage sludge (Construction, Operation and Decommissioning)

Impact 4.1: Pollution of soil and water

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.1).

Impact 4.2: Health impacts to employees and communities

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.2).

Impact 4.3: Nuisance impacts (odour and flies)

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.3).

Issue 5: Disposal of run-off / storm water

Impact 5.1: Pollution of land and water

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 3.1).

Issue 6: Management and disposal of obsolete equipment, scrap and tyres

Impact 6.1: Pollution of soil and water

This impact is considered to be the same for the operational phase as listed above for the construction phase (Section 9.4.2, no. i, impact 4.1).

ii. Impacts related to air quality

The operational phase of the mining and processing of mineral sands at the Zirco Kamiesberg Project is likely to affect two issues regarding ambient air quality. These two issues are detailed below.

Impact 1: Impact on particulates

Cause and Comment

Unmitigated mining operations and road haulage of the product was shown, during the atmospheric modelling study, to result in elevated particulate emissions, resulting in a negative effect on ambient air quality and potentially non-compliance with the National Dustfall Control Regulations.

Mitigation and Management

- *Wind erosion from exposed areas and TSF*:
  - Reshape all disturbed areas to their natural contours;
  - Cover disturbed areas with previously collected topsoil and replant native species; and
  - Progressive vegetation of side walls of the tailings facility to ensure 80% cover up to 1 m from the top. Proper vegetation cover would result in a control efficiency of approximately 60%.
- *Materials handling operations:* Drop height from excavator into haul trucks to be kept at a minimum for mineral sands.
- *Vehicle activity on unpaved haul roads:*
  - Regular water sprays preferably combined with chemicals on unpaved haul roads to ensure 75% control efficiency (estimated watering rates required provided in air quality assessment); and
  - Speed limit on internal unpaved roads not to exceed 40 km/hr.
- *Vehicle tailpipe emissions:*
  - Minimisation of gaseous emissions by preventative controls including minimisation of vehicle idling times; and
  - Regular maintenance and servicing of vehicles according to manufacturer's guidance.
- *Source monitoring:*
  - Regular monitoring of the emissions from the dryer stacks is likely to be stipulated in the conditions of the Atmospheric Emissions License to ensure compliance with the emissions standards; and
  - Regular servicing and maintenance of the dust abatement units, i.e. cyclones and baghouse.
- *Ambient Monitoring:*
  - Establish and maintain a dustfall monitoring network;
  - Dust fallout rates to be below 1 200 mg/m2/day at the property boundary and below 600 mg/m2/day at residences surrounding the mining operations, averaged over 30 days; and

- Establish and maintain a continuous PM10 monitor, possibly at the current meteorological stations.

Significance Statement

The simulated impact of unmitigated mining operations and road haulage of product will probably impact the dustfall rates across the study area very severely during the life-time of the mine (long-term). With mitigation, the impacts will be similar in temporal and spatial scales but the severity is likely to be severe. The overall significance of the impact is MODERATE.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Very Severe	Probable	**MODERATE**
With Mitigation	Long Term	Study Area	Severe	Probable	**MODERATE**

Impact 2: Impact on gaseous pollutants

Cause and Comment

The gaseous pollutants emitted from the dryers in the Mineral Separation Plant are regulated as Listed Activities Subcategory 4.1. The pollutants of concern, and regulated under the Listed Activities, are SO_2, NO_X (as NO_2). For a conservative estimate it was assumed that emissions from the dryer units would be close to the Minimum Emission Standards permitted for Subcategory 4.1 activities.

Mitigation and Management

Mitigation measures are the same as those discussed for Impact 1 above.

Significance Statement

The simulated impact of combustion of paraffin in the dryer units of the Mineral Separation Plant may result in slightly elevated SO_2 and NO_X concentrations locally during the life-time of the mine (long-term). The overall significance of the impact is LOW.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Slight	May Occur	**LOW**
With Mitigation	Long Term	Localised	Slight	May Occur	**LOW**

iii. ***Impacts related to noise***

Impact 1: Impact of the vehicle noise the residents along the transport routes (DR 2938)

Cause and Comment

There is no current traffic count for the DR2938. An assumption was made of approximately

2 vehicles per hour using the road. The predicted noise levels are shown in the table below.

Parameter	Predicted Current	Predicted Future Day (trucks and other vehicles)	Predicted Future Day (No trucks - other vehicles only
Traffic speed (km/h)	60	80	80
Heavy vehicles per hour	0	9	0
Total light vehicles per hour	2	29	29
Predicted Noise level (dBA)	41.3	58.1	53.5

The predicted current noise corresponds to the actual noise measured during the field study. There will thus be a 16.8 dB(A) increase in the noise levels along the DR2938. The noise at the resident's houses will be less than this depending on the distance from the road.

According to the categories of environmental community / group response in SANS 10103:2008 there could be widespread complaints accompanied with community action. This could be alleviated if the operational hours of the trucks are only during the daytime and not at night. A mitigating factor is that most of the night time traffic will be at the shift change times only.

Mitigation and Management

- As far as possible traffic along the DR2938 should be limited to daylight operations only;
- Noise training should be provided to all staff members;
- Speed restrictions must be adhered to; and
- Prohibit use of exhaust brakes.

Significance Statement

This impact is considered to be of HIGH negative significance and will be reduced to MODERATE negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	High	Probable	**HIGH**
With Mitigation	Long Term	Localised	Moderate	Probable	**MODERATE**

Impact 2: Impact of the vehicle noise on the residents along the transport routes (N7)

Cause and Comment

The expected increase in traffic noise is presented in the table below. SANS 10210:2004 (Equations 1 and 2 in the standard) was used to calculate the Basic Noise Level which was corrected for vehicle speed (100km/h) and percentage of heavy vehicles (current 23% and predicted 32%). The results are presented in the table below.

Parameter	Predicted Current	Predicted Future
Traffic speed (km/h)	100	100
Heavy vehicles per hour	10	19
Total light vehicles per hour	33	33
Predicted Noise level (dBA)	60.0	61.9

There will be a slight increase of 1.9 dB(A) in the noise levels along the N7. According to the categories of environmental community / group response in SANS 10103:2008, there could be little community reaction as the increase is 1.9dB(A).

Mitigation and Management

- Speed restrictions must be adhered to.

Significance Statement

This impact is considered to be of LOW negative significance with and without mitigation measures in place.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Slight	Probable	**LOW**
With Mitigation	Long Term	Localised	Slight	Probable	**LOW**

Impact 3: Impact of the process plants on the noise sensitive receptors

Cause and Comment

The likely extent of the operational noise pollution was modelled according to the Concawe method (with the lowest frequency used being 63 Hertz). Low frequency noise below 20 Hertz, potentially generated by on site machinery, is therefore not considered as part of this modelling; however it should not be overlooked. The effects of low frequency noise include sleep disturbance, nausea, vertigo etc. These effects are unlikely to impact upon residents due to the distance between the MSP plant and the nearest communities. Sources of low frequency noise also include wind and vehicular traffic, which are all sources that are closer to the residential areas.

Mitigation and Management

No suggested mitigation measures.

Significance Statement

This impact is considered to be of LOW negative significance with and without mitigation measures in place.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Localised	Slight	Probable	**LOW**
With Mitigation	Long Term	Localised	Slight	Probable	**LOW**

iv. Impacts related to radiation

Refer to Chapter 8, section 8.13

v. Impacts related to traffic and transport

Issue 1: Increased operational traffic on DR2938

Impact 1.1: Increased risk of vehicle collisions and personal injuries

Cause and Comment

The addition of an estimated 94 trips per day by heavy goods vehicles (product and fuels / lubricants), and up to 50 light vehicle and bus trips per day, to the existing low levels of local traffic has the potential to significantly increase the incidence of vehicle-to-vehicle and vehicle-to-pedestrian collisions, with the strong possibility of personal injuries, if appropriate mitigations measures are not implemented.

Mitigation and Management

- The road must be upgraded to ensure that it is wide enough to allow two heavy vehicles to pass safely. The carriageway may need to be widened in places, and realigned at sharp bends. Construction work on the road upgrade must be done in such a way as to minimise disruption to local traffic.
- A speed limit appropriate to the design and construction factors and characteristics of the road (such as width, horizontal and vertical alignment, grade, sightlines and surfacing material) must be specified for all construction vehicles, and strictly enforced. Signage must be erected at frequent intervals along the road.
- Warning signage must be erected at all intersections, including at the intersections with farm access roads.
- Operational trips must be minimised during the hours of darkness. Trips by heavy vehicles must, as far as possible, be avoided during the hours of darkness.
- Deliveries by heavy vehicles must, as far as possible, be scheduled to avoid the formation of convoys. Sufficient distance must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- An Operational Construction Traffic Management Plan must be developed and implemented.
- The Operational Emergency Preparedness and Response Plan must include provisions to deal with traffic accidents, and particularly accidents involving personal injuries, and all drivers must be made aware of the procedures to be followed.
- Communication with the local community and individuals must provide regular information on the volumes of traffic particularly heavy vehicles, anticipated on the road during the operation of the mine.

Significance Statement

This impact is considered to be of VERY HIGH negative significance and will be reduced to MODERATE negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Very Severe	Probable	**VERY HIGH**
With Mitigation	Long Term	Study Area	Severe	May Occur	**MODERATE**

Impact 1.2: Increased dust generation

Cause and Comment

The generation of fugitive dust from vehicle wheels depends, among other things, on the speed of the vehicle and the nature of the road surface. The extent to which dust is distributed beyond the road corridor depends on wind speed.

Operational traffic will generate considerable volumes of dust, particularly from multi-axle heavy vehicles, which will reduce visibility and increase the risk of vehicle collisions, and will also create a nuisance for the several residences that are situated close to the road.

Mitigation and Management

- The upgrade of the road must include measures to reduce the generation of fugitive dust, preferably by means of a bituminous / aggregate sealing / wearing course, but otherwise by regular and frequent application of dust suppressant, including water if it is available in sufficient quantities.

Significance Statement

This impact is considered to be of HIGH negative significance and will be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Study Area	Very Severe	Definite	**HIGH**
With Mitigation	Long-term	Study Area	Moderate	May Occur	**LOW**

Issue 2: Increased operational traffic on the N7 highway

Impact 2.1: Disruption of traffic flows on the N7

Cause and Comment

The N7 highway is designed for larger volumes of traffic than were recorded by SANRAL's 2011 traffic counts undertaken by SANRAL in 2011, when traffic volumes were noted as being low in comparison to similar highways.

Heavy vehicles carrying product will operate on the stretch of the N7 between Garies and Moorreesburg, a distance of about 325km.

Estimates of the volumes of heavy vehicles indicate that the addition of an estimated 94 heavy vehicles will increase the average daily truck traffic (ADTT) measured in 2011 by approximately 40%. Total volumes of all types of construction traffic on the N7 may increase average daily traffic (ADT) volumes measured in 2011 by approximately 10%. It is unlikely that construction traffic will significantly prejudice the free-flow traffic capacity of the N7.

Mitigation and Management

- Upgrade the N7 at its intersection with DR2938 as required by SANRAL, which may include the construction of an auxiliary acceleration lane south from the intersection, and upgrading the DR2938 bellmouth entrance.
- Extreme care must be exercised when travelling through the urban areas of Piketburg, especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- Avoid the formation of convoys.
- Maintain sufficient distances between heavy vehicles to allow light vehicles to overtake safely.
- Develop and implement an Emergency Preparedness and Response Plan to deal with incidents en route.

Significance Statement

This impact is considered to be of MODERATE negative significance and will be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Moderate	Probable	**MODERATE**
With Mitigation	Long Term	Regional	Slight	Unlikely	**LOW**

Issue 3: Increased operational traffic on provincial roads

Impact 3.1: Disruption of traffic flows on provincial roads

Cause and Comment

Product will be delivered from the N7 to the port at Saldanha Bay via provincial roads that pass through the urban areas of Moorreesburg and Hopefield en route to the ore terminal at the port of Saldanha. These areas will generate commuter traffic, both in town and from outlying areas, during morning and evening periods. The roads are already trafficked by heavy vehicles, but the addition of a significant number of additional heavy goods vehicles has the potential to result in significant impacts on existing traffic flows, residents and pedestrians if not properly managed.

Mitigation and Management

- Extreme care must be exercised when travelling through the urban areas of Moorreesburg and Hopefield, especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- The formation of convoys must be avoided.
- Sufficient distances must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- An Emergency Preparedness and Response Plan must be in place to deal with incidents en route.

Significance Statement

This impact is considered to be of MODERATE negative significance and will be reduced to LOW negative with mitigation measures employed.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long Term	Regional	Moderate	Probable	**MODERATE**
With Mitigation	Long Term	Regional	Slight	Unlikely	**LOW**

9.4.4 Impacts that may result from the decommissioning phase

i. Impacts associated with waste

Issue 1: Management of non-process general and hazardous wastes

Impact 1.1: Pollution of land and water

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 1.1).

Impact 1.2: Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 1.2).

Issue 2: Disposal of domestic wastewater, brine and sewage sludge (Construction, Operation and Decommissioning)

Impact 2.1: Pollution of soil and water

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.1).

Impact 2.2: Health impacts to employees and communities

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.2).

Impact 2.3: Nuisance impacts (odour and flies)

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 2.3).

Issue 3: Disposal of run-off / storm water

Impact 3.1: Pollution of land and water

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 3.1).

Issue 4: Management and disposal of obsolete equipment, scrap and tyres

Impact 4.1: Pollution of soil and water

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. i, impact 4.1).

ii. Impacts related to air quality

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. ii).

iii. Impacts related to noise

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. iii).

iv. Impacts related to radiation

Refer to Chapter 8, section 8.13

v. Impacts related to traffic and transport

This impact is considered to be the same for the decommissioning phase as listed above for the construction phase (Section 9.4.2, no. v).

9.5 CUMULATIVE IMPACTS

9.5.1 Cumulative impacts related to the biophysical environment

i. Impacts on surface and groundwater resources

As far as can be determined there are no other existing, planned or reasonably defined developments that might result in cumulative impacts, that are recognised as important on the basis of scientific concerns or concerns of affected communities, on the on surface and groundwater resources.

ii. Impacts on the marine environment

It is likely that there are some cumulative impacts on the marine environment associated with this project as this is not the only mining project situated on the Namaqualand coast (to the knowledge of the marine specialist there are at least four other seawater intakes for mines in the general area and a further 4 seawater intakes for mariculture operations). However, given that these are spread out over approximately 600 km of coast these impacts can almost certainly be considered as negligible.

iii. Impacts on flora

Mineral sand mining is a relatively recent undertaking on the West Coast, at least in comparison to the long history of diamond mining in the area. The only current operations are at Brand se Baai (Namakwa Sands), where the operator Tronox has just applied for a 5000ha extension to the mining area, which is already about 10 000ha in extent, although the actual footprint is about 4,800ha. Tormin has been granted mining rights on the coastal section west of the Eskom wind farm at Koekenaap, but this will have little effect on terrestrial vegetation. Goliath Gold has prospecting rights on a 30 000ha area between Brand se Baai and the Olifants River, and Exxaro has prospecting rights on properties in the Groen River area totalling about 10 000ha. Should all these areas (at least 55 000ha) be authorised for mineral sand mining it could mean the loss or degradation of about 50% of this area (25 000ha), which is the likely footprint of currently natural or largely natural habitat that will be affected, assuming that not all the prospecting areas will be mined in their entirety. To this needs to be added the proposed mining area for the current Zirco application (about 3800ha), taking the total close to 30 000ha. This cumulative impact is regarded as significant.

iv. Impacts on fauna

During the construction and operational phase of the project there will be an initial loss of faunal biodiversity and suitable habitat. With the rehabilitation program and over time this will improve and faunal numbers will increase to original capacity. No long-term cumulative faunal impacts could be identify, except for habitat transformation which will be rehabilitated to near original state. Conservation planning and creation of faunal corridors needs to be incorporated into other mining development plans, to lower the cumulative impacts on fauna.

9.5.2 Cumulative impacts related to the socio-economic environment

The KLM consists of four wards. The towns of these wards are considered to be the proposed mine's labour-sending communities (i.e. where most of its labour might be sourced from). These towns include:

Ward 1: Koiingnaas, Hondeklipbaai, Soebatsfontein and Spoegrivier
Ward 2: Garies, Lepelfontein, Klipfontein and Kheis
Ward 3: Kamieskroon, Kharkams and Tweerivier
Ward 4: Kamassies, Rooifontein, Nourivier, Leliefontein and Paulshoek

In addition to these towns, two towns on the northern border of the Western Cape Province, namely Molsvlei and Stofkraal are also considered as Project-Affected Communities (PACs).

The ward towns of the KLM offer limited employment opportunities, with a high (30.6%) unemployment rate. Many communities in this area used to be employed on mines, but have subsequently been retrenched as several of these mines have closed, which contributes to the area's high unemployment rate. The primary employment sector in the area remains the mining sector, which is envisaged by the government to experience growth with several other mining projects being planned in the area around Garies.

Therefore, the mining project is envisaged to stimulate the district economy. The project has the potential to significantly stimulate the local municipal economy and provide local job opportunities to a region deprived thereof. This is directly aligned with the government's intention for the industry to contribute to economic growth, with the mining sector enabling socio-economic development in communities hosting mining projects.

The area where the mine is to be developed is sparsely populated with a low agricultural potential and livestock carrying capacity. Since the area is rich in mineral resources, it makes sense that the mining sector is expanding in this region, with several mining projects in the proposal or operational phase (see section on vegetation cumulative impacts above). Closer to the project site, Frontier Rare Earths is in the process of establishing the Zandkopsdrift Mine, which will possibly employed around 250-300 people. In addition to the mining industry, according to the Municipal Manager of the KLM, Mr Cloete (pers. comm., 2014), several other development projects are also being planned in the area. These include proposals from three wind farm developers for Wind Energy Facilities (WEFs), as well as several proposed solar facilities.

Apart from cumulative mining developments, the Kamiesberg Project is proposed in close proximity to the 155,000ha Namakwa National Park (NNP) operated by the South African National Parks (SANParks). According to a representative from SANParks working at the park, Mr van Lente (pers. comm., 2014), it is an important catalyst for tourism in the area. It also supports numerous guesthouses, especially since it conserves the area's vegetation, which brings tourists during the spring time. In light of this, the mine development will have to take steps to reduce its possible impact on the park and the area's biodiversity, particularly since tourism is a key economic sector of the area. Accommodation required by mine for non-permanent staff and consultants is likely to boost business tourism in the area, which is a growing sector in the tourism industry. On balance, the cumulative impact on tourism is likely to be economically positive, as higher occupancy rates can be expected during the traditional slow, non-flowering season.

Development and employment are highly needed in the NDM and KLM. The region suffers from unemployment, a situation that can be attributed to a lack of local industries and investment. As the Kamiesberg Project is being planned alongside the Zandkopsdrift Mine, both developments will offer a significant number of employment opportunities. The expected increase in employment opportunities could change the current socio-economic dynamics of the affected towns, generally through the in-migration of job seekers or externally sourced employees. This was also affirmed as an issue for consideration by the Municipal Manager of the KLM, Mr Joseph Cloete.

9.5.3 Cumulative impacts related to cultural heritage

The loss/destruction of archaeological heritage resulting from mining and mining related activities; i. e. sites that have been rated as having low (Grade 3C) significance is unlikely to result in a significant cumulative impact.

The most effective way of addressing and managing cumulative (archaeological) impacts from sites that are located in non-mining areas, is through implementation of a Heritage Management Plan (HMP).

9.5.4 Cumulative impacts related to waste and infrastructure

i. Impacts associated with waste

Local knowledge of waste management practices (Construction and Operational phase) - In addition to consideration of direct impacts associated with the production of waste streams by the proposed development, it is also necessary to consider the cumulative impacts which may manifest as a consequence of multiple large-scale commercial developments within the region. With respect to waste management, key considerations are the change in the profile of waste streams produced by local communities and awareness of local community members about the management wastes. Each of these is discussed in more detail below.

Based on available information, there appears to be a lack of well-designed and operated waste management infrastructure, including disposal facilities, and recycling initiatives in the locality of the project area. The knowledge amongst local community members of the need for and best practice regarding management of waste streams is expected to be limited. While a limited knowledge of waste management may not pose a significant risk while communities subsist largely off agriculture and use of natural resources, the potential risks to environmental and human health are expected to increase as communities become more affluent and densely populated and the waste profile change to resemble those more commonly associated with urban societies. In particular, the quantity of waste may increase and waste streams may start to include a greater proportion of non-biodegradable materials and even small quantities of hazardous wastes.

It is expected that a significant proportion of the employees at the Kamiesberg Project will come from local communities. In addition, other individuals from the same villages may be employed at other large-scale developments proposed for the area. Through their employment at such operations, these local community members will be trained on a range of environmental issues, including the correct management of waste. This knowledge may then be transferred to other members of the local communities, thus resulting in a general increased awareness of the importance of waste management, and potential opportunities for recycling, within the local communities.

Mitigation and Management

- Train all employees on the importance of proper management of waste streams and sanitation;
- Consider options to facilitate improved management of solid waste in local communities. This may include allowing local farming communities to dispose of their solid wastes at the new landfill facility or training local communities on composting techniques. This may be incorporated into an urbanisation plan for the area.
- Consider involving local communities in waste recycling initiatives if these are considered practical within the context of the project.

The development of a knowledge and appreciation of the need for sound waste management amongst employees, and subsequent informal dissemination of this knowledge into local communities may ultimately, together with the provision of waste management infrastructure such as formal temporary storage areas or a landfill (perhaps through an urbanisation plan), result in an improved management of waste streams within the local communities. As one of the positive impacts would be an enhanced local knowledge, the impact may be considered permanent.

Change to waste profiles in the local communities - The proposed development, together with others in the region, will elevate the economic profile of the local communities and will result in a change in the profile of community waste streams, both in terms of quantity and the nature of the wastes. If existing waste management practices are not adapted, this could result in potential visual impacts as well as health, safety and environmental impacts around the communities.

Mitigation and Management

- The mine could assist in the facilitation of the development of an urbanisation plan for the local communities;
- Consider options to facilitate improved management of solid waste in local communities. This may include allowing local communities to dispose of their solid wastes at the new landfill facility, training local communities on composting techniques or investigating and, if considered feasible, supporting recycling initiatives.

This cumulative impact would probably be of moderate negative significance without mitigation and low negative with mitigation.

ii. Impacts related to air quality

Other mineral sands mining activities along the Namaqua Coast will impact the baseline air quality in the vicinity of the Zirco Kamiesberg operations. However, not enough information is publically available to be able to quantify the cumulative impact of concurrent mining activities. Assuming other mining activities occur within, or near the boundary of the modelling domain and follow a similar process to that used for the Kamiesberg assessment, it is likely that particulate concentrations may be negatively impacted. The highest risk of cumulative impacts will be where mining activities occur on either side of a mining rights boundary, simultaneously. Similarly the use of the district road for product haulage by multiple parties would negatively impact particulate concentrations along the length of the road

iii. Impacts related to radiation

Refer to Chapter 8, section 8.13

iv. Impacts related to traffic and transport

The only known development in the general project area that could contribute significant additional volumes of road traffic is the Frontier Rare Earths mine at Zandkopsdrift, situated some 35km south-east of the Kamiesburg project.

Frontier plans to commence production from Zandkopsdrift in 2015 at a rate of 20 000 tonnes of separated rare earths per annum. Ore will be processed at Zandkopsdrift and the resulting 99% pure mixed rare earth carbonate transported by road to a separation plant to be constructed at Saldanha. The tonnage of mixed rare earth carbonate to be transported between the mine and Saldanha will be slightly more than 20 000tpa. This is a small fraction – around 4% - of the 570 000tpa of product from the Kamiesberg project, and the cumulative impacts of heavy vehicles on the N7 and provincial roads is expected to be negligible.

10. THE EFFECTS OF THE KAMIESBERG PROJECT ON GLOBAL CLIMATE CHANGE

This chapter deals with climate change as it relates to the Kamiesberg Project. Climate generally induces change to physical and biological systems and the adverse change in the global and regional climate scenarios can exert considerable stress on a country and region's vulnerable sector, specifically those who rely heavily on ecological resources. This chapter will describe the climate change scenario in South Africa and assess the potential contribution of the Kamiesberg Project to climate change and the impacts thereof on local ecological and social systems.

10.1 CLIMATE CHANGE: CAUSE AND EFFECT

Climate change is a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. Fluctuations in the weather patterns in periods shorter than a few decades, such as El Niño, do not represent climate change. According to the Intergovernmental Panel on Climate Change (IPCC), climate change refers to any change in climate over time, whether due to natural variability or as a result of anthropogenic activity. This usage differs from that in the UN Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC Summary for Policymakers, 2007).

The change in climate is generally attributed to the change in the atmospheric gaseous composition and this could be enhanced by anthropogenic sources of greenhouse gas (GHG). The increased concentrations of GHG (including water vapour, carbon dioxide, methane, nitrous oxide, and ozone) produce global warming that affects long-term climate, with potential impacts, both negative and positive, on humanity in the foreseeable future.

Concern over the anthropogenic factors relates primarily to emissions from fossil fuel combustion and the removal of vegetation due to land use changes. Vegetation can provide an important sink for atmospheric carbon as physiological processes performed by the plants convert atmospheric carbon dioxide into plant tissue. In the case of longer-lived tree species, this process can result in large amounts of carbon being sequestered ("locked away") for a number of years. Based on this process, protection of vegetation or afforestation can help to mitigate the potential impact of anthropogenic atmospheric releases on climate change. However, conversely, destruction of vegetation (such as would be associated with clearing of land) could result in the release of significant quantities of carbon dioxide and, potentially, other GHG to the atmosphere.

Based on available information, climate change may influence key climate variables such as temperature, precipitation, sea level and the frequency of extreme weather events. This, in turn, may manifest as changes to rainfall patterns, increased frequency of flooding and droughts and loss of coastal land as a result of higher sea levels. Such changes may have significant ecological and socio-economic consequences.

It should be noted, however, that not all impacts of climate change will have adverse effects. While some parts of the world experience more frequent or severe droughts, floods or significant sea level rise, in other places such as the sub-arctic, which may become more habitable, crop yields may increase due to the fertilising effects of CO_2 and longer growing seasons. However, the likely fast rate of change will result in an increased pressure on diminishing natural resources creating problems such as substantial damage to infrastructure and extinction of indigenous life forms with slow adaptation rates.

Globally, the implementation of a low carbon economy is proposed as a means to avoid catastrophic climate change, and as a precursor to an ideal, zero carbon society.

10.2 PREDICTED MANIFESTATIONS OF CLIMATE CHANGE IN SOUTH AFRICA

South Africa is a Non-Annex I country and is not required to reduce its emissions of greenhouse gases. However, its economy is heavily dependent on fossil fuel and the country can be judged to be a significant emitter due to the relatively high values that can be derived for emissions intensity and emissions per capita. Such calculations put South Africa as one of the world's top 15 most energy intensive economies, with a significant contribution to greenhouse emissions at a continental level and as such contributing to climate change impacts.

According to the 17th Conference of the Parties (COP17 2011), predictable measurable Climate Change manifestations in South Africa may include:

- Warming of the coastal regions by around 1-2°C by about 2050 and around 3-4°C by about 2100;
- Warming of the interior regions by around 3-4°C by about 2050 and around 6-7°C by about 2100;
- Significant changes in rainfall patterns coupled with increased evaporation will result in significant changes in respect of water availability, e.g. the western side of the country is likely to experience significant reductions in the flow of streams in the region;
- Biodiversity will be severely impacted, especially the grasslands, fynbos and succulent Karoo where a high level of extinction is predicted;
- Small scale and homestead farmers in dry lands are most vulnerable to climate change and although intensive irrigated agriculture is better off than these farmers, irrigated lands remain vulnerable to reductions in available water;
- Some predictions suggest that maize production in summer rainfall areas and fruit and cereal production in winter rainfall areas may be badly affected;
- Commercial forestry is vulnerable to an increased frequency of wildfires and changes in available water in south-western regions;
- Alien invasive plant species are likely to spread more and have an ever-increasing negative impact on water resources;
- Increase in the vulnerability and exacerbated health threats resulting from climate change;
- There will be an increase in the frequency and severity of extreme weather events. Damage costs due to extreme weather-related events (flooding, fire, storms and drought) have already been conservatively estimated at being roughly 1 billion rand per year between 2000 and 2009.

Measurable changes in climate can be expected to have significant effects on various sectors of South African society and the economy. These potential impacts have been explored in the South African Country Studies for a time horizon of 50 years, using a series of general circulation model (GCM) simulations (DEAT 2004). According to the findings, health impacts can be expected from increases in temperature and changes in rainfall patterns. These include an increase in the occurrence of strokes, skin rashes, dehydration and the incidence of non-melanoma skin cancers. As a result of ecosystem changes, climate change may also bring about indirect health impacts such as an increase in the incidence of water-borne diseases. The occurrence of vector-borne diseases such as malaria could also increase if there is a significant extension of the malaria prone areas, as has been predicted in the projected climate change scenarios for South Africa as presented in the first national communication.

With regard to water resources, South Africa's rainfall is already highly variable in spatial distribution and unpredictable, both within and between years. Much of the country is arid or semi-arid and the whole country is subject to droughts and floods. Bulk water supplies are largely provided via a system of large storage dams and inter-basin water transfer schemes and such infrastructure takes years to develop. Thus a reduction in the amount or reliability of rainfall, or an increase in evaporation would exacerbate the already serious lack of surface and ground water resources. Water availability in the arid and semi-arid regions, which cover nearly half of South Africa, is particularly sensitive to changes in precipitation. Desertification, which is already a problem in South Africa, could be exacerbated by climate change. Furthermore, climate change may alter the magnitude, timing and distribution of storms that produce flood events.

Biodiversity is important for South Africa because of its key role in maintaining ecosystem functioning, its proven economic value for tourism and its role in supporting subsistence lifestyles. Climate change modelling suggests a reduction of the area covered by the current biomes by up to 55% in the next 50 years. The largest losses are predicted to occur in the western, central and northern parts of the country. Species composition is expected to change, which may also lead to significant changes in the vegetation structure in some biomes, and, in some extreme cases, even leading to total species loss. With regard to animal taxa, climate modelling predicts that most animal species will become increasingly concentrated in the proximity of the higher altitude eastern escarpment regions, with significant losses in the arid regions of the country. Some species are predicted to become extinct.

Marine biodiversity is not expected to be impacted by the predicted ranges for rise in sea level. However, the predicted rise in sea surface temperature would result in the migration of species residing along the coast. Further, the changes in sea temperature may increase the intensity and frequency of upwelling events. This would cause alterations of near-shore currents, which can be expected to have the most significant impact on rocky shore ecosystems in South Africa. The nutrient and larval supply to the coast would be affected, thus influencing the community structures. In addition, studies have indicated that there would be an increase in the occurrences of the harmful 'red tide' events on the west coast which cause mass mortalities of fish, shellfish, marine mammals, seabirds and other animals, and can result in illness and death in persons who eat contaminated seafood.

10.3 CLIMATIC ISSUES POSSIBLY EXACERBATED BY THE KAMIESBERG PROJECT

Climate change issues are of global concern and all anthropogenic activities contribute to climate change. Due to the global nature of climate change, it is not possible to describe climate change impacts in the same way as other impacts described in the previous chapter. The purpose of this section is therefore to discuss the potential impacts of global climate change on the study area, and how the proposed Kamiesberg Project could contribute to climate change as well as exacerbate or mitigate expected manifestations thereof. Where possible, mitigation measures to counter negative impacts or enhance positive impacts are suggested.

10.3.1 Issue 1: Loss of ecosystem goods and services

The Kamiesberg Project will result in the temporary loss of approximately 3 400 ha of natural vegetation in the first 20 years of mining.

Loss of Carbon Stock

Vegetation can act as an important carbon sink. If cleared vegetation is either burned or allowed to decompose, the carbon stored within the plant material will be released as carbon dioxide, thereby eliminating any future carbon storage potential of these plants while at the same time, releasing additional carbon dioxide to the atmosphere. However, this needs to be put in context specific to the project site. A large portion of the vegetation is made up of annual plant species. Since these plants grow and then die within a year they don't function as carbon sinks and therefore don't contribute towards sequestering carbon. The only species that will be relevant are the dwarf shrubs and even then their effectiveness as carbon sinks, compared to areas covered in thicket and forest, is questionable.

The following mitigation measures should be implemented by the Kamiesberg Project to mitigate against the climate change impacts of the loss of habitat:

- As far as possible, minimise clearing of vegetation.
- Educate employees about conservation of vegetation resources;
- Maintain vegetation in drainage lines to reduce loss of soil by erosion in the event of increased rainfall;
- Minimise vegetation clearing ahead of the mine path so as to minimise erosion and pressure on vegetation and related resources; and
- Prepare a detailed rehabilitation strategy that takes into consideration the likely impacts of climate change.

10.3.2 Issue 2: Energy Consumption

In addition to the potential climate change-related impacts associated with the clearing of vegetation, the consumption of fossil fuels, whether directly as fuel or indirectly through the use of electricity from non-renewable sources, will also contribute to climate change.

According to the IFC's Performance Standard 3 (2012), the production of more than 25 000 tonnes of CO_2-equivalents annually by a development should be regarded as significant. Based on an estimated diesel consumption of 4 million litres/annum during the initial stages of the operational phase and an increase to 5 million litres/annum by year 16 as the mining rate increases to 1,875 tph and an emissions factor of 2.63 kg CO_2 e/L diesel, fuel consumption alone is therefore likely to equate to 10,520 (initial stage of mining) and 13,150 (by year 16) tonnes of CO_2-equivalents per annum, respectively. The annual power consumption for the project is estimated at 10.3 MW, increasing to 13.3 MW when the mining rate increases to 1,875 tph. Based on these values and an emmissions factor of 0.99 tons CO_2e/MWh (ESKOM), power usuage will equate to 89,325 (initial stage of mining) and 115,342 (by year 16) tonnes of CO_2-equivalents per annum, respectively. The CO_2 emissions will thus exceed the IFC threshold and be regarded as a significant contribution to CO_2 emissions. As such, it is recommended that a carbon footprint be established for the facility within the first year of operation. This must take into consideration the loss of vegetation. Thereafter it will be necessary to develop a greenhouse gas management plan for the operation with the specific intention of reducing GHG emissions as far as practicable.

Potential mitigation measures could include:

- Quantification of GHG emissions must be conducted annually in accordance with internationally recognized methodologies and good practice;
- Committing to efficient use of energy through the environmental policy;
- Correctly sizing motors and pumps and use of adjustable speed drives in applications with highly variable load requirements;

- Actively considering and, where practical, implementing measures to reduce energy consumption of the development. This may include the installation of solar water heaters;
- Ensuring that all machinery, including vehicles, are well maintained;
- An Operating procedure for carbon management, including key performance targets, should be designed and implemented. This should include the management of re-vegetated areas (as carbon sink) for carbon offsetting measures;
- Development and implementation of an Energy Management Plan for the facility; and
- Consideration of carbon sequestration potential when developing the rehabilitation strategy for the facility.

10.3.3 Issue 3: Health Impacts

It has been predicted that climate change will influence the prevalence of certain diseases such as an increase in the occurrence of strokes, skin rashes, dehydration and the incidence of non-melanoma skin cancers. As a result of ecosystem changes, climate change may also bring about indirect health impacts such as an increase in the incidence of water-borne diseases. The occurrence of vector-borne diseases such as malaria could also increase if there is a significant extension of the malaria prone areas, as has been predicted in the projected climate change scenarios for South Africa as presented in the first national communication.

Potential mitigation measures could include:

- Take steps to improve awareness of vector-borne health risks amongst employees and local communities;
- Develop an integrated pest management plan for the facility that includes vectors for disease;
- Implement necessary procedures to minimise the presence of stagnant water on the site.

10.3.4 Issue 4: Waste Management

<u>Landfill Biogas Production</u>

About 99% of landfill gas is comprised of methane (CH_4) and carbon dioxide (CO_2) which are primarily of concern due to their being greenhouse gases (GHG). These biogases are produced through the natural process of bacterial decomposition of organic waste under anaerobic conditions. Studies indicate that over 200 compounds can be encountered in a landfill site and these include highly odorous compounds such as limonene, xylene, ethyl benzene, propyl benzenes and butyl benzenes, which have been found to be common to municipal and industrial waste sites, and appear to be produced consistently by the waste (State of the Environment: DEA, 2010).

Landfill CH_4 has historically been the largest source of GHG emissions from the waste sector. Global CH_4 emissions from landfills are estimated to be 500 – 800 $MtCO_2$-eq/yr (US EPA, 2006) and a total of 8.09 $MtCO_2$-eq was estimated as being generated from landfills in South Africa for the year 2000 (Greenhouse gas Inventory; DEA, 2009). According to the IPCC (2006), the growth in landfill emissions has diminished during the last 20 years due to increased rates of landfill CH_4 recovery and decreased rates of landfilling in the developed countries. The same cannot be said for developing countries such as South Africa which registered a considerable increase approximately 71% in CH_4 emission from 1990 to 2000. The increasing quantity of CH_4 emissions from landfills is reasoned to be a direct consequence of the high rate of waste generation which itself is a consequence of the rapidly increasing population in the urban areas of the country (State of the Environment: DEA, 2010). This trend is likely to continue as waste disposal by landfill remains the predominant means of managing waste in South Africa (Gauteng Waste Management Forum, 2013).

Potential mitigation measures could include:

- Reducing the amount of biodegradable waste to landfill by implementing the waste management hierarchy – prevention, reduction, re-use, recovery, recycling, disposal;
- Developing landfill with inclusion of engineering designs for harvesting the CH_4 biogas as renewable energy; and
- Landfill site must be sited, designed and operated to international standards (EHS Guidelines for Waste Management Facilities 2007 and EPA 2000) in order to isolate the wastes and prevent environmental contamination and GHG emission.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 SUMMARY OF THE KEY FINDINGS OF THE EIA

The main areas of concern are considered to be the ecological sensitivity of the site and to a lesser extent cultural heritage. In terms of vegetation, the following sensitive sites where identified:

Wetlands and rivers

Wetland and rivers constitute features of conservation concern as they are important process areas, especially in arid environs. They are essential for ecosystem functioning and process, and provide niche habitats for a variety of plants and animals. These areas have a VERY HIGH sensitivity.

The Groen River and Bitter River occur on either side of the project's boundaries. These rivers are ephemeral in nature and support riparian vegetation which is important for several bird species. They have been identified as critical biodiversity areas and must be conserved and maintained as far as possible. As these water courses are not particularly close to the proposed footprint of the mine, they are not likely to be directly affected by it, and their functioning should remain relatively intact, provided that there is no groundwater abstraction .

Some small drainage lines are present in the eastern section of Leeuvlei. These wetland areas also constitute process areas even though they are seasonal, often dry, and do not have specific wetland vegetation. These areas need to be avoided , and consequently they have been included in the proposed corridor, as described earlier (refer to Figure 11.1).

Steep slopes, rocky areas and areas with shallow soils

These important features are of conservation concern as they are difficult to rehabilitate and are easily affected by changes in land use, with erosion being an important impact factor. They also support unique assemblages of dwarf succulents and bulbs, and are important reptile habitats. They exist throughout the eastern section of Leeuvlei in the Klipkoppe shrubland vegetation. It is recommended that these areas are excluded from the mining footprint in order to maintain niche habitats for reptiles and plant biodiversity, as well as high insect and bird diversity in the rainy season. The extensive calcrete outcrops south of Soutfontein are similarly important reptile habitats, and also support the rare *Dicrocaulon ramulosum* vygie. This is the only part of the study area in which this species occurs. Due to this sensitivity the majority of the areas identified as Klipkop Shrubland (91 %) have been incorporated into an ecological corridor (Figure 11.1) and thus will not be impacted on by mining activities or the construction of associated infrastructure. Only a small portion of this vegetation type (9 %) will be impacted by mining activities in the southern section of Leeuvlei.

Sand Fynbos

Significant concentrations of populations of plant SCC (>10 species) have resulted in areas been classified as High ecological sensitivity, and this is the primary reason for the identification of the Northern Sand Fynbos as an area of High sensitivity.

Sixty five percent (65% or 15 SCC) of the 23 SCC in the study area are found within the Namaqualand Sand Fynbos, which is also one of the primary target habitats for mining operations. All 15 SCC known from the Sand Fynbos are found within the northern Sand

Fynbos, including all the most localised species, and the two undescribed species (*Elegia* and *Lachenalia*). All 15 SCC known from the Sand Fynbos in the study area are found within the proposed mining area, but none are restricted to this area, and all are present either in the northwestern or northeastern corners of Roode Heuwel - that are not part of the proposed mining area – and these areas should thus serve as critical offset conservation areas should mining proceed. Each of these “conservation corners” is about 900ha in extent, and the northwestern one is adjacent to the Namaqua National Park. It is important to note that of the 15 SCC that occur within this area, 10 species have a distribution of 5% or less of the known population within the prospecting area and for this reason the sensitivity of this area is rated as HIGH, and not VERY HIGH . In addition to this, 54.5% of the northern Sand Fynbos has been incorporated into the proposed ecological corridor and thus will not be impacted upon.

Based on additional surveys undertaken outside of the prospecting area, only 2 of the SCC (*Agathosma elata* and *Leucoptera nodosa)* have more than 10% of the known population located within the mining area. In addition to these two species, three other species, *Argyrolobium velutinum, Elegia sp nov* and *Lampranthus procumbens* have more than 10% of the known population located within the prospecting area. The following should however be noted:

- *Agathosma elata* - 10% of known population within the mining area, with the majority of this species (75%) incorporated into the proposed ecological corridors
- *Elegia* sp. Nov - 30% of known population occurs within the prospecting area, with the entire population included in the proposed ecological corridor.
- *Lampranthus procumbens* - 20% of known population occurs within the mining area and 10% within the prospecting area, with more than a third (35%) of this population included in the proposed corridor. This species is widely spread outside of the prospecting area.
- *Leucoptera nodosa* - 20% of known population occurs within the prospecting area, with the main population of *Leucoptera nodosa*, and a buffer of 100m incorporated into the proposed ecological corridors.
- *Argyrolobium velutinum* - 20% of known population occurs within the prospecting area, but this species was found in all major areas surveyed in and outside the prospecting area, but typically widely scattered in Sand Fynbos.

Based on the above, it can be concluded that the majority of the populations of the SCC that are present within the prospecting area have been incorporated into an ecological corridor that will be protected from any development.

Quartz patches

Quartz patches usually harbour many interesting and unusual species (as they are stable and cooler), but the ones near the Outeep river (on Leeuvlei) proved to be exceptionally interesting. Two completely new vygie species were discovered here, and to date these species are only known from this single 5ha area (nearby quartz patches were checked), and may in fact occur nowhere else. In addition to these major finds there were three other SCC in this habitat, and there may also be others that were not found. This area has a Very High conservation value and sensitivity and has accordingly been included into an ecological corridor (Figure 11.2).

To summarize, of the 23 SCC identified within the prospecting area, 6 occur within the area classified as hardeveld. These species are *Phyllobolus tenuiflorus, Pelargonium caroli-henrici, Othonna lepidocaulis, Jacobsenia sp nov, Cheiridopsis sp nov* and *Aloe krapohliana.* Two of these species, *Jacobsenia sp nov* and *Cheiridopsis sp nov* are undescribed and

100% of the known population occurs within the prospecting area. As shown in Figure 11.2 these species are limited to the area identified as Outeep Quartz which have been incorporated (in its entirety) into the proposed ecological corridor and thus will not be impacted on by the proposed development.

Main population of Leucoptera nodosa

The main population of *Leucoptera nodosa*, and a buffer of 100m, has been given a Very High sensitivity as this area supports more than 50% of the total known population (>100 plants) of this Vulnerable and rare species. This population, including the buffer area have been incorporated into the proposed ecological corridor .

The proposed corridors incorporate the following sensitive areas (please refer to Figures 11.1):

- 54% of the northern sand fynbos
- 100% of the Outeep Quartz
- 91% Klipkop Shrubland
- The Bitter River
- The Groen River (with the exception of the area where the pipeline and servitude crosses the Groen River)
- Small drainage lines are present in the eastern section of Leeuvlei
- The Outeep River (tributary of the Bitter River)
- 100% Soutfontein Calcrete
- 100% of the main population of Leucoptera nodosa

An additional north-south corridor will be required to protect Namaqualand Sand Fynbos, as this vegetation type has a north – south regional distribution, through the western half of the study area (mainly on Roode Heuwel), and it is part of a largely continuous strip of habitat that runs from northeast of Hondeklipbaai in the north to the Olifants River in the south. However, due to the progressive nature of the rehabilitation process, there will always be a corridor from north to south through the project area. For the first 5 years of mining, rehabilitation must focus on the years 1-4 area to ensure that at least one 300m wide north – south ecological corridor can be re-instated. This will necessitate leaving a portion of the year 20 mining area in an undisturbed state along the western edge of the project area, to ensure there is a north-south linkage. Based on the mine path provided a permanent corridor along the western edge of the project site is not required as long as there is always a link between the northern and southern borders of the project site. This link would, in any event, be provided by the portion of land to the west of Roode Heuvel, as it is highly unlikely any mining will take place in the next 5 years, since exploration and project development activities in this area have been limited, and 5 years is approximately how long it would take to get a project up and running from scratch.

Rehabilitation

Due to the sensitivity of the site (taking mitigation measures in account), it is recommended that the prospecting area referred to as Roode Heuvel, which has been identified by the ecologists as an area of high sensitivity is rehabilitated back to its natural state throughout the life of mine and post closure and that the land is offered to Namaqua National Park (NNP) for incorporation. This will tie in with the expansion stategy for the NNP as discussed previously, of which the intention is to include the western portion of Roode Heuvel into the NNP footprint. Should the NNP decline the offer of incorporating this area, a biodiversity offset should be sought within close proximity to the proposed development and the land post-closure rehabilitated back to agricultural land.

In addition to the above, it is recommended that the prospecting areas identified as Sabies and Leeuvlei are rehabilitated back to agricultural land if mined in the future and the land purchased by Zirco, as the majority of the area has been identified to be of low to moderate sensitivity. Areas of conservation concern within the borders of these prospecting areas have been incorporated into the proposed ecological corridors and will not be impacted upon by the project.

Cultural Heritage

In terms of cultural heritage, 18 sites have been identified within the prospecting area that require mitigation. Of these 18 sites, half have been incorporated into the ecological corridors (please refer to Figure 11.3). Mitigation at the remainder of the sites is easily and the impact on these are thus considered to be of low significance.

Socio-economic considerations

The mine site is not in close proximity to any small towns, with the small town of Garies located 35km to the southwest.
Issues and impacts pertaining to the farm-owners who will lose their land relate to land acquisition, which will affect the economic viability of remaining farm titles (should some farmers decide to remain on their land). As sheep farming is one of the major income sources for these farmers, many owners were concerned that the mine would reduce their income-earning capacity. The proponent will compensate landowners above the land's commercial value ans it is argued that, from an economic viability perspective, compensation should allow farmers to either invest in their remaining land, or buy alternative land. This is therefore seen as having a positive impact on affected farmers.

Many farm-owners' land has been in their families for several decades. This reinforces their attachment to the land from a cultural and individual perspective, and impacts related to the landowners' sense of land attachment is the most significant impact rated in the social impact assessment, as there are no mitigation measures for this impact.

A different set of impacts have been recorded from a labour-sending community perspective. As these communities are relatively far from the proposed mine site, issues relate more to Local Economic Development (LED), employment provision and a concern over an influx of job-seekers and outside workers. The data reveals that the project is highly desired from employment benefits and community development perspectives. No community member was opposed to the project.

However, influx and community expansion are listed as significant impacts as there is a concern amongst community members that social pathologies in the communities (such as substance-abuse, crime etc.) might increase in response to community expansion and the influx of 'outsiders'. These are major impacts and a central mitigation measure is the development of a Corporate Social Responsibility (CSR) Programme based on the outcome of a community needs analysis.

The project could ultimately uplift communities, which are in need of employment, skills transfer and learnership opportunities. Through the mine's Social and Labour Plan (SLP), local communites could be supported with LED projects and possibly basic social service provision.

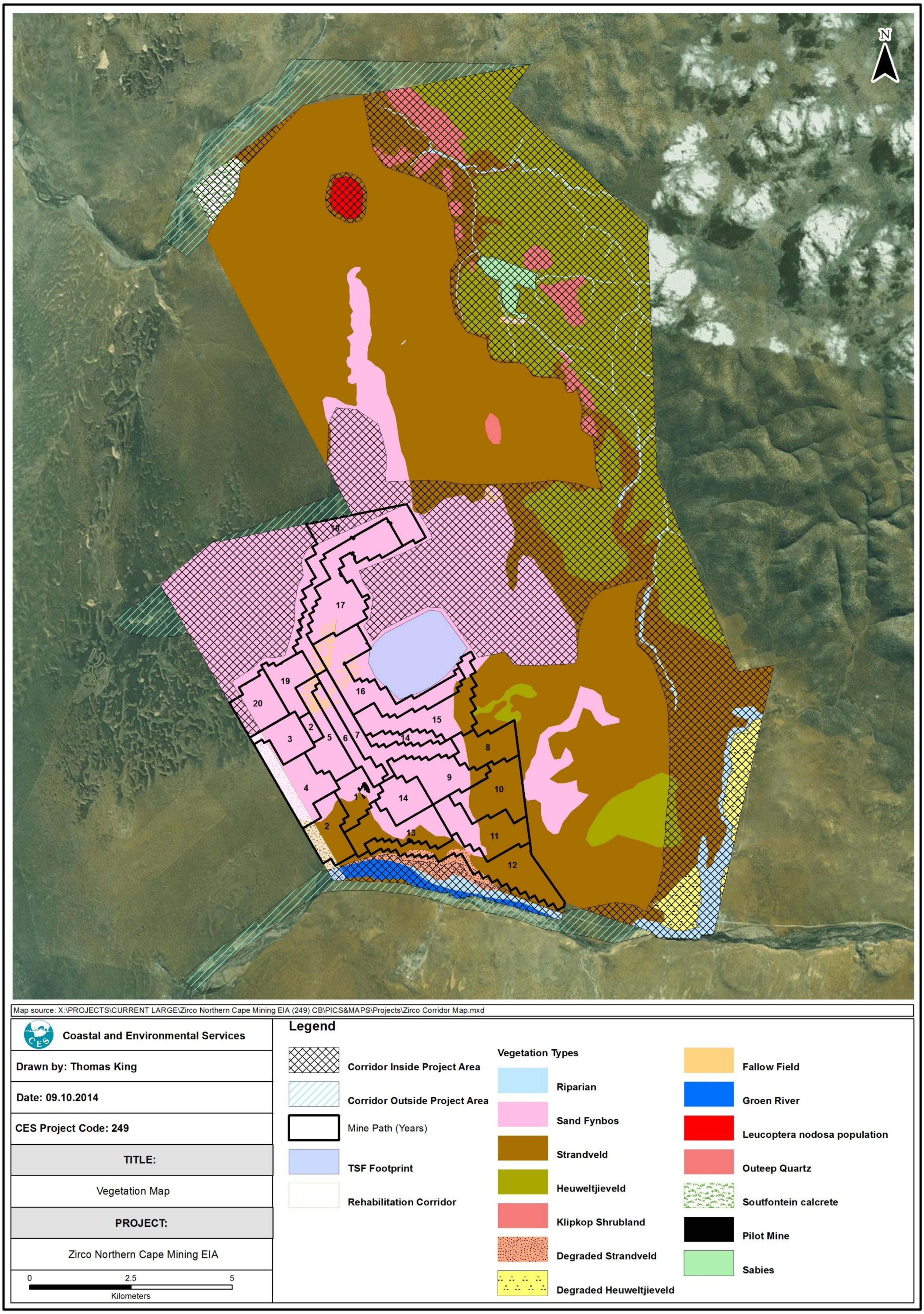


Figure 11.1: Vegetation map and ecological corridors

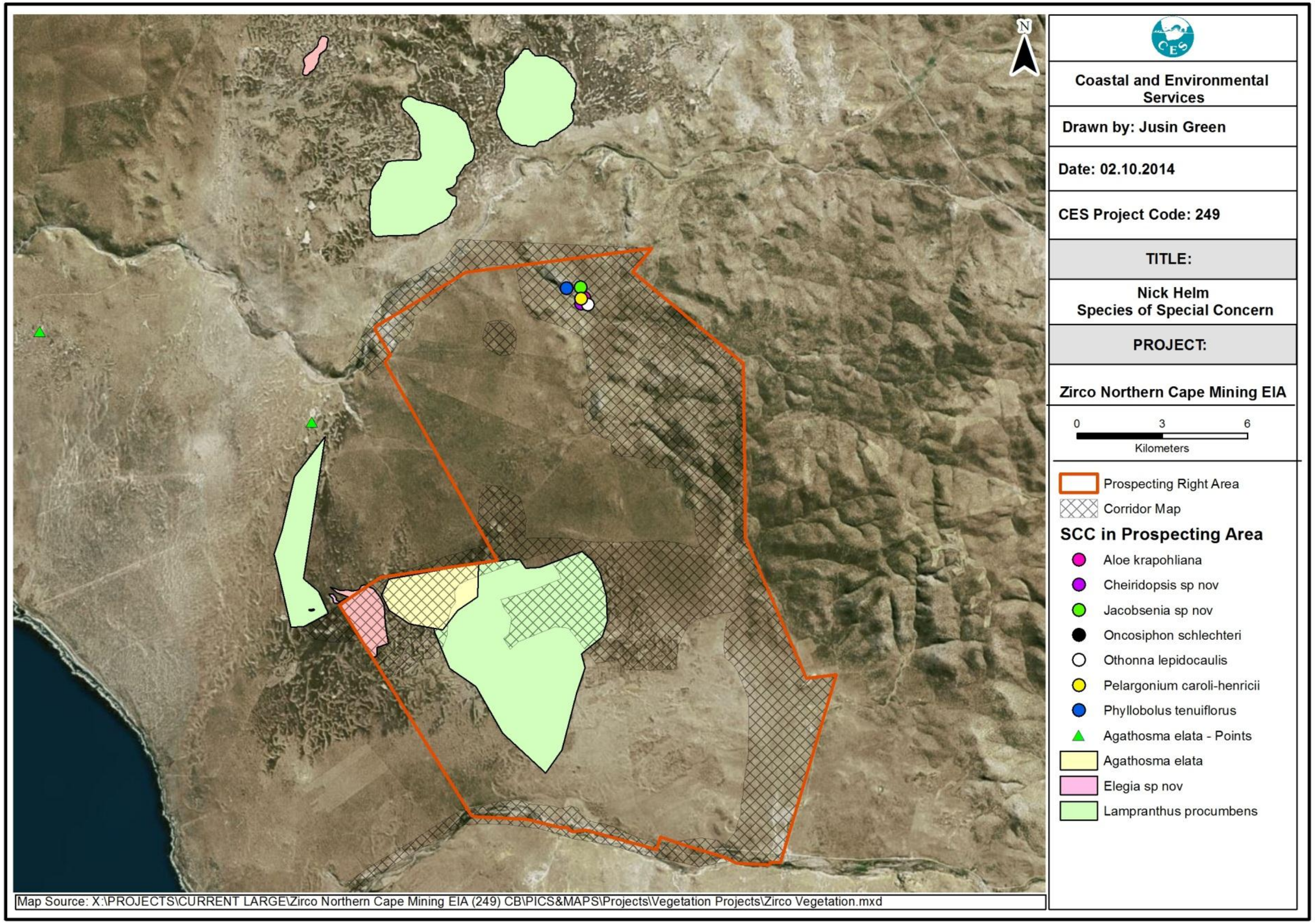


Figure 11.2: Distribution of SCC and ecological corridors

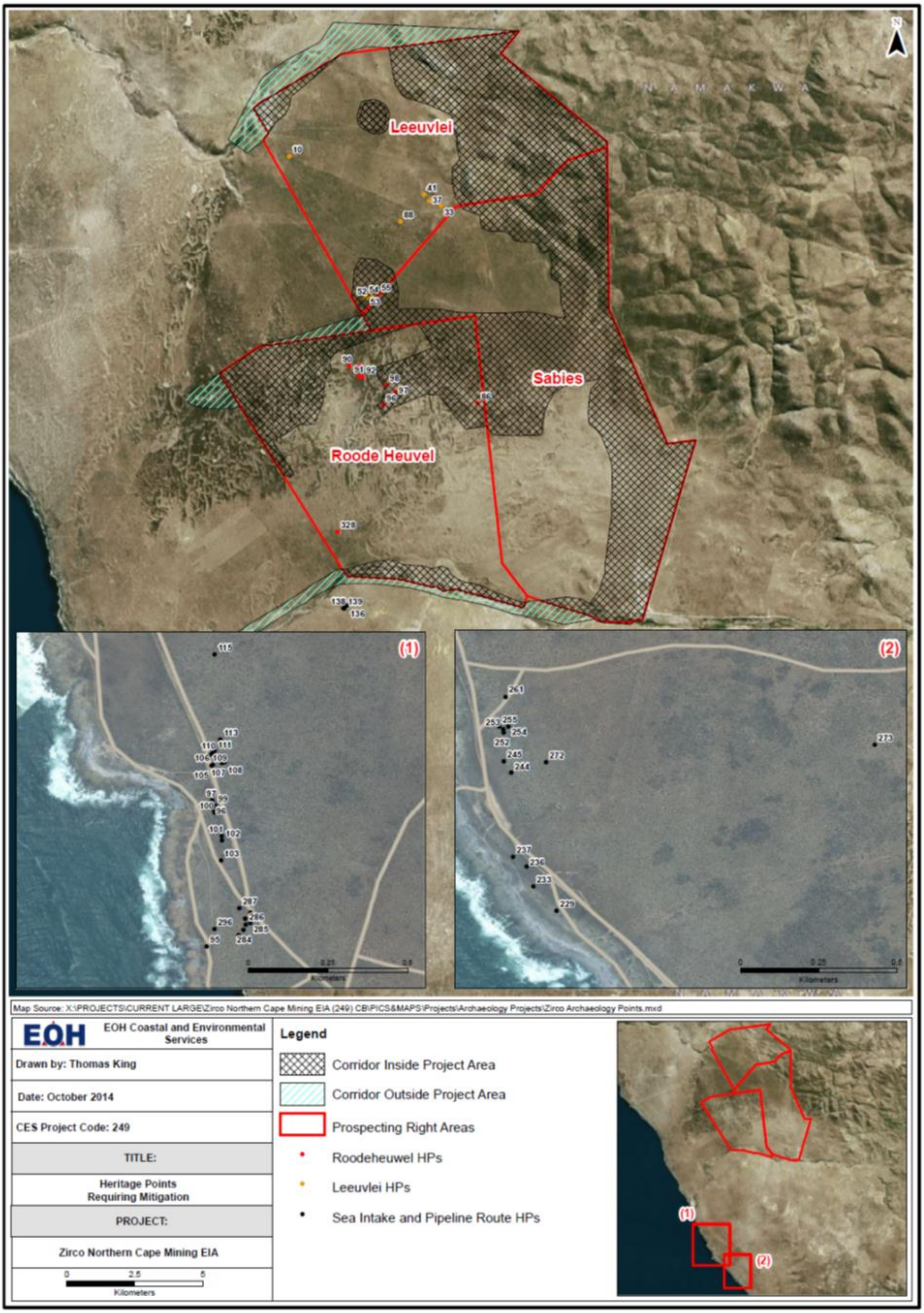


Figure 11.3: Heritage resources that require mitigation in and outside the project affected area

Table 13.1: Residual impacts as a result of the construction phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Impacts on topography and geology	Long Term	Localised	Slight	LOW -	N/A	N/A
Soil profile disturbance	Short Term	Localised	Severe	**MODERATE**	Slight	**LOW**
Soil erosion	Long Term	Study Area	Severe	**HIGH**	Moderate	**MODERATE**
Groundwater abstraction	Long term	Local	Moderate	**LOW**	Slight	**LOW**
Impacts on groundwater of pollution by contaminants	Short Term	Study Area	Severe	**MODERATE**	Moderate	**LOW**
Impact on surface water of groundwater abstraction from the Groenrivier valley	N/A	N/A	N/A	**NO IMPACT**		
Impacts of river crossing infrastructure	Short Term	Local	Moderate	**MODERATE**	Slight	**LOW**
Direct losses of intertidal and infratidal biota	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Barotrauma of marine fauna as a result of blasting	Short term	Regional	Severe	**MODERATE**	Slight	**LOW**
Impaired water quality impacts to marine fauna	Short term	Regional	Severe	**LOW**	Slight	**LOW**
Litter during construction	Medium term	Localised	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Strandveld (Namaqualand Strandveld)	Permanent	Localised, within Study Area	Moderate	**MODERATE**	Moderate	**LOW TO MODERATE**
Loss of Sand Fynbos (Namaqualand Sand Fynbos)	Permanent	Localised, within Study Area	Fairly Minor	**LOW TO MODERATE**	Minor	**LOW**
Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)	Temporary to Permanent	Study Area	Low	**LOW**	Low	**LOW**
Loss of Riparian Vegetation (Namaqualand Riviere)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Seashore Dunes	Permanent	Study Area	Moderate	**LOW TO MODERATE**	Low	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of Coastal Duneveld	Permanent	Study Area	Low - Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Species of Conservation Concern	Permanent	Study Area	Moderate	**MODERATE**	Low - Moderate	**LOW**
Fragmentation of vegetation and edge effects	Permanent	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Amphibian Diversity	Medium term	Localised	Moderate	**LOW**	Slight	**LOW**
Loss of Reptile Diversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Bird Diversity	Medium term	Study Area	Moderate	**LOW**	Slight	**LOW**
Loss of Mammal Diversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Loss of Species of Conservation Concern	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Impacts on fauna due to habitat fragmentation and habitat loss	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Faunal impacts from dust	Short term	Study Area	Severe	**MODERATE**	Slight	**LOW**
Disruption to fauna from increased noise levels	Short term	Study Area	Severe	**LOW**	Moderate	**LOW**
Visual intrusion on views of sensitive visual receptors due to mine construction	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living:	Short Term	Study Area	Moderate	**MODERATE**	Slightly Beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Short Term	Study Area	Severe	**HIGH**	Slight	**LOW**
Increased social pathologies	Short Term	Study Area	Very Severe	**HIGH**	Severe	**LOW**
The use of security personnel for mine access control	Short Term	Study Area	Severe	**LOW**	N/A	**N/A**
Assisting with housing requirements in Garies	Long Term	Localised	Slightly Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Assisting with local economic development	Medium Term	Study Area	Moderately Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Upgrading of roads	Long Term	Study Area	Slight Beneficial	**LOW +**	Slightly Beneficial	**LOW +**
Economic viability of remaining unaffected land	N/A	N/A	N/A	**N/A**	Slight	**MODERATE +**
Employing local labour	Short Term	Study Area	Slightly Beneficial	**LOW +**	Very Beneficial	**HIGH +**
Developing and supporting local businesses	Short Term	Regional	Slightly Beneficial	**LOW**	Very Beneficial	**HIGH +**
Skills training and further training opportunities	N/A	N/A	N/A	**N/A**	Beneficial	**HIGH +**
Effects on farm-owners' place attachment	Long Term	Study Area	Severe	**HIGH**	N/A	**N/A**
Effects on the area's tourism industry	Medium Term	Localised	Slight Beneficial	**LOW +**	Slight Beneficial	**LOW +**
EHA #2: Acute respiratory infections and respiratory effects from housing	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #4: Sexually-Transmitted Infections, Including HIV/AIDS	Permanent	Regional	Very Severe	**VERY HIGH**	Moderate Beneficial	**MODERATE +**
EHA #5: Soil-, water- and waste-related diseases	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #6: Food- and nutrition-related issues	Medium Term	Study Area	Severe	**MODERATE**	Moderate Beneficial	**LOW +**
EHA#7: Accidents/Injuries	Long Term	Study Area	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
EHA #8: Exposure to potentially hazardous materials, noise and malodours	Permanent	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
EHA #9: Social determinants of health	Medium Term	Study Area	Severe	**MODERATE**	Moderate Beneficial	**MODERATE +**
EHA #9: Social determinants of health (social cohesion and well-being)	Medium Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
EHA #12: Non-Communicable Diseases	Long Term	Regional	Severe	**HIGH**	Moderate Beneficial	**MODERATE +**
ECONOMIC IMPACTS						
Impact on tourism	Short Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Impact on landowners	Short Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Impact of project related expenditure	Short Term	Regional	Moderately Beneficial	**MODERATE +ve**	Moderately Beneficial	**MODERATE +ve**
CULTURAL HERITAGE IMPACTS						
Proposed seawater intake, pump station and pipeline	Long Term	Study Area	Severe	**MODERATE**	Low	**LOW**
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Pollution of land and water *(General wastes)*	Long term	Study area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water *(Hazardous wastes)*	Permanent	District	Very Severe	**HIGH**	Moderate	**MODERATE**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Health impacts to employees and communities	Long term	District	Severe	**MODERATE**	Slight	**LOW**
Nuisance impacts (odour and flies)	Short Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Impacts related to air quality	Short Term	Study Area	Severe	**LOW**	N/A	**N/A**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Impacts related to noise	There are currently no impacts related to this issue.					
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Short Term	Study Area	Severe	HIGH	Severe	MODERATE
Increased dust generation	Short Term	Study Area	Severe	MODERATE	Slight	LOW
Disruption of traffic flows on the N7	Short Term	Regional	Slight	LOW	Slight	LOW
Disruption of traffic flows on provincial roads	Short Term	Regional	Moderate	MODERATE	Slight	LOW
Disruption of traffic flows on the N7 and provincial roads	Very Short Term	Regional	Moderate	MODERATE	Low	LOW

Table 13.2: Residual impacts as a result of the operational phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Changes to topography	Long term	Study Area	Definite	MODERATE	Definite	LOW
The occupation of the land by a mining activity and associated infrastructure	Medium term	Study Area	Severe	HIGH	Moderate	MODERATE
The existence of hard surfaces	Permanent	Study Area	Moderate	HIGH	Slight	LOW
Mining activities may cause increased sediment load	Long term	Study area	Moderate	MODERATE	Slight	LOW
Mining activities will result in various vegetation types being cleared	Permanent	Study Area	Very severe	HIGH	Moderate	LOW
Loss of water (ground and surface water) as a result of mining activities	Permanent	Study area	Very Severe	HIGH	Moderate	MODERATE
Impacts on groundwater of the tailings storage facility and backfill	Permanent	Study area	Very Severe	HIGH	Moderate	MODERATE
Impacts on groundwater of groundwater abstraction	Long term	Local	Moderate	LOW	Slight	LOW
Impacts on groundwater of pollution by contaminants	Long Term	Study Area	Severe	HIGH	Moderate	LOW

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Impacts on surface water of the tailings storage facility and backfill	Permanent	Local	Slight	**LOW**	Slight	**LOW**
Impact on surface water of groundwater abstraction from the Groenrivier valley	N/A	N/A	N/A	**NO IMPACT**		
Impacts of river crossing infrastructure	Long Term	Local	Slight	**LOW**	Slight	**LOW**
Impingement of organisms	Long term	Localised	Severe	**MODERATE**	Slight	**LOW**
Loss of Strandveld (Namaqualand Strandveld)	Permanent	Study Area	Severe	**HIGH**	Moderate	**MODERATE**
Loss of Sand Fynbos (Namaqualand Sand Fynbos)	Permanent	Study Area	Severe	**HIGH**	Moderate - Severe	**HIGH-MODERATE**
			With Mitigation and Biodiversity Offset		Slight	**LOW**
Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)	Temporary to Permanent	Study Area	Moderate	**MODERATE**	Low	**LOW**
Loss of Riparian Vegetation (Namaqualand Riviere)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)	Temporary	Study Area	Minor	**LOW**	Minor	**LOW**
Loss of Seashore Dunes	Permanent	Study Area	Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Coastal Duneveld	Permanent	Study Area	Low - Moderate	**LOW TO MODERATE**	Low	**LOW**
Loss of Species of Conservation Concern	Permanent	Study Area	Severe	**HIGH**	Moderate	**HIGH-MODERATE**
			With Mitigation and Biodiversity Offset		Moderate	**LOW-MODERATE**
Fragmentation of vegetation and edge effects	Permanent	Study Area	Severe	**HIGH**	**HIGH**	**MODERATE**
Increased dust levels on vegetation	Long Term	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Invasion of alien species	Permanent	Study Area	Moderate	**MODERATE**	Slight	**LOW**
Loss of faunal biodiversity	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of Species of Conservation Concern	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Introduction of alien fauna	Medium term	Localised	Moderate	**LOW**	Slight	**LOW**
Impacts on fauna due to habitat fragmentation and habitat loss	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Increased Dust Levels	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Noise Pollution	Medium term	Study Area	Severe	**LOW**	Moderate	**LOW**
Pollution and Contamination	Medium term	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Threats to Animal Movements	Long term	Regional	Severe	**HIGH**	Moderate	**MODERATE**
Impact of introducing highly visible mine infrastructure	Permanent	Study Area	Moderate	**MODERATE**	Moderate	**LOW**
Impact of mine operation in light of the Department of Environmental Affairs' Strategy on Buffer Zones for National Parks	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living:	Long-term	Study Area	Moderate	**MODERATE**	Slightly Beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Long-term	Study Area	Slight	**MODERATE**	Slight	**LOW**
Increased social pathologies	Long Term	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
The use of security personnel for mine access control	Long Term	Study Area	Severe	**MODERATE**	N/A	**N/A**
Assisting with housing requirements in Garies	Long Term	Localised	Slighty Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Assisting with local economic development	Medium Term	Study Area	Moderately Beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Upgrading of roads	Long Term	Study Area	Slighty Beneficial	**LOW +**	Slighty Beneficial	**LOW +**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Economic viability of remaining unaffected land	N/A	N/A	N/A	**N/A**	Slight	**MODERATE +**
Employing local labour	Long Term	Regional	Slightly Beneficial	**LOW +**	Very Beneficial	**HIGH +**
Developing and supporting local businesses	Long Term	Regional	Slightly Beneficial	**LOW +**	Beneficial	**HIGH +**
Skills training and further training opportunities	N/A	N/A	N/A	**N/A**	Beneficial	**HIGH +**
Effects on farm-owners' place attachment	Long Term	Localised	Severe	**HIGH**	N/A	**N/A**
Effects on the area's tourism industry	Medium Term	Localised	Slight Beneficial	**LOW +**	Slight Beneficial	**LOW +**
ECONOMIC IMPACTS						
Impact on tourism	Long Term	Study Area	Moderate to Severe	**HIGH-MODERATE**	Moderate	**MODERATE**
Impact on landowners	Long Term	Study Area	Moderate to Severe	**HIGH-MODERATE**	Moderate	**MODERATE**
Impact of project related expenditure	Long Term	Regional	Moderately Beneficial	**MODERATE +ve**	Substantially Beneficial	**HIGH +ve**
Macro-economic impacts	Long Term	National	Substantially Beneficial	**HIGH +ve**	N/A	**N/A**
CULTURAL HERITAGE IMPACTS						
Impacts that may result from the operational phase	Long Term	Study Area	Severe	**MODERATE**	Low	**LOW**
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Health and safety of employees and local communities	Medium Term	Localized	Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water resources	Medium Term	Localized	Very Severe	**MODERATE**	Slight	**LOW**
Risk to Health and Safety of Employees	Medium Term	Localized	Very Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long term	Study area	Moderately Severe	**MODERATE**	Slight	**LOW**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of soil and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Health impacts to employees and communities	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Pollution of land and water	Long Term	Study Area	Moderately Severe	**MODERATE**	Slight	**LOW**
Impact on particulates	Long Term	Study Area	Very Severe	**MODERATE**	Severe	**MODERATE**
Impact on gaseous pollutants	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impacts related to air quality	Short Term	Study Area	Severe	**LOW**	Moderate	**LOW**
Impact of the vehicle noise the residents along the transport routes (DR 2938)	Long Term	Localised	High	**HIGH**	Moderate	**MODERATE**
Impact of the vehicle noise on the residents along the transport routes (N7)	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impact of the process plants on the noise sensitive receptors	Long Term	Localised	Slight	**LOW**	Slight	**LOW**
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Long Term	Study Area	Very Severe	**VERY HIGH**	Severe	**MODERATE**
Increased dust generation	Long Term	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
Disruption of traffic flows on the N7	Long Term	Regional	Moderate	**MODERATE**	Slight	**LOW**
Disruption of traffic flows on provincial roads	Long Term	Regional	Moderate	**MODERATE**	Slight	**LOW**

Table 13.3: Residual impacts as a result of the decommsioning phase

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Incorrect or insufficient rehabilitation of soil will result in a decrease of agricultural ability	Short term	Study Area	Moderate	**LOW**	Slight	**LOW**
Incorrect or insufficient rehabilitation of soil will result in a decrease of agricultural ability	Short term	Study Area	Moderate	**LOW**	Slight	**LOW**
Impacts on groundwater of the tailings storage facility and backfill	Permanent	Study Area	Very Severe	**HIGH**	Moderate	**LOW**
Impacts on surface water of the tailings storage facility and backfill	Permanent	Local	Slight	**LOW**	Slight	**LOW**
Direct losses of intertidal and infratidal biota in development footprint	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Barotrauma of marine fauna as a result of blasting	Short term	Regional	Severe	**MODERATE**	Slight	**LOW**
Impaired water quality impacts to marine fauna	Short term	Localised	Moderate	**LOW**	Slight	**LOW**
Litter during decommisioning	Medium term	Regional	Moderate	**MODERATE**	Moderate	**LOW**
Impacts on the marine environment	Medium term	Localised	Moderate	**MODERATE**	Slight	**LOW**
Increased Dust Levels	Short term	Study Area	Slight	**LOW**	Slight	**LOW**
Pollution and Contamination	Short term	Study Area	Slight	**LOW**	Slight	**LOW**
Noise Pollution	Medium term	Study Area	Severe	**MODERATE**	Moderate	**MODERATE**
Visual intrusion on views of sensitive visual receptors due to mine decommissioning	Short term	Study area	Moderate	**MODERATE**	Slight	**LOW**
Impact of mine construction in light of the Department of Environmental Affairs' Strategy on Buffer Zones for National Parks			N/A	**N/A**	N/A	**N/A**

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
SOCIO-ECONOMIC IMPACTS						
Loss of social services	Permanent	Study Area	Severe	MODERATE	Severe	MODERATE
Retrenchment	Permanent	Study Area	Very Severe	VERY HIGH	Moderate	MODERATE
CULTURAL HERITAGE IMPACTS						
Due to the fact that significant sites of cultural heritage value that will be impacted on by the proposed development will be removed prior to construction and/mining, no impacts are anticipated for the decommissioning phase.						
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Pollution of land and water	Long term	Study area	Moderately Severe	MODERATE	Slight	LOW
Nuisance impact (Production of odours, visual impact and attraction of pest and vermin)	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Pollution of soil and water	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Health impacts to employees and communities	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Nuisance impacts (odour and flies)	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Pollution of land and water	Long Term	Study Area	Moderately Severe	MODERATE	Slight	LOW
Impact on particulates	Long Term	Study Area	Very Severe	MODERATE	Severe	MODERATE
Impact on gaseous pollutants	Long Term	Localised	Slight	LOW	Severe	MODERATE
Impacts related to air quality	Short Term	Study Area	Severe	LOW	Moderate	LOW
Impacts related to radiation	Refer to Chapter 8, section 8.13					
Increased risk of vehicle collisions and personal injuries	Long Term	Study Area	Very Severe	VERY HIGH	Severe	MODERATE
Increased dust generation	Long Term	Study Area	Very Severe	HIGH	Moderate	LOW
Disruption of traffic flows on the N7	Long Term	Regional	Moderate	MODERATE	Slight	LOW
Disruption of traffic flows on provincial roads	Long Term	Regional	Moderate	MODERATE	Slight	LOW

Table 13.4: Residual impacts as a result of the Cumulutaive Impacts

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
BIOPHYSICAL IMPACTS						
Impacts on surface and groundwater resources	There are currently no cumulative impacts anticipated on surface and groundwater resources					
Impacts on flora	Variable – mostly Long Term, and some permanent	Site, and Regional, especially when cumulative impacts are considered	Medium to Severe	**MODERATE - HIGH**	Medium	**MODERATE**
SOCIO-ECONOMIC IMPACTS						
Community expansions and increased burdens on service delivery and cost of living	Long-term	Study area	Moderate	**MODERATE**	Slightly beneficial	**MODERATE +**
Increased community conflicts due to differential benefits between local labour and outside workers	Long-term	Study area	Slight	**MODERATE**	Slight	**LOW**
Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)	Long-term	Study area	Very severe	**HIGH**	Moderate	**LOW**
Assisting with housing requirements in Garies	Long-term	Localised	Slightly beneficial	**MODERATE +**	Very Beneficial	**HIGH +**
Assisting with Local Economic Development	Medium-term	Study area	Moderately beneficial	**MODERATE +**	Very beneficial	**HIGH +**
Employing local labour	Long-term	Regional	Slightly beneficial	**LOW +**	Very beneficial	**HIGH +**
Developing and supporting local businesses	Long-term	Regional	Slightly beneficial	**LOW +**	Beneficial	**HIGH +**
Skills training and further training opportunities	Long-term	Regional	No affect		Beneficial	**HIGH +**
CULTURAL HERITAGE IMPACTS						

			Without Mitigation		With Mitigation	
Impact	**Temporal scale**	**Spatial scale**	**Severity**	**Significance**	**Severity**	**Significance**
Loss of archaeological remains	No significant impacts are anticipated					
IMAPCTS ASSOCIATED WITH WASTE INFRASTRUCTURE AND PROCESS RELATED ISSUES						
Local knowledge of waste management practices	Permanent	District	Slightly Beneficial	LOW	Beneficial	**MODERATE +**
Change to waste profiles in the local communities	Permanent	District	Severe	MODERATE	Slight	LOW
Impacts related to radiation	Refer to Chapter 8, section 8.13					

11.2 EAP'S RECOMMENDATION

It is recommended that an ECO be appointed to ensure all recommendations in the EMP as well as mitigation measures are adhered to. The most important mitigation measures are included below:

- Due to the botanical sensitivity of the site it is recommended that discussions are held with SANParks in regards to potential biodiversity offsets (whether to incorporate the area referred to as Roode Heuvel into the NNP or if another offset will be preferred). Recommendations in regard to this are made in the vegetation report as well as this Final EIR.
- A search and rescue for SCC must be undertaken by a qualified botanist, prior to any construction taking place. These plants should be transferred to an on-site nursery and/or transplanted into the proposed ecological corridors.
- The proposed ecological corridors that are located on land owned by the proponent must be clearly demarcated and no development may be allowed within these corridors. In addition to this livestock grazing must be prohibited in these areas to ensure that no further degradation will take place.
- The SLP must be implemented.
- Baseline monitoring for all parameters listed in the monitoring plan must be undertaken prior to operations taking place.
- An operational environmental management programme must be drafted prior to the operation phase of the mine.
- A community grievance mechanism must be developed and implemented.
- Water Use Licenses must be in place prior to the construction of the pipeline and the realignment of the road. All conditions within these licences must be strictly adhered to.
- Silt fences or any other sedimentation prevention measures must be implemented prior to any construction taking place within riverine areas.
- A Waste License must be in place prior to the construction of the landfill site. All conditions within this licence must be strictly adhered to.
- Groundwater quality and quantity must be monitored throughout the life of the mine and post closure.
- Groundwater may only be utilised for processing purposes, in the event of electrical, mechanical or process failure of the seawater abstraction, delivery and treatment system.
- All relevant permits must be obtained from SAHRA prior to any heritage sites being disturbed.

Based on the above, it is believed that with appropriate mitigation, the social benefits of the proposed Kamiesberg Project will outweigh the negative impacts. **It is the opinion of the EAP environmental authorisation for this project should be granted under certain conditions**, in order to address those impacts with a high significance rating, and included in Chapter 9 of this report.

It is also strongly suggested that the recommendations made in Volume 4: Environmental Management Programme: Kamiesberg Project (CES, May 2012) also be followed.

11.3 THE WAY FORWARD

This Final EIAR, together with the Specialist Volume (Volume 2) and the EMPr (Volume 4), has been submitted to the DENC.

Upon thorough examination of the Final EIAR, the authority (DENC) will issue a decision, which either authorises the project or rejects the EIAR – in which case the DENC will request additional information or clarification of certain issues. Should an Environmental Authorisation be granted, it usually carries Conditions of Approval. The project proponent is obliged to adhere to these conditions.

Within a period determined by the competent authority, all registered I&APs will be notified in writing of (i) the outcome of the application, and (ii) the reason for the decision. The public or applicant (depending on the outcome of the authorisation) will then have time in which to appeal the decision should they wish to do so. The appeals procedure will also be communicated by the EAP. Any appeal must be submitted to the responsible Legal Officer at DEA.

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