Biodiversity Assessment for the renewal of Environmental Authorisation for West Coast Resources, Koingnaas Mine, Koingnaas, Northern Cape

bergwind
Botanical Surveys & Tours

Dr David J. McDonald
Bergwind Botanical Surveys & Tours CC.
14A Thomson Road, Claremont, 7708
Tel: 021-671-4056
Fax: 086-517-3806

Prepared for Myezo Environmental Management Services

September 2016

National Legislation and Regulations governing this report

This is a 'specialist report' and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2014.

Appointment of Specialist

David J. McDonald of Bergwind Botanical Surveys & Tours CC was appointed by Myezo Environmental Management Services to provide specialist botanical consulting services for renewal of the Environmental Authorisation for the Koingnaas Mine (West Coast Resources) Northern Cape Province. This aspect comprises an assessment of potential impacts on the flora and vegetation in the designated study area by the proposed future mining. In addition, Simon Todd of Simon Todd Consulting was appointed to undertake a concurrent faunal study. These two aspects of the project together constitute a biodiversity study as reported here, that is a combination of the botanical and faunal studies.

Details of Specialist

Dr David J. McDonald Pr. Sci. Nat.
Bergwind Botanical Surveys & Tours CC
14A Thomson Road
Claremont
7708
Telephone: 021-671-4056
Mobile: 082-876-4051
Fax: 086-517-3806
e-mail: dave@bergwind.co.za
Professional registration: South African Council for Natural Scientific Professions No. 400094/06

Expertise

Dr David J. McDonald:

- Qualifications: BSc. Hons. (Botany), MSc (Botany) and PhD (Botany)
- Botanical ecologist with over 35 years' experience in the field of Vegetation Science.
- Founded Bergwind Botanical Surveys & Tours CC in 2006
- Has conducted over 400 specialist botanical / ecological studies.
- Has published numerous scientific papers and attended numerous conferences both nationally and internationally (details available on request)

Independence

The views expressed in the document are the objective, independent views of Dr McDonald and the survey was carried out under the aegis of, Bergwind Botanical Surveys and Tours CC. Neither Dr McDonald nor Bergwind Botanical Surveys and Tours CC have any business, personal, financial or other interest in the proposed development apart from fair remuneration for the work performed.

Conditions relating to this report

The content of this report is based on the author's best scientific and professional knowledge as well as available information. Bergwind Botanical Surveys & Tours CC, its staff and appointed associates, reserve the right to modify the report in any way deemed fit should new, relevant or previously unavailable or undisclosed information become known to the author from on-going research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of the report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I **David Jury McDonald**, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of Section 49A of NEMA.

Note: The terms of reference must be attached.

Signature of the specialist:

Bergwind Botanical Surveys & Tours CC

Name of company:

6 September 2016

Date:

CONTENTS

INTRODUCTION

Myezo Environmental Management Services (Myezo) was appointed by West Coast Resources (WCR) to carry out an Environmental Assessment process to support an application for renewed authorisation for future mining at Koingnaas Mine in the Kamiesberg Local Municipality, Namaqua District Municipality, Northern Cape Province. For this purpose, a study of the biodiversity of the proposed future mining areas was required. As reported here the study comprises an appraisal of the vegetation in the Koingnaas Mine study area (defined below) together with a faunal study, including avifauna.

Bergwind Botanical Surveys and Tours CC was appointed by Myezo to conduct a botanical assessment of the study area and Simon Todd Consulting was commissioned to conduct a faunal study. The main objective of the assessment was to describe the biodiversity of the environment of the mining rights areas at Koingnaas and to determine if there are any 'red-flags' that would require a precautionary approach. If present, the 'red flags' should be included in the Environmental Management Programme (EMPr) when mining operations commence.

The assessment takes careful note of the requirements and recommendations of the Department of Environment Affairs and Nature Conservation, Northern Cape (DENC) and the Botanical Society of South Africa for proactive assessment of biodiversity of sites where there is a proposed change of land use or potential impact (positive or negative) on natural vegetation and fauna. The study follows published guidelines for evaluating potential impacts on the natural environment in an area earmarked for some form of development (Brownlie 2005, De Villiers *et al.* 2005). **Particular note was taken of the Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009) and Regulations (2011).**

This report comprises two sections. **A.** Botanical Assessment and **B.** Faunal Assessment. Each section is a stand-alone assessment with a general summary and conclusions at the end of the report.

The Terms of Reference for the Biodiversity Study as supplied by Myezo are as follows:

SPECIFIC TERMS OF REFERENCE (TOR) FOR BIODIVERSITY (from Myezo Environmental Consulting Services).

- Review of existing data and surveys of the proposed areas to be disturbed to determine vegetation/habitat types, dominant fauna and flora species, as well as rare/endangered/threatened/invasive/alien species - plants/animals that are protected by law - also indicate any plants used for medicinal or cultural purposes - map/GPS locations - plants that might be sacred;

- Broad-scale structural classification of the vegetation into homogeneous units;
- Describe dominant and characteristic species identified within the broad-scale plant communities comprising each of these units. These descriptions will be based on visual estimates of cover/abundance and density following established vegetation survey techniques;
- Map plant communities and describe dominant and characteristic species within these communities;
- GPS and map rare/endangered species;
- Describe each vegetation unit in terms of its sensitivity, biodiversity value and conservation importance;
- Provide recommendations on aspects such as management of threatened plant species and communities, eradication / control of alien invasive species;
- Recommend species for protection *in situ*, translocation or use in rehabilitation practices.
- Develop a Biodiversity Management Plan in terms of National Environmental Management: Biodiversity Act, No.10 of 2004;
- Profile aquatic systems and characterize fauna and flora
- Determine biodiversity potential of the affected areas and provide measure on how they could be avoided
- All the mapping should be overlaid over the surface infrastructure layout plan which will be provided.
- Provide mitigation measures to alleviate or reduce the determined impacts.
- Provide a cost assessment of the proposed mitigation measures, costing estimates of how much the implementation of each mitigation measure will cost.

A. BOTANICAL ASSESSMENT OF THE KOINGNAAS MINING RIGHTS AREAS

A1. TERMS OF REFERENCE AND SITE DESCRIPTION

A1.1 TERMS OF REFERENCE

The terms of reference for the botanical study are summarized, providing the essential elements, from the above as follows:

- To broadly describe the terrestrial vegetation and flora of the study area that will be affected by the proposed future mining;

- To provide a description of possible impacts (direct, indirect and cumulative) that are anticipated;
- To assess cumulative impacts of the proposed mining on the flora and vegetation.
- To recommend appropriate and practical mitigation measures to minimize the negative impacts and maximize potential benefits associated with the mining; and
- To highlight any 'red flags' that would need to be observed to minimize impacts on the vegetation and flora.

A1.2. Location

The study area is located in Namaqualand in the Kamiesberg Municipality, Namaqua District Municipality, Northern Cape Province. It lies on the Namaqualand West Coast, around Koingnaas and north to Samson's Bak and south of Hondeklip Bay at Rooiwal Bay and Mitchell's Bay (Figures 1 & 2). The area falls within the Succulent Karoo Biome on the 'Coastal Plain' which also is often called the Sandveld or Namaqualand Sandveld Bioregion (Figure 3) (Van Wyk & Smith, 2001; Le Roux, 2005, 2015; Rutherford, Mucina & Powrie, 2006).

Figure 1. General locality of the study area on the Namaqualand coast.

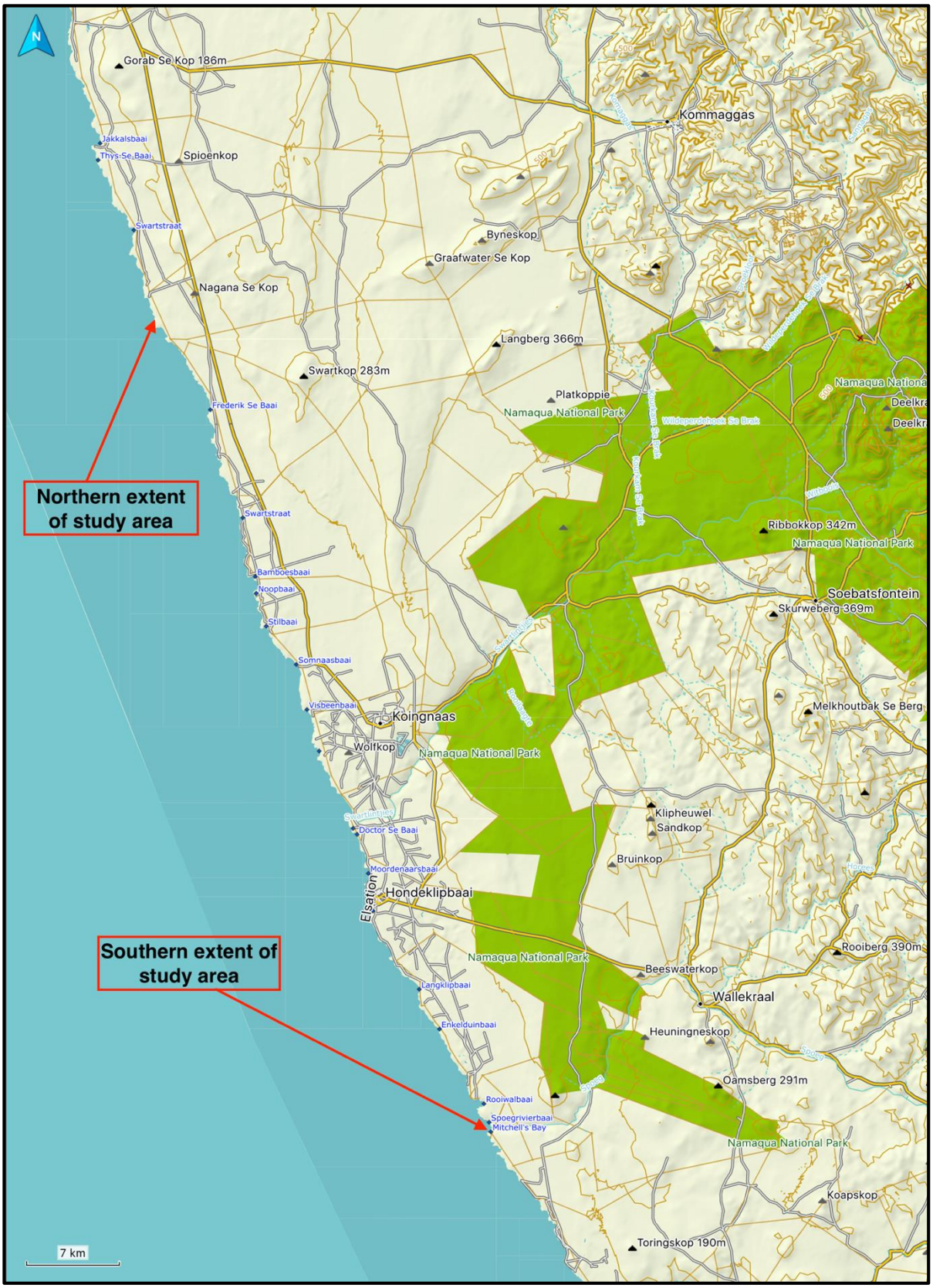


Figure 2. The southern and northern extents of the area investigated, south of Hondeklip Bay and north of Koingnaas.

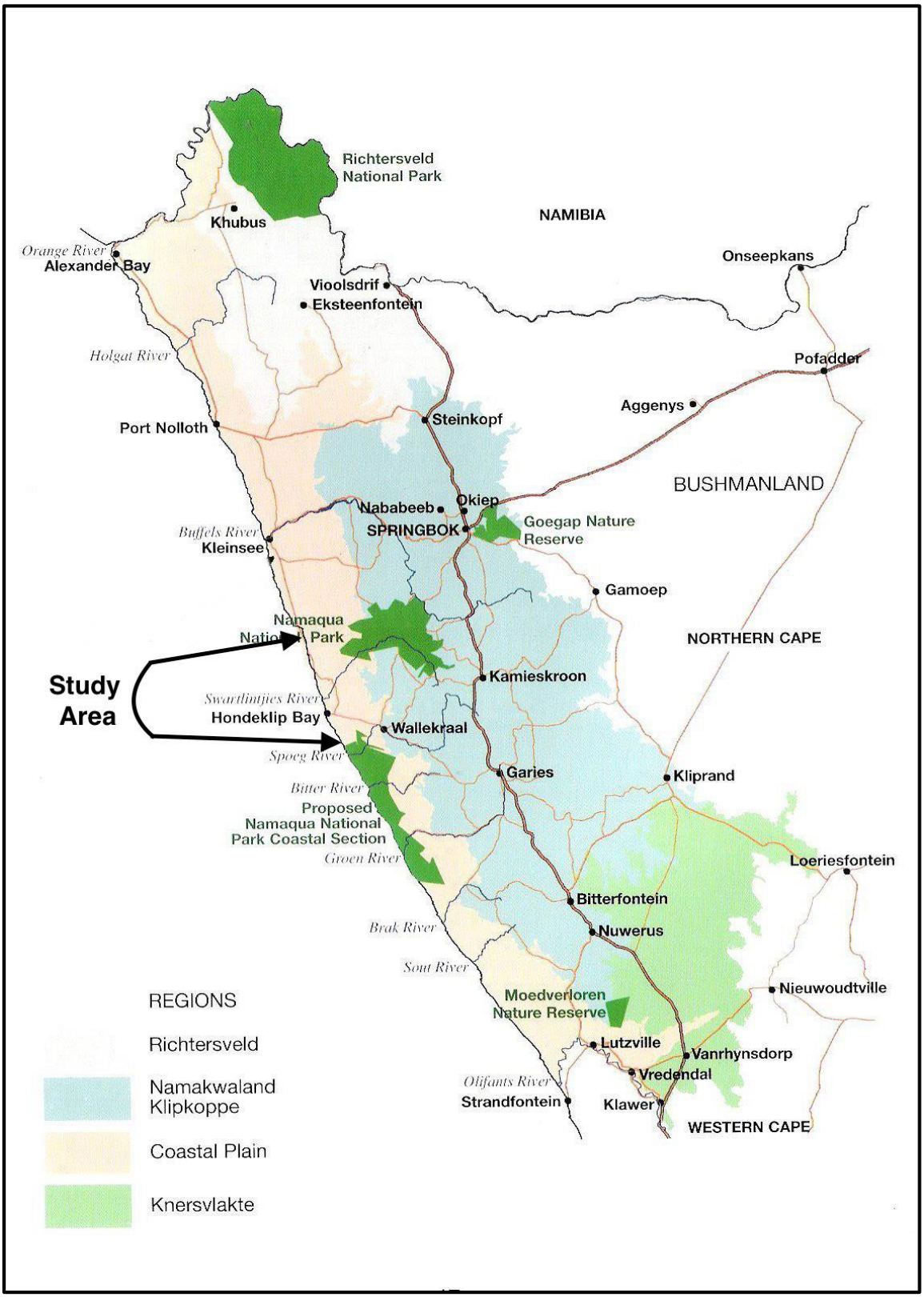


Figure 3. Broad regions of Namaqualand after Le Roux (2005), showing the position of the study area.

A1.3 Geology, topography and soils

The study site is along the Namaqualand coastline on the coastal foreland or 'Coastal Plain'. Elevation of the study area is between sea-level and 72 m above mean sea level (a.m.s.l.).

The region of the study area is underlain by rock of the Namaqua-Natal Metamorphic Belt (Cornell *et al.* 2006). The surface geology in the coastal zone consists of deep stabilized aeolian sands (Quaternary) that are white to grey and calcareous, overlying marine sediments that are composed of calcrete or dorbank hardpans. Immediately above the high-water mark the coastline has exposed granite of the Dikgat and Brazil Formations (Goraap Suite) (Marais, 2001). Further inland the soils are yellow sands becoming either red or yellowish-red overlying granite and gneisses.

The undulating coastal plain is about 30 km wide and separates the coast from the inland Namaqualand Klipkoppe (also known as the Namaqualand Hardeveld) comprising Mokolian granites and gneisses that form domes and rock sheets and weather to form yellow-brown to brown loamy sand (Mucina *et al.* 2006). Le Roux (1991) described the coastal Sandveld topography as consisting of three major landforms, based on the presence or absence of dunes: unstable dunes, semi-stable dunes and shallow, flat sand.

Observations on the study site indicate that a large quantity of the white, wind-blown sand that has given rise to low dunes has been deposited recently due to disturbance associated with diamond mining on the coast.

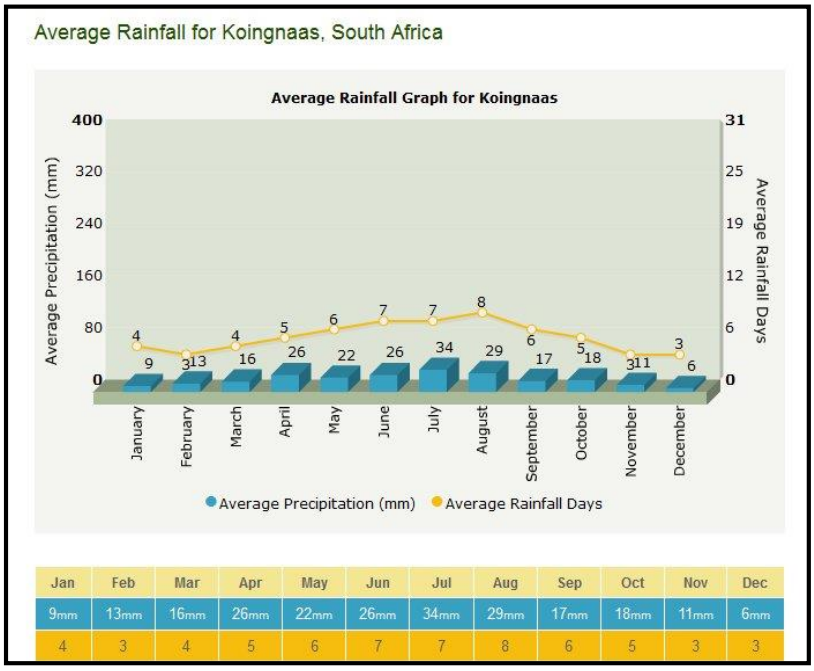
A1.4 Climate

The Namaqualand coast experiences low rainfall and from rainfall data collected at Koingnaas (Burger, 2007 in Arcus Gibb 2008), mean annual precipitation is 75 mm. Rain falls mainly in winter (see also Figure 4 obtained from www.worldweatheronline.com). However, climate diagrams published for Namaqualand Coastal Duneveld (Figure 6) and Namaqualand Strandveld (Figure 7) (Mucina *et al.* 2006) indicate that the rainfall is in excess of 100 mm per annum for the areas where these vegetation types occur.

The mean maximum temperature does not vary much throughout the year whereas there is a slightly greater amplitude in mean minimum temperature (Figure 5). This is due to the proximity to the Atlantic Ocean and the effect of the Benguela Current with regular fog occurring over the coastal zone. However, there are extremes with summer temperatures as high as 40 °C having been recorded at Koingnaas (November 2006). Winter temperatures can fall to 4 °C (Koingnaas: June 2006).

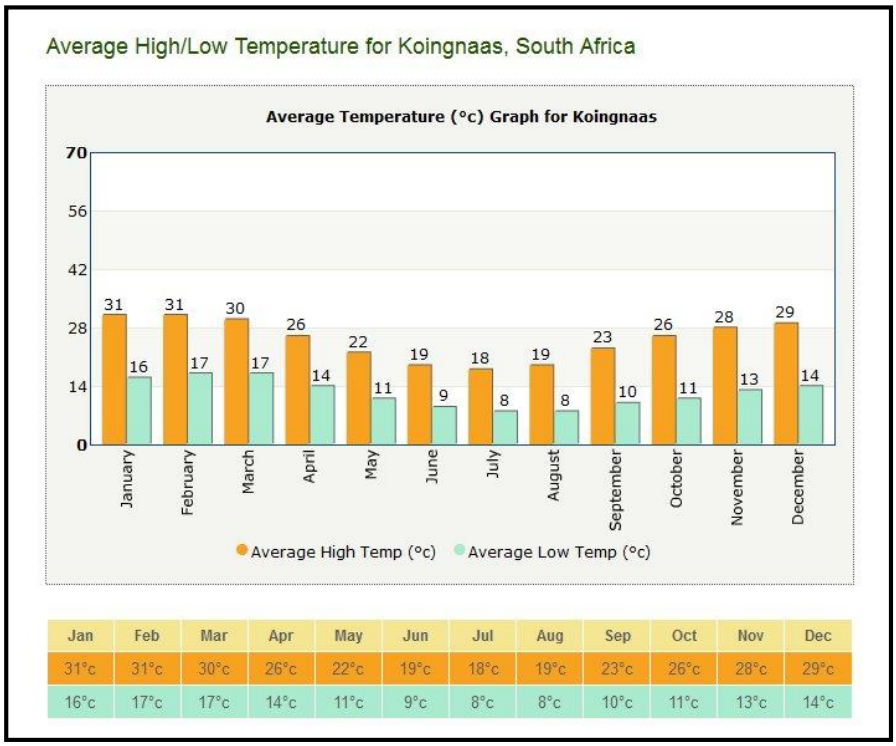
Temperatures can also be influenced by easterly berg wind conditions (off shore flow) in winter when the temperature may exceed 35 °C.

The prevailing surface winds are mostly from the south and south-east in the summer when winds are strong and speeds can exceed 10 m/s. Strong winds also occur from the west and north-west, mainly in winter.



Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9mm	13mm	16mm	26mm	22mm	26mm	34mm	29mm	17mm	18mm	11mm	6mm
4	3	4	5	6	7	7	8	6	5	3	3

Figure 4. Average rainfall for Koingnaas (source: http://www.worldweatheronline.com/weather-averages/South-Africa/2610093/Koingnaas/2614753/info.aspx



Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31°c	31°c	30°c	26°c	22°c	19°c	18°c	19°c	23°c	26°c	28°c	29°c
16°c	17°c	17°c	14°c	11°c	9°c	8°c	8°c	10°c	11°c	13°c	14°c

Figure 5. Average temperature at Koingnaas

(source: http://www.worldweatheronline.com/weather-averages/South-Africa/2610093/Koingnaas/2614753/info.aspx)

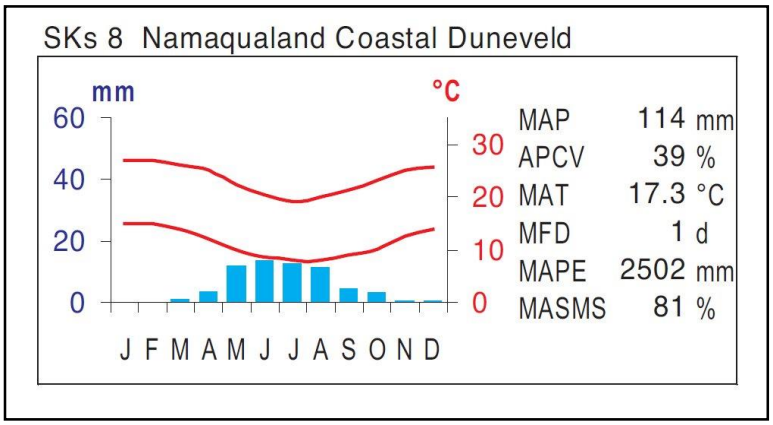


Figure 6. Climate diagram for Namaqualand Coastal Duneveld (from Mucina *et al.* 2006).

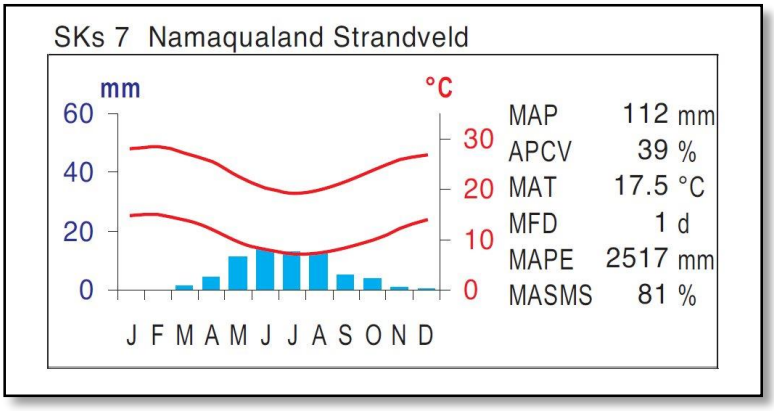


Figure 7. Climate diagram for Namaqualand Strandveld (from Mucina *et al.* 2006).

A2. METHODOLOGY

A2.1 METHODS AND APPROACH

Firstly, relevant literature was consulted. The author has previous experience of botanical surveys along the Namaqualand coast and these together with other studies were used to inform the present study (Low & Desmet, 2007; McDonald, 2011a, 2011b, 2012, 2013). Books such as 'The Vegetation of South Africa, Lesotho & Swaziland' (Mucina & Rutherford, 2006) and the Botanical Society Guide: Wild Flowers of Namaqualand (le Roux, 2015) have also been liberally consulted.

Field work was carried out over three days (21 – 24 July 2016). I was accompanied by Mr Tommie Diergaard, Security Officer at Koingnaas Mine and the survey followed the route taken by Mr Steve van der Westhuizen of Siteplan Consulting when he was investigating the dust, dune and rehabilitation earlier in July 2016. In this way it was attempted to 'twin' the botanical survey with the work of Siteplan. (A meeting was held with Mr van der Westhuizen in mid-July before my site visit to discuss their findings).

The approach was to first drive through Koingnaas Mine via Hondeklip bay to the southern extent of the study area at Rooiwal Bay that lies on the farm Mitchell's Bay (Farm No 495/0) and at the mouth of the Spoeg River. Thereafter the survey was carried out northwards towards Hondeklip Bay and Koingnaas. Twenty-two sample waypoints were recorded on 21 July 2016 (Figures 8 & 9) and a further 11 waypoints were recorded in 22 July 2016 (Figure 10). Additional photographs were taken at Samson's Bak on 23 July 2016.

The survey method used was a 'rapid appraisal' method where sample waypoints are recorded as surrogates for sample plots. At and around these waypoints, the structure and composition of the vegetation was recorded. In addition, the condition of the area was noted and photographs taken as a record of each site. The approach was not a formal phytosociological survey but the method is a 'tried and tested' method to enable the description of the vegetation.

A2.2 Assumptions and Limitations

The botanical study was carried out in winter. The seasonal timing of the study was not optimal but acceptable. Vegetation in Namaqualand is at its best in spring.

However, a high level of confidence was achieved in the observations made so season was not a limiting factor in this study.

The study area is large and the logistics within the mine are difficult due to security constraints. Therefore, only limited time could be assigned to field-work. The rapid assessment approach allowed for appropriate sampling to be carried out within the time available. It would always be desirable to spend as much time as possible surveying vegetation but despite the limited time, adequate information was collected and this is not seen as a limitation for the study.

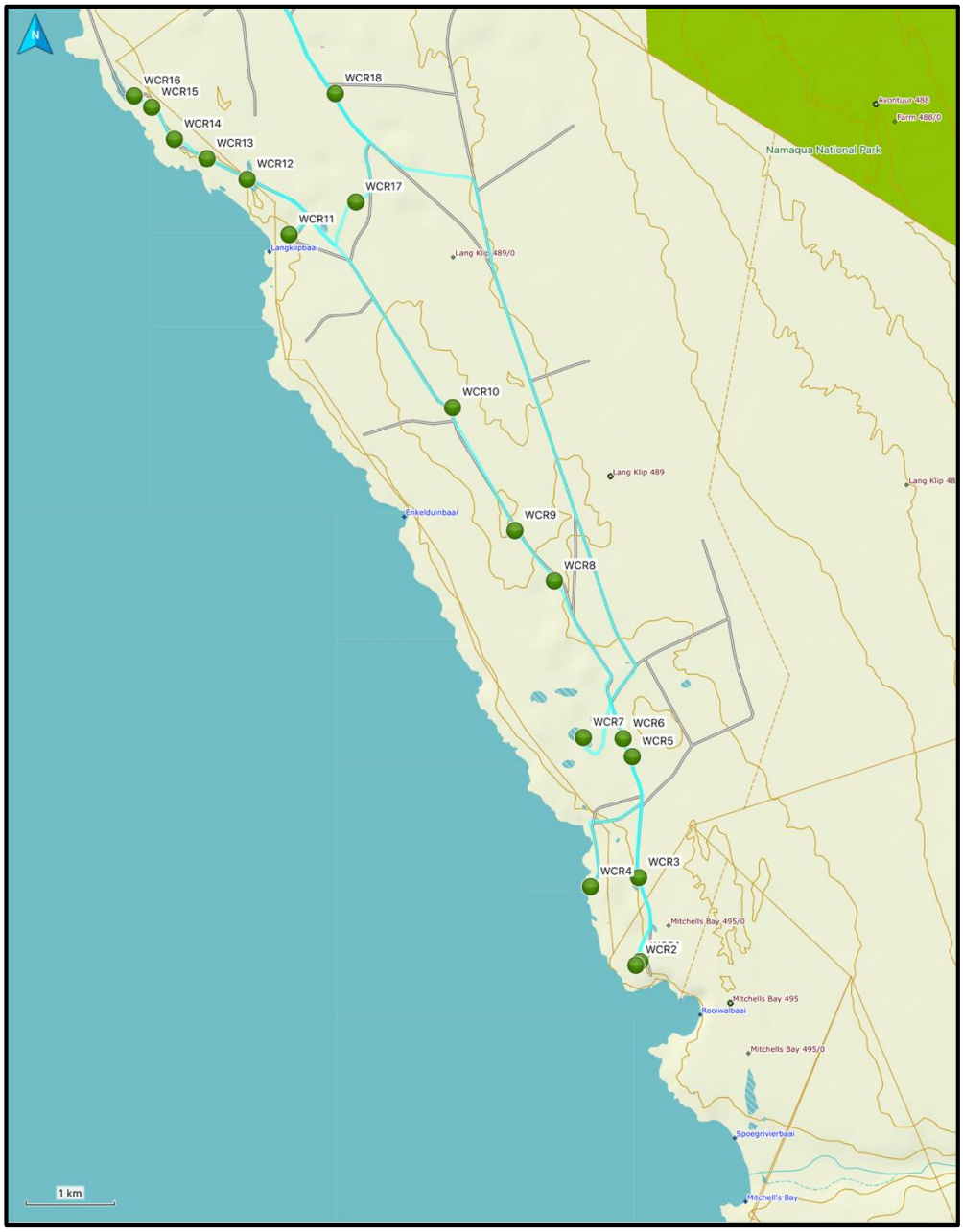


Figure 8. Waypoints (green dots) and track followed in the southern part of the study area, south of Hondeklip Bay.

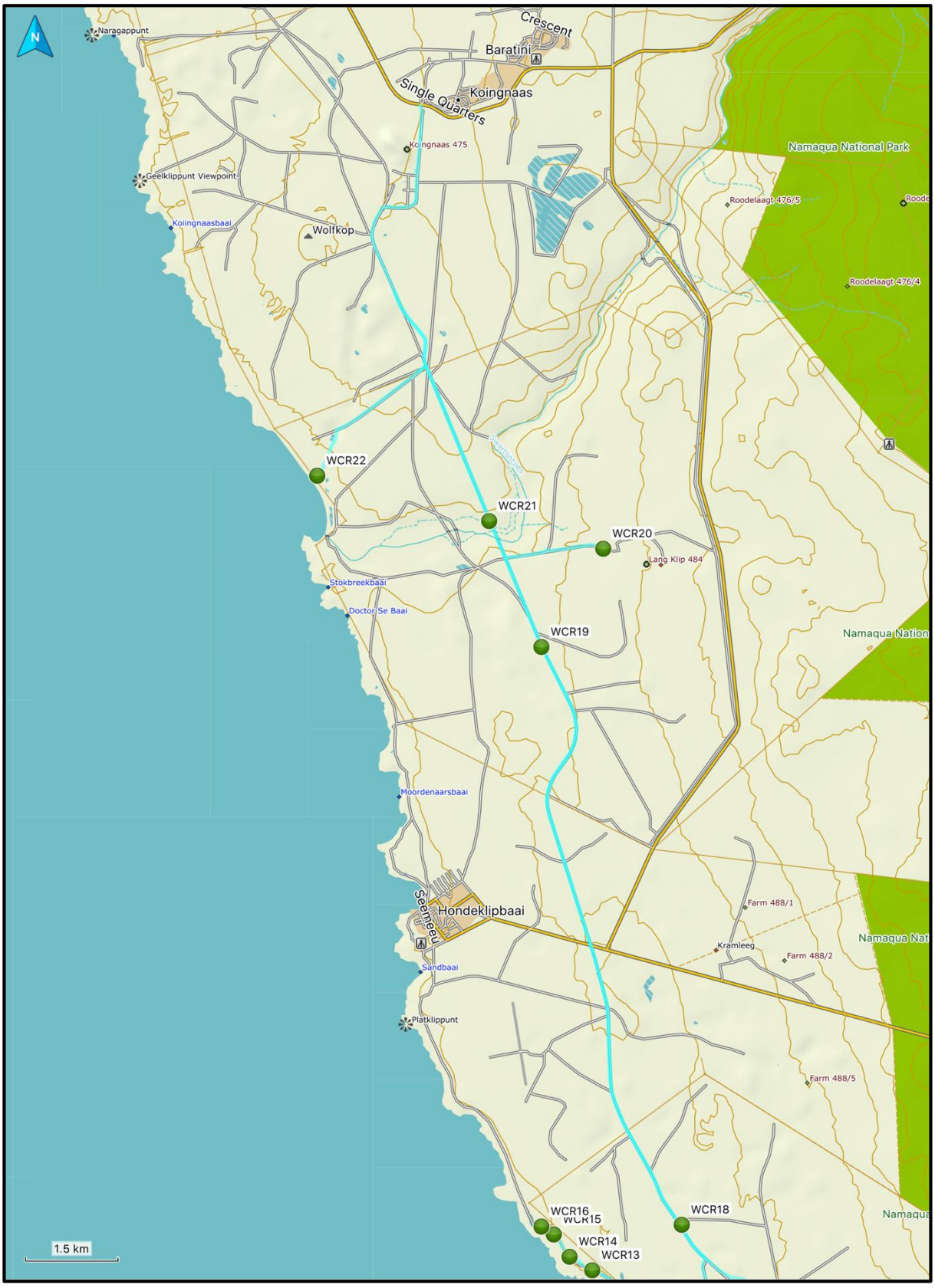


Figure 9. Waypoints (green dots) and track followed in the southern part of the study area from south of Hondeklip Bay to Koingnaas.

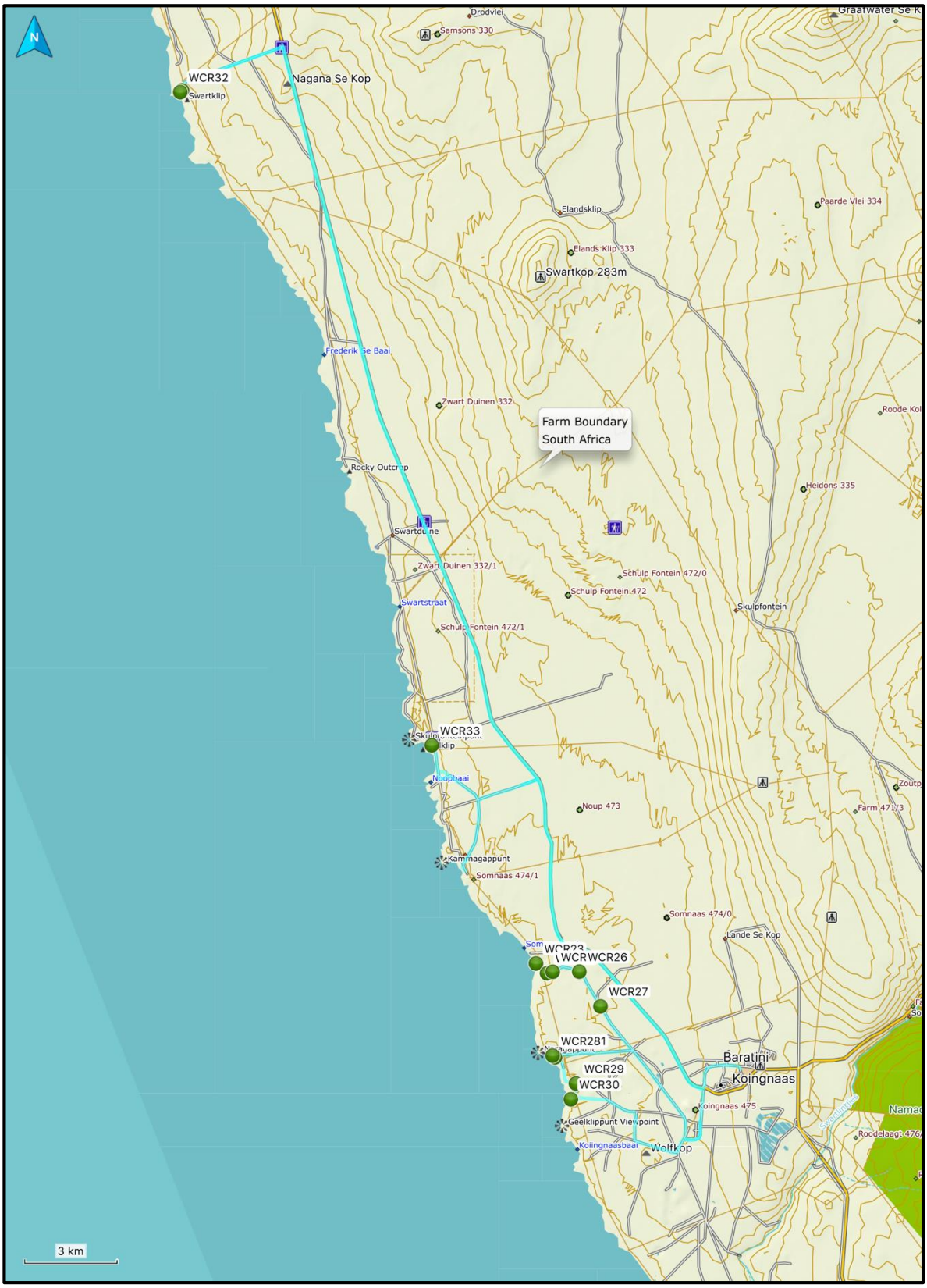


Figure 10. Waypoints (green dots) and track followed in the Koingnaas area and north to Samson's Bak.

A.3 THE VEGETATION

A.3.1 Broad context

The study area falls within the extensive, arid Succulent Karoo Biome (Rutherford & Westfall, 1994; Mucina *et al.* 2006 in Mucina & Rutherford, 2006) and regionally within the Namaqualand Sandveld Bioregion that lies parallel to the west coast in the western part of the Succulent Karoo Biome (Rutherford, Mucina & Powrie, 2006 in Mucina & Rutherford, 2006; Desmet, Turner & Helme, 2009) (Figure 8). The Succulent Karoo Biome has high levels of plant diversity and endemism and is one of the earth's 'hotspots' of plant diversity and the only entirely arid hotspot in the world (Van Wyk & Smith, 2001). Four vegetation types are found in or near the study area. They are (1) azonal Namaqualand Seashore Vegetation (AZd2) along the coast; (2) azonal Namaqualand Salt Pans (AZi2); (3) Namaqualand Coastal Duneveld (SKs8) on the semi-mobile coastal dunes and (4) Namaqualand Strandveld (SKs7) found on red to yellow stabilized aeolian sand overlying a basement of marine sediments and granite-gneisses.

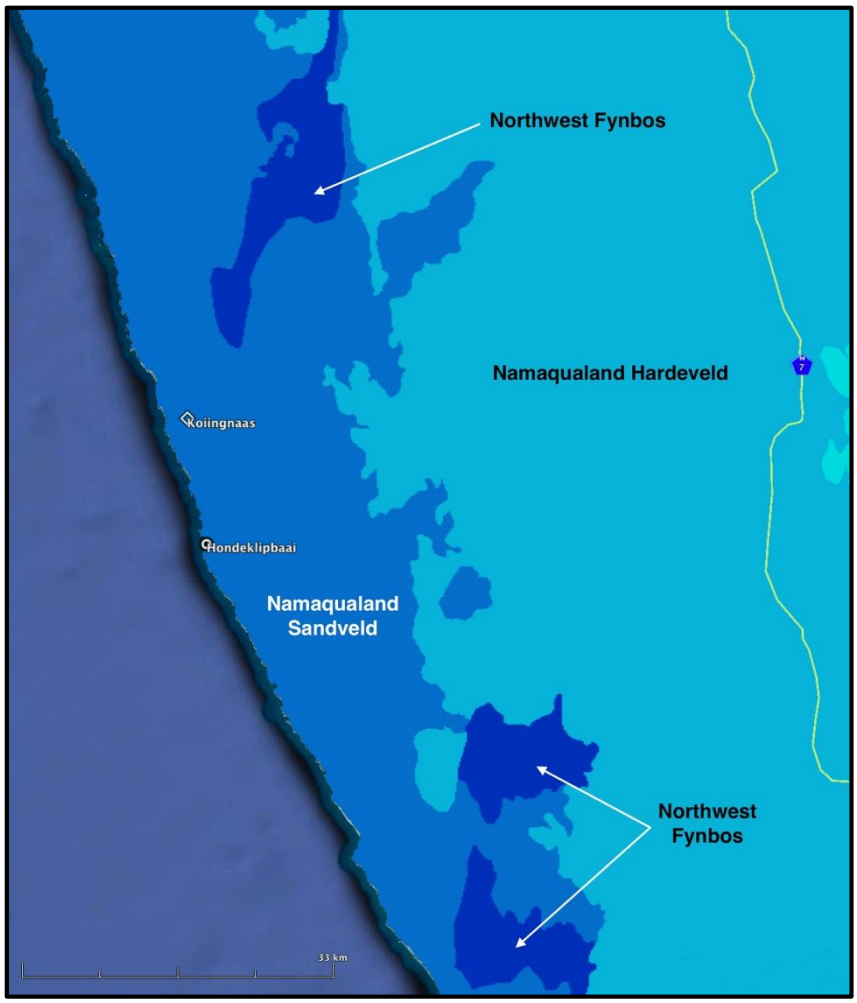


Figure 11. Portion of the bioregions map from Mucina, Rutherford and Powrie (2005) with the dark blue indicating the Namaqualand Sandveld bioregion closest to the coast.

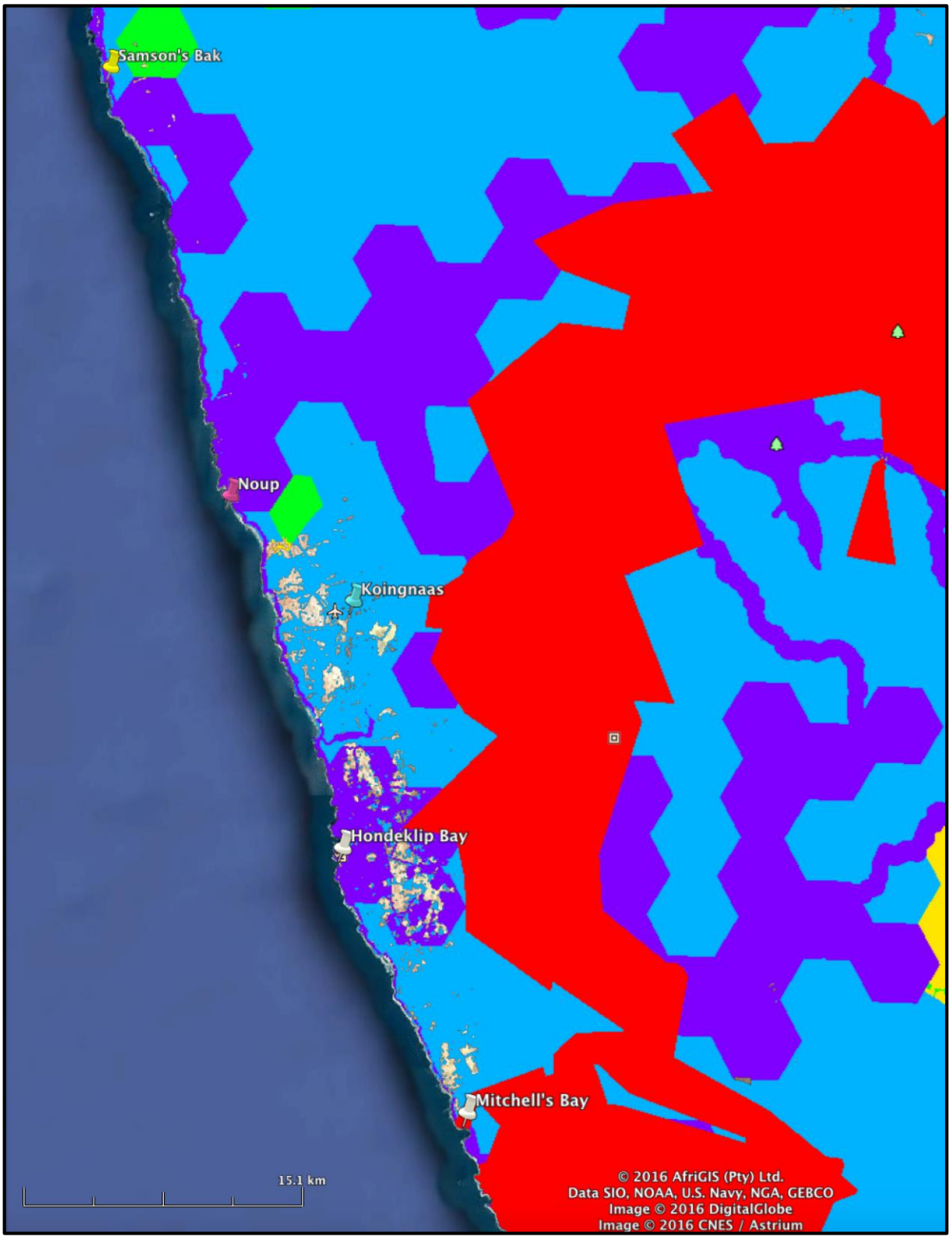


Figure 12. Portion of the mapped Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESAs) for Namaqua District Municipality on the coast. The purple shading represents Critical Biodiversity Areas (1); the light blue areas are Critical Biodiversity Areas (2), the green areas are Ecological Support Areas (ESAs) and the red area is a protected area, in this case Namaqua National Park.

A3.2 Critical Biodiversity Areas

Critical Biodiversity Areas (CBAs) within the Namaqua District Municipality (NDM) were mapped by Desmet and Marsh (2008). Subsequently Critical Biodiversity Areas maps have been developed and are available for the whole of the Northern Cape Province. The shapefiles for the latter were made available to the author by Mr Enrico Oosthuysen at DENC and have been applied here to obtain the CBA map in Figure 12. The study area largely falls within CBA (1) and CBA (2) within the coastal corridor.

A3.3 Vegetation communities

Owing mainly to restricted access to the diamond-mining areas along the Namaqualand coast there have been few detailed botanical studies in the coastal sandveld of Namaqualand. Le Roux (1991) in a study of Brazil recognized three major plant communities: *Zygophyllum cordifolium–Drosanthemum marinum* Shrubland with *Stoeberia beetzii-Wooleya farinosa* Shrubland on flat, shallow sands and *Zygophyllum morgsana-Arctotis decurrens* (syn. *A. merxmuelleri*; *A. scullyi*) Shrubland on unstable to semi-stable white dunes. Low & Desmet (2007) observed that the dunes in the south of the Brazil area are unstable and poorly vegetated but overall the vegetation is in moderate to good condition with 43 species found in the above communities. These species include *Fenestraria rhopalophylla* subsp. *aurantiaca* the "window succulent", also of conservation importance.

The broad vegetation types recognized by Low & Desmet (2007) are shown in Figure 13 as determined for their study at Brazil and Schulpfontein (that lie immediately north of Samson's Bak). This map is very similar to the National Vegetation Map for the area (Mucina *et al.* 2005, 2009).

The vegetation units recognized by Mucina, Rutherford & Powrie (2005, 2009) and Mucina *et al.* (2006) which occur within the study area are Namaqualand Seashore Vegetation (AZd2), Namaqualand Coastal Duneveld (SKs8), Namaqualand Strandveld (SKs7) and Arid Estuarine Salt Marshes (AZe1) (Figure 14). Namaqualand Salt Pans (AZi2) do not occur in the area investigated. The vegetation types principally affected by mining are Namaqualand Seashore Vegetation (AZd2), Namaqualand Coastal Duneveld (SKs8) and Namaqualand Strandveld (SKs7).

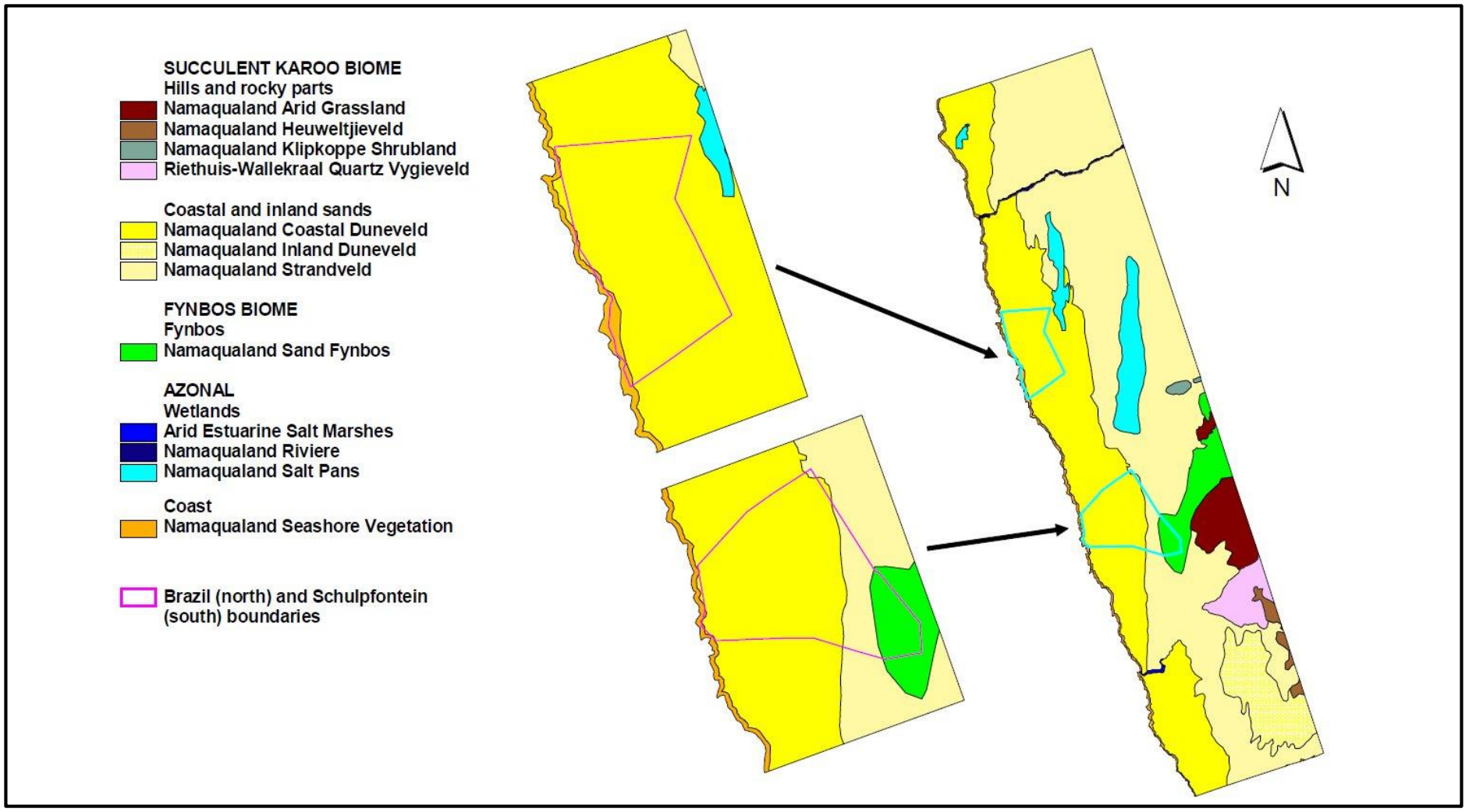


Figure 13. Vegetation map from Low & Desmet (2007) indicating the units they recognized for farms Brazil & Schulpfontein near Samson's Bak.

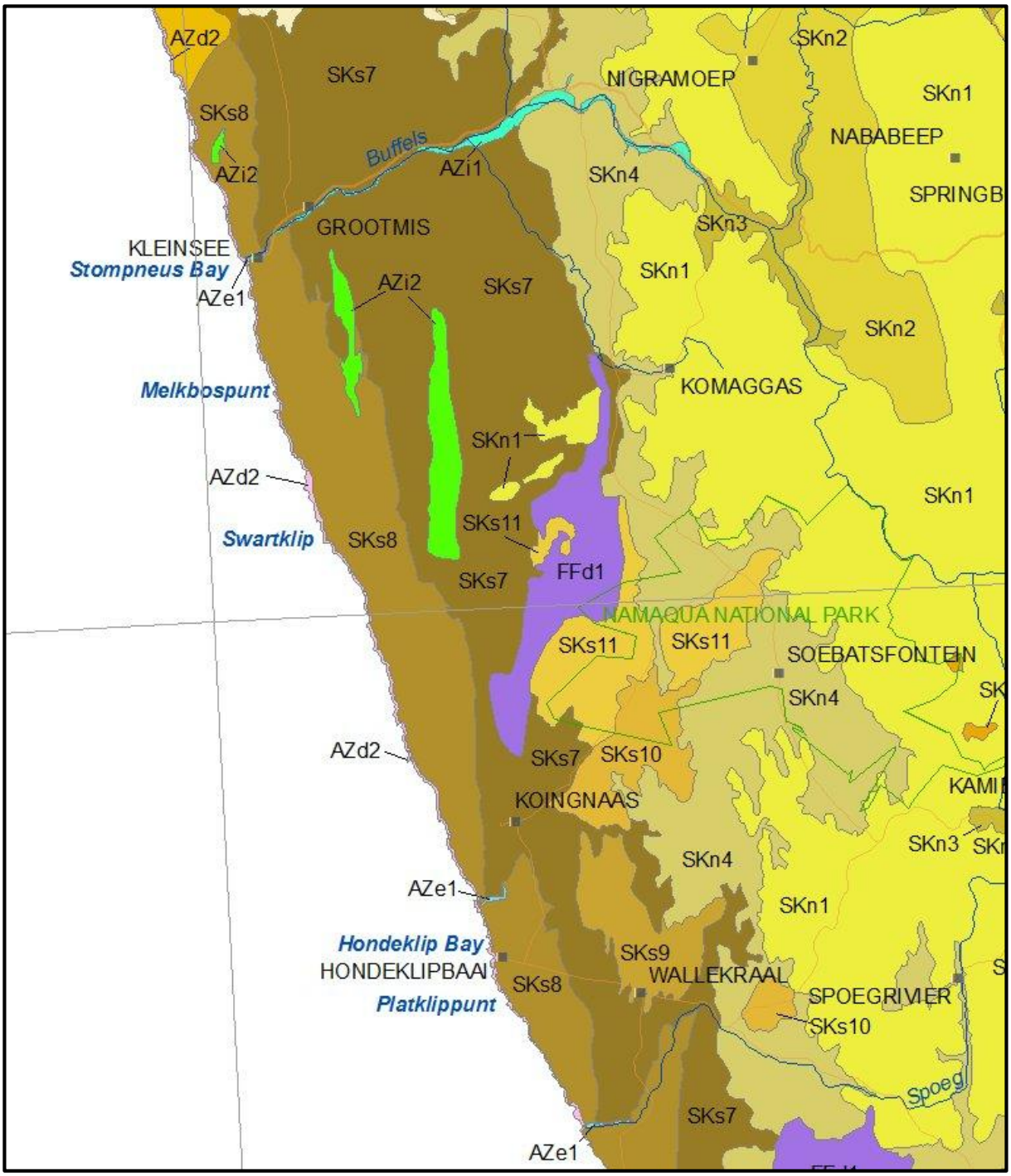


Figure 14. Portion of the Vegetation map of South Africa, Lesotho & Swaziland (Mucina *et. al.* 2005, 2009) showing the vegetation found on the Namaqualand coast. Codes for the relevant units are given in the text in Section A3.3.

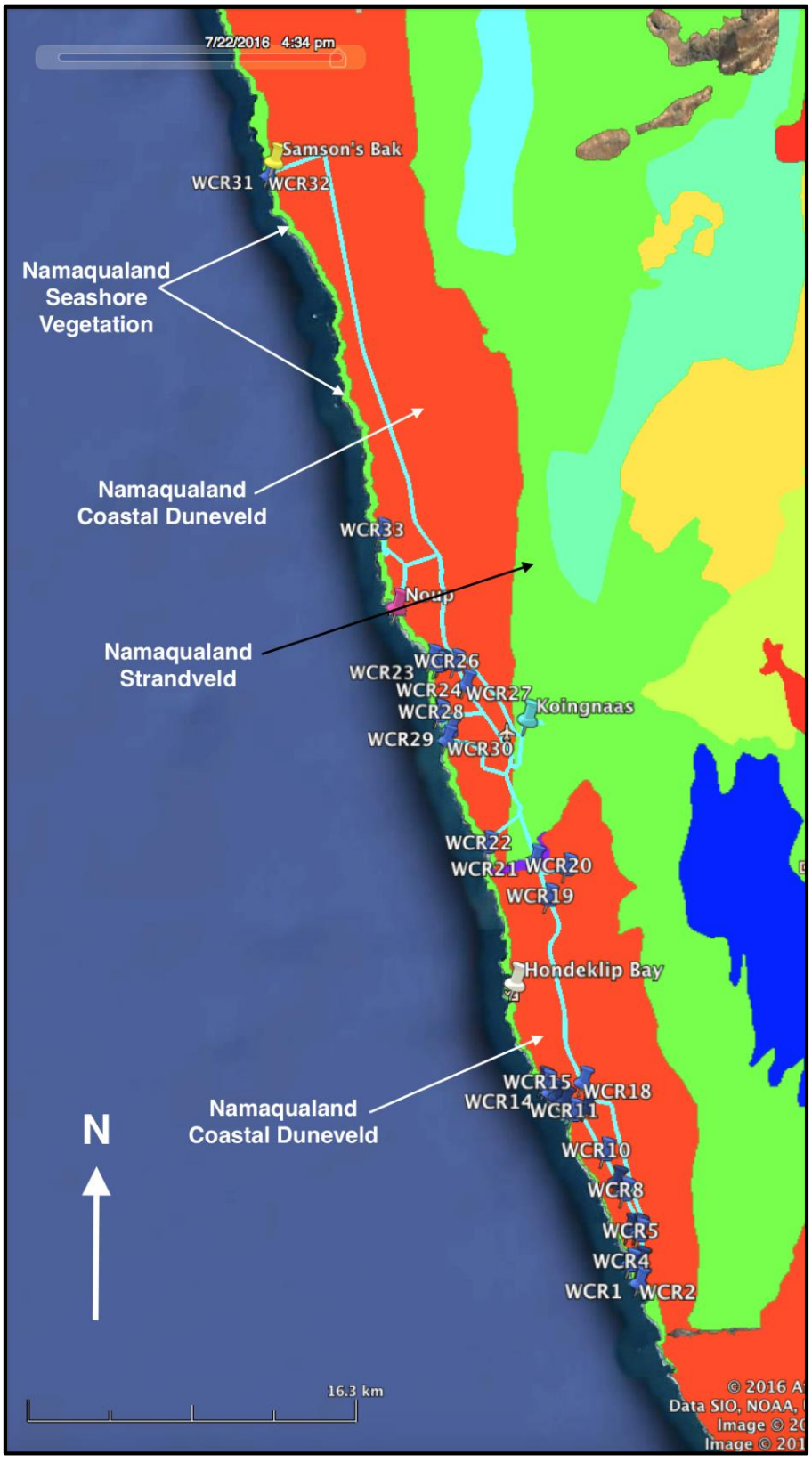


Figure 15. Vegetation map of South Africa, Lesotho & Swaziland (Mucina *et. al.* 2005, 2009) overlaid on Google Earth ™with the survey tracks and sample waypoints superimposed.

A3.3.1 Vegetation recorded at sample waypoints

Observations recorded during the survey at the sample waypoints are given in Table 1.

Table 1. Waypoints, descriptive notes and illustrations of the sites recorded during the field investigation of the WCR study area.

Waypoint	Co-ordinates	Descriptive notes	Illustration
WCR1	S30° 27' 01.3" E17° 20' 50.4	At Rooiwal Bay, Mitchell's Bay Mining Complex. A high level of disturbance of the near-shore environment with significant areas not vegetated. The original vegetation was probably Namaqualand Coastal Duneveld. Piles of soil have been heaped near the diggings. Plant species recorded amongst the spoil heaps include, *Asparagus capensis, Galenia sarcophylla, Helichrysum sp.,Hypertelis angra-pequenae, Lycium sp. (flat, spreading), Crassothonna cylindrica, Stoeberia beetzii, Tetraria decumbens.*	

			
WCR2	S30° 27' 02.6" E17° 20' 48.8	Undisturbed Namaqualand Coastal Duneveld on the sea-side of the diggings. Low open shrubland on yellow sandy soil. Species include, *Amphibolia maritima, Arctotis decurrens, Asparagus capensis, Atriplex cinerea, Babiana hirsuta, Cheiridopsis sp., Cladoraphis cyperoides, Crassothonna cylindrica, Felicia sp. Galenia sarcophylla, Gazania sp., Helichrysum sp., Hypertelis angra-pequenae, Lycium tetrandrum, Mesembryanthemum guerichianum, Osteospermum oppositifolium, Othonna arborescens, Pteronia onobromoides,Ruschia sp., Stoeberi beetzii, Zygophyllum cordifolium, Zygophyllum morgsana.*	

WCR3	S30° 26' 30.8" E17° 20' 49.9	Along main road in Mitchell's Bay Mining Complex. At netted 'white sand' dune. The rehabilitation is very successful here.	
WCR4	S30° 26' 34.1" E17° 20' 31.4	At lower sea water intake for Mitchell's bay Mining Complex. This area is disturbed by roads and pipelines as well as soil dumps. It is not well rehabilitated.	

		Spoil heaps near the lower sea water intake have not been revegetated and are rutted from erosion.	
WCR5	S30° 25' 46.9" E17° 20' 47.4	A rehabilitated rounded spoil heap. This heap was ploughed to break up the surface. It has revegetated, with *M. guerichianum* dominant. The local environment is generally disturbed but with some patches of intact vegetation. Other species noted include *Atriplex cinerea, Atriplex lindleyi* subsp. *inflata, Othonna* sp. and *Senecio arenarius.*	

WCR6	S30° 25' 40.4" E17° 20' 43.9	The spoil heap at this location has not been well rehabilitated when compared with that at waypoint WCR5.	
WCR7	S30° 25' 40.0" E17° 20' 28.6	At a slimes dam surrounded by highly disturbed spoil. Rehabilitation is non-existent.	

WCR8	S30° 24' 43.1" E17° 20' 17.4	At old De Beers mining block. The excavation is very deep and there is minimal revegetation. Alongside the main road are patches of intact vegetation consisting of dense low shrubland.	 

WCR9	S30° 24' 24.9" E17° 20' 02.3	Intact Namaqualand Strandveld with low succulent vegetation. The vegetation has a high diversity of species and is ecologically functional (noted: rodents, millipedes, birds). One of the prominent species is *Jordaaniella spongiosa* (opposite) and endemic species on the coastal plain.	 

WCR10	S30° 23' 40.3" E17° 19' 38.3	Near a netted area where restoration is only partial and not good. It could improve with time. The area nearby is in good condition with 1 m tall strandveld vegetation. Abundant birdlife in this area including Malachite Sunbird feeding on *Lycium cinereum*.	
WCR11	S30° 22' 37.6" E17° 18' 35.3	At coffer dam mining site at the coast in Mitchell's Bay Mining Complex. Massive disturbance with the coastal dunes and vegetation totally destroyed.	

		Intact Namaqualand Strandveld was noted inland of the coastal mining zone both to the north and south of this waypoint.	
WCR12	S30° 22' 17.5" E17° 18' 19.2	On road overlooking a mobile sand dune. This is referred to as the Mitchell's Bay Dune Plume by Siteplan. The dunes are hardly vegetated. The main species is *Cladoraphis cyperoides* on hummock-like crests.	

		On the inland (east) side of the road is low to mid-high Namaqualand Strandveld.	
WCR13	S30° 22' 10.0" E17° 18' 03.7	This is a 'bedrock sweeping area' that was mined by De Beers. Soil has washed over part of the area and the vegetation is very sparse.	

WCR14	S30° 22' 03.0" E17° 17' 51.2	Bedrock mining area (De Beers). Highly disturbed and not actively rehabilitated at all.	
WCR15	S30° 21' 51.4" E17° 17' 42.4	A spoil heap has been scarified at this location and it is gradually restoring. At present the vegetation is open but with time it could gain higher cover.	

WCR16	S30° 21' 47.3" E17° 17' 35.7	R1B inland mining area (not far from the sea). Salt water seeps into the diggings. The terrain is totally destroyed with no vegetation left.	
WCR17	S30° 22' 25.7" E17° 19' 01.1	Extensive netted area where rehabilitation has been highly successful.	

WCR18	S30° 21' 46.4" E17° 18' 53.1	At a massive mining pit where there is no rehabilitation. In the area nearby where spoil has been deposited, netting is in place and vegetation restoration is moderate to good.	 

WCR19	S30° 16' 45.9" E17° 17' 35.7	On the main mine road, north of the junction with the Hondeklip Bay road. Some spoil heaps are located to the west but between the road and the dumps the Namaqualand Strandveld is in good condition and ecologically functional.	
WCR20	S30° 15' 54.8" E17° 18' 09.7	At Swartlintjies (SL4-2) – a massive excavation with netted slopes on the east side.	

		Marginal revegetation on the sides of the pit but no active rehabilitation. The area around the pit supports intact vegetation that is ecologically functional. Birds are active in this area e.g. larks and Ant-eating Chat.	
WCR21	S30° 15' 40.4" E17° 17' 06.8	At Swartlintjies River. This is the only place in the study area where there is Arid Estuarine Salt Marsh. It will not be affected by mining except that the main road that crosses N-S will be regularly used.	

		Arid Estuarine Salt Marsh on the west side of the main road at Swartlintjies River.	
		The river-bed of the Swartlintjies River is impacted by the presence of the main mine road.	

WCR22	S30° 15' 16.8" E17° 15' 32.0	Current beach mining north of Swartlintjies River. The activity has resulted in total loss of any vegetation except in some places where halophytic salt marsh plant species (cf. *Sarcocornia* sp.) have colonized the brack soils.	 

WCR23	S30° 09' 54.3" E17° 13' 25.6	Somnaas area at Coetzee Family graves. To the north of the graves is a huge pit that is now filled with water. The general environment around the mined pit is highly disturbed with random placement of spoil heaps. Vegetation has recolonized in places.	 

		At the coast near the graves is well-developed Namaqualand Coastal Duneveld grading into Namaqualand Seashore Vegetation. This area is not disturbed and provides a good example of what the coastal environment is like without massive disturbance from mining. Plant species recorded here include, *Amphibolia laevis, Atriplex vestita, Calobotra halenbergensis, Caroxylon aphyllum, Cladoraphis cyperoides, Crassothonna cylindrica, Galenia sarcophylla, Hypertelis angra-pequenae, Lycium cinereum, Stoeberia beetzii, Stoeberia frutescens, Tetragonia fruticosa.*	

WCR24	S30° 10' 04.5" E17° 13' 37.8	Somnaas area, along track. A denuded area with abundant spoil heaps that have not been rehabilitated.	
WCR25	S30° 10' 02.9" E17° 13' 43.9	*Lessertia frutescens* subsp. *frutescens* (Jantjie-Bêrend) growing on spoil heaps with *Cladoraphis cyperoides* (dune grass). This is natural, unaided restoration.	

		Lessertia frutescens subsp. *frutescens* (Jantjie-Bêrend) used in traditional medicine for treating cancer, stomach ailments and other illnesses. This leguminous species (nitrogen-fixing) could be successfully used for rehabilitation purposes.	
WCR26	S30° 10' 02.8" E17° 14' 13.3	An area of undisturbed Namaqualand Coastal Duneveld in the Somnaas area on a convex crest next to the road. The vegetation is dominated by low vygies 10 – 75 cm tall. The veld is open to mid-dense and the species recorded include, *Crassothonna cylindrica, Crassothonna sedifolia*, *Ehrharta* sp., *Galenia sarcophylla, Lycium cinereum, Manochlamys albicans, Mesembryanthemum guerichianum, Mesembryanthemum subnodosum, Ruschia* sp. *Stoeberia beetzii, Tetragonia fruticosa, Tetragonia* sp., *Trachyandra falcata, Zaluzianskya* sp., *Zygophyllum cordifolium.*	

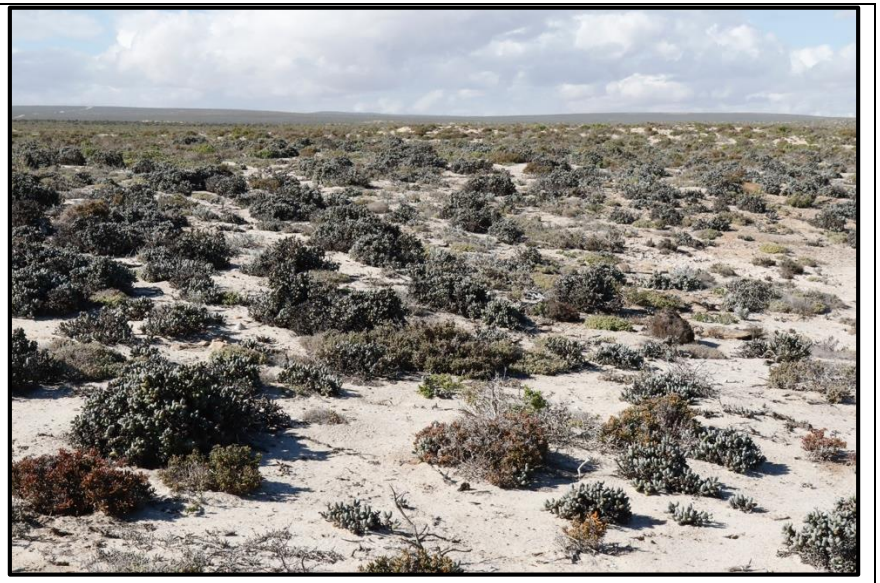
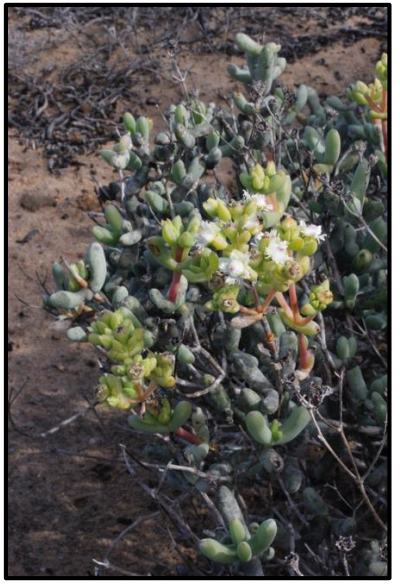
WCR27	S30° 10' 38.8" E17° 14' 36.8	Somnaas area on main road, at a large trench. Disturbance is restricted to the area on both sides of the trench. The undisturbed vegetation is Namaqualand Strandveld.	
WCR28	S30° 11' 31.8" E17° 13' 46.6	On coast at Visbeenbaai. Coffer dams have been built here and the coastal environment is extremely disturbed by mining activities. No coastal vegetation remains in the mining footprint.	

		Where the dunes are not disturbed, the dominant species are *Caroxylon aphyllum* and *Cladoraphis cyperoides*. *Senecio arenarius* and *Mesembryanthemum guerichianum* are also present on degraded dunes (i.e. degraded Namaqualand Coastal Duneveld).	
		Very high intensity disturbance with no signs of attempted restoration.	

WCR28-1	S30° 11' 30.1" E17° 13' 43.8	High intensity disturbance along the access road to Visbeenbaai. Note the unnecessary tracks over the dune through Namaqualand Coastal Duneveld.	
WCR29	S30° 11' 58.9" E17° 14' 09.5	An area south of Visbeenbaai where bedrock sweeping was carried out by De Beers. The rock is denuded of soil and hence vegetation.	

WCR30	S30° 12' 15.3" E17° 14' 04.0	A large excavated pit in the near-coastal zone. A wet screening plant was previously located here. The environment is extremely disturbed and not restored at all.	
WCR31	S29° 54' 47.8" E17° 06' 55.0	Samson's Bak. A wide, moderate gradient landscape extends from the Koingnaas—Kleinsee road to the coast. The vegetation is low Namaqualand Strandveld and is dominated by succulent- and sclerophyllous-leaved plant species.	

		A hard gravel track extends from the main road to the bay at Samson's Bak. The Namaqualand Strandveld is low, mid-dense shrubland that uniformly covers an extensive area. Apart from the access roads, mining at Samson's Bak is unlikely to negatively impact this vegetation to any significant extent. The near-shore zone at Samson's Bak supports Namaqualand Coastal Duneveld and Namaqualand Seashore Vegetation.	 

		An important species in the low succulent strandveld shrubland is *Wooleya farinosa*, seen here as a rounded low, grey-leaved shrub (dominant). Other species include, *Arctotis decurrens, Calobotra halenbergensis, Caroxylon* sp., *Cheiridopsis* sp., *Cladoraphis cyperoides, Crassothonna cylindrica, Crassothonna sedifolia, Didelta carnosa, Drosanthemum hispidum, Galenia sarcophylla, Gazania splendidissima, Lycium cinereum, Lycium tetrandrum, Mesembryanthemum guerichianum, Osteospermum oppositifolium Osteospermum oppositifolium,Pteronia onobromoides, Ruschia* sp., *Stoeberia beetzii, Zygophyllum cordifolium, Zygophyllum morgsana.* *Stoeberia beetzii* – co-dominant with *Wooleya farinosa* in the duneveld at Samson's Bak	 

WCR32	S29° 54' 49.7" E17° 06' 53.1	The bay at Samson's Bak that will be mined, with vegetation transitional between Namaqualand Coastal Duneveld and Namaqualand Seashore Vegetation.	
WCR33	S30° 06' 07.9" E17° 11' 30.5	Steep west-facing dune-slopes at Noup. The coastal vegetation has been impacted by use of the area for recreation in the past. It is now restoring naturally.	

A3.3.2 Plant species

Since this study was not undertaken over a long period and was not a comprehensive phytosociological survey, a checklist of plant species for the study area was obtained from the South African National Biodiversity Institute SIBIS database (*Accessed through the SIBIS portal, sibis.sanbi.org, 2009-06-01 Note: This database is no longer available and will be replaced by the South African National Biodiversity Institute in due course)* – Appendix 1. The status of the species listed was obtained from the Red List of South African Plants (Raimondo *et al.* 2009; www.redlist.sanbi.org).

Wooleya farinosa (Figure 12) is a Namaqualand Strandveld / Namaqualand Coastal Duneveld endemic species and therefore has important conservation value. It has been impacted by diamond-mining along the Namaqualand coast and is listed as RARE (Raimondo *et al.* 2009) although locally dominant not only on sandy dune substrates but also on granite-gneisses (Low & Desmet, 2007).

Low & Desmet (2007) speculated that several Namibian endemic plant species may occur in the vegetation found at Brazil and by inference could occur southwards in the study area to Rooiwal Bay. Determination of this would require systematic plant collection over a wide area which was beyond the scope of the current project.

Figure 12. *Wooleya farinosa* – a localized endemic species from the Namaqualand Sandveld bioregion (Namaqualand Coastal Plain).

A3.3.3 Summary of vegetation attributes, sensitivity and condition

The vegetation in the area investigated between Mitchell's Bay and Samson's Bak consists of (1) Namaqualand Seashore Vegetation that is limited to a narrow band in the near-shore zone either on consolidated dunes or on loose sand, (2) Namaqualand Coastal Duneveld and (3) Namaqualand Strandveld that extends from the near-shore environment inland on consolidated yellow sandy soils.

Namaqualand Seashore Vegetation is usually completely lost at any site where coffer dams are built and where beach mining occurs e.g. at Visbeenbaai (see waypoint WCR28 in Table 1). The seashore vegetation is not species-rich and is not botanically sensitive. However, it is adapted to the harsh conditions of the seashore and so acts as a stabilizer in a highly dynamic environment, both physically and chemically.

Namaqualand Coastal Duneveld is found on dunes immediately inland of the coastline, mainly on white sandy soils. This vegetation is mapped by Mucina *et al.* 2005, 2009) as occurring as much as 8 km inland from the coast. However, observations in the study area indicate that the vegetation found inland of the dune-fields is Namaqualand Strandveld and not Namaqualand Coastal Duneveld as mapped.

Namaqualand Strandveld is in a less physically and chemically dynamic environment than Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld. However, it is subject to significant stressors such as wind and low rainfall. Namaqualand Strandveld is highly adapted to its environment, is species-rich and harbours a number of endemic species e.g. *Arctotis decurrens, Jordaaniella spongiosa, Wooleya farinosa* and others. Even though it is resilient, high levels of disturbance from activities such as mining can result in degradation and successive loss of plants species. This can result, for example, from excessive wind-blown sand that arises from disturbance of the beach environment during mining.

The mining that has taken place in the past by De Beers has resulted in extremely high impacts locally. In addition, there has been little to no rehabilitation. Shade-netting has been installed in places but this appears to be a haphazard approach. Apparently, no systematic restoration / rehabilitation programme was implemented. The landscape is thus fragmented by diggings both on the coast

due to beach-mining and further inland due deep pit and trench mining. Many of the areas that could have been rehabilitated were simply left untended and spoil-heaps are found randomly in the landscape. The only positive aspect is that the vegetation that has been most affected by past mining i.e. Namaqualand Strandveld is widespread, uniform and not threatened in any way. Sufficient habitat of this type remains and ecological processes are intact. Nevertheless, that is no excuse for lack of rehabilitation.

A4. Conservation Status

The principal vegetation types in the study area, namely Namaqualand Seashore Vegetation, Namaqualand Coastal Duneveld and Namaqualand Strandveld have been assigned the status of Least Threatened in the Nation List of Threatened Ecosystems (Government Gazette, 2011). However, the entire coastal zone and immediate inland zone from Mitchell's Bay in the south to Samson's Bak in the north is within either a Critical Biodiversity Area (1) [CBA1] or Critical Biodiversity Area (2) [CBA2] according to the Critical Biodiversity Map for the Northern Cape Province (available for download from https://cirrus.nmmu.ac.za/index.php/s/20fe43905396fca0025948bc0d3b514d) This means that any mining-related activities resulting in habitat loss would negatively affect the conservation targets for habitats on the Namaqualand Coast.

In addition, numerous plant species, genera or families e.g. Aizoaceae (vygies) and Aloaceae are specifically protected under the **Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009) and Regulations (2011).** Authorisation and permits would thus be required from the Department of Environment and Nature Conservation (Northern Cape Province) for the removal or translocation of protected plant species as well as a general permit for the clearing of natural vegetation.

A5. Impact Assessment

A5.1 'No Go' Alternative

The 'No Go' alternative would mean that there would be no further mining the in the Koingnaas Mining Rights area. It would mean that there would be no further disturbance of the natural environment. However, it would also mean that no

remedial action would be implemented to rectify unacceptable practices that have negatively impacted the environment from past mining. The opportunity to mine into the future comes with the responsibility to rehabilitate as much of the despoiled landscape as possible. The responsibility would be negated if there was to be no further mining.

A5.2 Direct Impacts

The two main direct impacts on the vegetation and flora would firstly be the destruction of plant communities at the beach-mining / coffer dam sites and loss of vegetation due to construction of new roads. This would principally affect Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld (**High Negative** impact) but to a lesser extent, Namaqualand Strandveld (**Medium Negative** impact). Secondly, the construction of new roads would result in **High Negative** impact on all of the above vegetation types (Table 2).

Table 2. Direct impacts on natural plant communities

Impact Description: Direct impacts on vegetation would occur due to mining-related habitat loss (mining activities and roads)						
	Extent (Spatial Scale)	**Duration**	**Severity**	**Probability**	**Status**	**Significance**
Without Mitigation	Local	Long-term	High	Highly Probable	-ve	Medium
With Mitigation	Local	Long-term	Medium	Probable	-ve	Medium-Low
	Mitigation: 1) New and existing mining pits should be backfilled with existing spoil and any new spoil generated according to a systematic plan. 2) New soil dumps should not be within areas of intact habitat adjacent to mining pits, but should be used to backfill or rehabilitate existing disturbed areas. 3) Existing roads should be used wherever possible. The number of access roads at the mining sites should be reduced and they should be constructed so as to avoid undisturbed habitat. 4) An ECO must be appointed who will be involve with planning of roads and other infrastructure and who will monitor and audit impacts on the undisturbed natural environment.					

	5) A long-term monitoring program should developed for the site that monitors and should aim to quantify changes in habitat.	
	Impact to be addressed/ further investigated and assessed in Impact Assessment Phase?	The vegetation (habitat) present in the Mining Rights Area will be described in more detail for specific mining sites and sensitive habitats identified and delineated.

A5.3 Cumulative Impacts

Significant disturbance of the natural environmental has historically taken place in the area investigated. Further mining would no doubt contribute negatively to the cumulative impacts on the vegetation and habitat (Table 3). Every measure possible should be implemented to avoid past negative practices and to implement good environmental governance to ensure that negative cumulative impacts are minimized.

Table 3. Cumulative impacts on natural plant communities

Impact Description: Cumulative impact on CBAs with respect to terrestrial plant communities. Cumulative impacts on the CBA 1 and CBA2 along the Namaqualand coast in the study area are **High Negative** due to historical mining and lack of restoration. Habitat loss due to future mining will contribute to the negative cumulative impact that will result from increased habitat fragmentation.						
	Extent	**Duration**	**Severity**	**Probability**	**Status**	**Significance**
Without Mitigation	Local	Long-term	High	Probable	-ve	High
With Mitigation	Local	Long-term	Medium	Probable	-ve	Medium-Low
	Mitigation: 1) Minimise the mining footprint, especially with regards to roads which should be carefully planned with the input of an environmental officer. 2) Ensure that waste-rock and soil is not dumped in undisturbed areas, but are rather used to fill existing pits and trenches or used to aid rehabilitation of previously disturbed areas. 3) An integrated monitoring plan should be developed for the mining sites that makes provision for evaluating habitat and ecological status over the lifespan of the mine.					

A6. MITIGATION MEASURES FOR INCLUSION IN DRAFT ENVIRONMENTAL MANAGEMENT PLAN

A list of generally applicable mitigation measures that should be included in the draft Environmental Management Plan are as follows:

Objective: Minimization of impacts on natural vegetation namely due to mining on the coastline and immediately inland			
Project components	(1) Building of coffer dams (2) On-land location of screening plant (3) Construction of internal access roads (4) Stockpile areas (5) Construction of pipelines (6) Dumping of spoil		
Potential impact	Removal and loss of Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld.		
Activity / risk source	Non-compliance with recommended mitigation measures		
Mitigation: Target / Objective	The target would be to minimize loss of natural vegetation. This could be achieved by AVOIDANCE of disturbance in the first place and secondly by restoration (rehabilitation) of the vegetation.		
		Responsibility	**Timeframe**
Mitigation: Action / Control	➢ The first principal must be to ensure that only carefully demarcated areas are accessed i.e. areas not directly involved with a mine operation should be avoided	Mine management	Pre-mining, operational phase
Mitigation: Action / Control	➢ An on-site environmental control officer should be consulted at each step of the operation i.e. from planning to operation.	Mine management	Pre-mining, operational phase

Mitigation: Action / Control	➢ An important objective should be to reduce negative edge effects e.g. no unnecessary tracks or roads should be permitted.	Mine management	Operational phase
Mitigation: Action / Control	➢ There should be no random traversing of the natural vegetation off designated mining areas and roads.	Mine management / ECO	Operational phase
Mitigation: Action / Control	➢ Material for coffer dams should be sourced from existing disturbed sites. No new sites for rock material should be opened.	ECO in conjunction with mine management.	Operational phase
Mitigation: Action / Control	➢ Where possible access roads should follow existing roads. If new roads are required they should be planned to take the least damaging routes.	ECO in conjunction with mine management	Pre-mining and operational phase
Mitigation: Action / Control	➢ Stockpile areas should be carefully sited on existing disturbed areas so as not to further damage	ECO in conjunction with mine management	Operational phase
Mitigation: Action / Control	➢ Any areas that can be restored after mining must be identified and actively rehabilitated under the direction of a qualified restoration practitioner.	Environmental Control Officer (ECO) with restoration specialist and mine management	Post operational phase

Performance indicators	Compliance with recommended mitigation measures. ECO to keep a log of activities which must be inspected and signed off once monthly by the relevant manager. The mine should appoint a suitably qualified restoration specialist to compile a vegetation rehabilitation plan for areas deemed necessary. The restoration specialist must submit the vegetation rehabilitation plan to the ECO and mine management for approval. The vegetation rehabilitation plan should include: Seed collection, harvesting methods and seed storage methods; Handling of plant material suitable for restoration purposes; Establishment of a holding area or nursery from which plants to be used for restoration can be sourced; Report to the ECO on progress, obstacles etc. Re-vegetation of areas disturbed by mining or roads should take place as soon after completion of mining at a particular site as possible. No vehicles, equipment and unauthorized people to be allowed into areas that have been re-vegetated.
Monitoring	It would be the responsibility of the ECO to ensure compliance of the restoration specialist with recommended mitigation measures and to monitor the outcomes. Six-monthly reporting would be required.
Monitoring	Disturbed areas should be monitored for at least three years after the rehabilitation is initiated to check on progress of vegetation rehabilitation and

	any alien invasion. Areas that show signs of poor re-vegetation should be treated to enhance vegetation re-establishment.

A7. MANAGEMENT PLAN

From a botanical viewpoint the major concerns are (1) loss of sensitive plant communities and (2) loss of Red List plants species. The main objectives would be to (1) minimize general disturbance as far as possible; (2) avoid sensitive plant communities; (3) relocate sensitive plant species if possible or if they cannot be avoided, and (4) rehabilitate disturbed areas post-mining wherever these areas are not required for other purposes. The overriding principal would be to implement recommended mitigation measures as strictly as possible.

OBJECTIVE 1: Limit loss of natural vegetation at mining sites		
Project component/s	Mining in Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld	
Potential Impact	Unnecessary loss of natural vegetation	
Activity/risk source	Mining operations	
Mitigation: Target/Objective	Correct alignment of roads to minimize impacts would be essential. All mining activities must be contained within designated areas.	
Mitigation: Personnel should not routinely enter or use areas outside strictly demarcated construction areas.	Responsibility ECO and mine management	Timeframe From project inception to closure
Performance Indicator	Minimize loss of natural vegetation	
Monitoring	Bi-annual audit of condition of vegetation at mining sites	

OBJECTIVE 2: Limit loss of botanically sensitive plant communities		
Project component/s	Mining and road construction in Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld	
Potential Impact	Loss of botanically sensitive plant communities e.g. where *Wooleya farinosa* occurs	
Activity/risk source	Mining and road construction	
Mitigation: Target/Objective	AVOID botanically sensitive areas	
Mitigation: Adjust roads routes to accommodate sensitive vegetation	Responsibility ECO / Mine management	Timeframe Mining operational phase
Performance Indicator	Limited loss of botanically sensitive habitat	
Monitoring	Post-mining audit	

OBJECTIVE 3: Relocation of sensitive plant species and / or Red List species	
Project component/s	Mining and road construction in Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld

Potential Impact	Loss of sensitive (protected) plant species e.g. *Wooleya farinosa*		
Activity/risk source	Mining operation including roads		
Mitigation: Target/Objective	Where possible relocate species that can be transplanted (Not all species will be successfully transplanted). Collect cuttings / seed of rare species for propagation in a nursery.		
Mitigation: Relocate sensitive plant species to safe areas in similar habitat		Responsibility ECO, min management and restoration specialist	Timeframe Operational phase to post-mining phase
Performance Indicator	Limited loss of sensitive plant species		
Monitoring	Post-mining audit		

OBJECTIVE 4: Rehabilitate disturbed areas post-construction wherever these areas are not required in the operational phase			
Project component/s	Mining and road construction in Namaqualand Seashore Vegetation and Namaqualand Coastal Duneveld		
Potential Impact	Removal of natural vegetation to make way for roads and mining		
Activity/risk source	Mining operation including roads		
Mitigation: Target/Objective	Restore all areas post-mining to attempt to rehabilitate the original plant community to ensure minimal degradation of habitat		
Mitigation: Re-vegetate disturbed areas		Responsibility Construction / ECO in collaboration with restoration specialist and mine management	Timeframe Operational phase to post-mining phase
Performance Indicator	Successful re-establishment of natural shrubland		
Monitoring	Post-mining audit		

A8. CONCLUSIONS

The area of the Namaqualand coast between Mitchell's Bay in the south and Kleinsee in the north has been poorly explored and documented botanically due to restricted access over many years. However, a limited number of botanical studies have shown that apart from some localized 'special' plant communities, large areas are covered by one or a few types of vegetation. This is true in the study area where the vegetation is mainly Namaqualand Strandveld with limited areas of Namaqualand Coastal Duneveld and Namaqualand Seashore Vegetation. It is contended that there are no botanical fatal flaws for the area investigated but that there are 'red flags'. Certain plant communities and plant species within the general vegetation matrix **are sensitive**. These plant communities and species are described in the report and it is essential that these are noted and that the recommended mitigation measures are implemented as per the management plan. If this happens satisfactorily the impacts on the vegetation and flora can be reduced from potentially **High negative** to **Medium negative** and the proposed future mining becomes more acceptable within the described botanical context.

The most striking impression from investigation of the botanical aspects of the study area between Mitchell's Bay and Koingnaas is the dramatic negative impact of mining on the natural environment. Past mining activities were driven by production and paid little heed to the environment. Very little restoration was undertaken, apart from a few areas where netting was implemented to minimize wind-blown sand and to attempt to restore the vegetation. The open-cast diamond mining has left a fragmented landscape in its wake. Lessons must be learnt from the former lack of restoration and the *modus operandi* employed in the past should not be repeated. In addition, areas requiring rehabilitation should still be attended to within the context of the renewed mining activities.

The area north of Koingnaas and particularly at Samson's Bak that is earmarked for future mining, is less disturbed than in the southern areas from Somnaas southwards. Opportunity therefore nexists in the areas where future mining is proposed, e.g. at Samson's Bak, to ensure that best environmental practice is observed. Spoil should not be randomly dumped but should only be deposited in approved spoil areas, preferably where there is already disturbance. Loss of undisturbed vegetation and habitat should be avoided wherever possible. Also, wherever possible existing roads should be used and new roads should only be constructed with discretion.

It is important that an environmental officer (ECO) should be appointed to be involved with planning from the outset. Such a person should advise on the alignment of new roads, placement of spoil and general environmental best practice. The ECO should also be responsible for monitoring the status of the habitat in the mining rights area, determination of sensitive habitats, overseeing translocation of important plant species where necessary and should be in charge of rehabilitation / restoration activities.

A9. REFERENCES

Arcus Gibb, 2008. ESKOM Nuclear Power Station and Associated Infrastructure – Final Scoping Report. Arcus Gibb (Pty) Ltd Report No. J 27035

Brownlie, S. 2005. *Guideline for involving biodiversity specialists in EIA processes: Edition 1.* CSIR Report No. ENV-S-C 2005-053 C. Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning.

Cornell. D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M. and Gibson, R.L., 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (eds), *The Geology of South Africa*. The Geological Society of South Africa (Johannesburg) and the Council for Geoscience (Pretoria), pp. 325—379.

De Villiers, C.C. Driver, A. Clark, B. Euston-Brown, D.I.W. Day, E.G. Job, N. Helme, N.A. Holmes, P. M. Brownlie, S. and Rebelo, A. G. 2005. *Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape*. Fynbos Forum, Cape Town 94pp.

Desmet, P. and Marsh A. 2008*. Namakwa District Biodiversity Sector Plan*. Available from BGIS at http://bgis.sanbi.org/namakwa/project.asp.

Desmet, P, Turner, R. & Helme, N. 2009. *Namaqua Sands Regional Context Vegetation Study*. Unpublished report for Golder & Associates, Johannesburg.

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Government Gazette No. 34809. 2011. Threatened Terrestrial Ecosystems in South Africa.

Le Roux, A. 1991. NSIP West Coast: Site-Specific Environmental Study - Assessment of the Sensitivity of Vegetation on Tweepad, Brazil and Schulpfontein. Environmental Evaluation Unit, University of Cape Town for ESKOM.

Le Roux, A. 2005*. South African Wild Flower Guide 1: Namaqualand* – Third revised edition. Botanical Society of South Africa, Cape Town.

Le Roux, A. 2015. *Wild Flowers of Namaqualand*, Struik Nature, Cape Town.

Low, A.B. & Desmet, P. 2007. Nuclear 1 Environmental Impact Assessment and Environmental Management Plan: Specialist Study (Botany) for Inception Report. Arcus Gibb (Pty) Ltd and ESKOM Holdings Limited, Generation Division.

Marais, J A H (2001) (compiler). 2916 Springbok 1:250 000 geological sheet. Government Printer, Pretoria

McDonald, D.J. 2011a. Botanical Impact Assessment, Koingnaas Wind Energy Facility, Northern Cape. Unpublished report, Bergwind Botanical Surveys & Tours for Savannah Environmental.

McDonald. D.J. 2011b. Environmental Scoping: The Potential Impacts on the Vegetation of the Proposed Kleinzee 300MW Wind Farm, Northern Cape. Unpublished report, Bergwind Botanical Surveys & Tours for Savannah Environmental.

McDonald, D.J. 2012. Botanical Impact Assessment: Project Blue Renewable Energy Facility, north of Kleinzee, Northern Cape. Unpublished report, Bergwind Botanical Surveys & Tours for Savannah Environmental.

McDonald, D.J. 2013. Botanical impact assessment for the proposed Eskom 300MW Kleinzee Wind Farm, Northern Cape. Unpublished report, Bergwind Botanical Surveys & Tours for Savannah Environmental.

Mucina, L., Rutherford, M.C., & Powrie, L.W. (eds.). 2005. *Vegetation map of South Africa, Lesotho, and Swaziland 1:1 000 000 scale sheet maps.* South African National Biodiversity Institute, Pretoria. ISBN 1-919976-22-1.

Mucina, L., Rutherford, M.C., & Powrie, L.W. (Eds.). 2005, 2009 & 2012. *Vegetation map of South Africa, Lesotho, and Swaziland 1:1 000 000 scale sheet maps*. South African National Biodiversity Institute, Pretoria. ISBN 1-919976-22-1.

Mucina, L. & Rutherford, M.C. 2006. (eds.) The Vegetation of South Africa. Lesotho & Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Mucina, L., Jürgens, N., Le Roux, A, Rutherford, M.C., Schmiedel, U., Esler, K.J., Powrie, L.W., Desmet, P.G. & Milton, S.J. 2006. Succulent Karoo Biome. In: Mucina, L., & Rutherford, M.C. (Eds.). 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama, P.A. (eds) 2009. Red List of South African plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

Rutherford, M.C. & Westfall, R.H. 1994. Biomes of southern Africa: An Objective Categorization. Memoirs of the Botanical Survey of South Africa No. 63. National Botanical Institute, Pretoria.

Rutherford, M.C., Mucina, L. & Powrie, L.W. 2006. Biomes and Bioregions of Southern Africa. In: Mucina, L. & Rutherford, M.C. 2006. (eds.)The Vegetation of South Africa. Lesotho & Swaziland. *Strelitzia 1*9. South African National Biodiversity Institute, Pretoria. pp. 31-51.

Van Wyk, A.E. & Smith, G.F. 2001. *Regions of Floristic Endemism in Southern Africa*. Umdaus Press, Pretoria.

Website: http://www.worldweatheronline.com/weather-averages/South-Africa/2610093/Kleinzee/2614644/info.aspx

APPENDIX A1: Preliminary plant species checklist for the area of the WCR Mining Rights between Mitchell's Bay (south) and Samson's Bak (north) (Source: SIBIS Portal - http://sibis.sanbi.org/ - Note – this source is under revision by SANBI)

LC= Least concern; VU = Vulnerable; DDD = Data deficient, declining; DDT – Data deficient – taxon uncertain; NT= Near threatened; RARE = rare species; ?? = Status unknown

Family Name	Species Name	Status
AIZOACEAE	Galenia crystallina var. crystallina	LC
AIZOACEAE	Galenia fruticosa	LC
AIZOACEAE	Galenia sarcophylla	LC
AIZOACEAE	Galenia secunda	LC
AIZOACEAE	Malephora crocea var. crocea	LC
AIZOACEAE	Mesembryanthemum serotinum	??
AIZOACEAE	Tetragonia distorta	DDT
AIZOACEAE	Tetragonia fruticosa	LC
AIZOACEAE	Tetragonia microptera	LC
AIZOACEAE	Tetragonia pillansii	VU
AIZOACEAE	Tetragonia sarcophylla	LC
AIZOACEAE	Tetragonia spicata	LC
AIZOACEAE	Tetragonia virgata	LC
AMARYLLIDACEAE	Brunsvigia bosmaniae	LC
AMARYLLIDACEAE	Gethyllis britteniana subsp. britteniana	LC
AMARYLLIDACEAE	Gethyllis grandiflora	VU
AMARYLLIDACEAE	Haemanthus coccineus	LC
AMARYLLIDACEAE	Haemanthus pubescens subsp. arenicola	RARE
AMARYLLIDACEAE	Haemanthus unifoliatus	LC
ANACARDIACEAE	Searsia glauca	LC
ANACARDIACEAE	Searsia incisa var. incisa	LC
ANACARDIACEAE	Searsia undulata	LC
ANTHERICACEAE	Chlorophytum undulatum	LC
APIACEAE	Cynorhiza typica	DDT
APOCYNACEAE	Ceropegia occidentalis	NT
APOCYNACEAE	Microloma namaquense	LC
APOCYNACEAE	Microloma sagittatum	LC
APOCYNACEAE	Microloma tenuifolium	LC
APOCYNACEAE	Quaqua armata subsp. maritima	LC
APOCYNACEAE	Quaqua parviflora subsp. parviflora	LC
ASPARAGACEAE	Asparagus capensis	LC
ASPARAGACEAE	Asparagus capensis var. litoralis	LC
ASPHODELACEAE	Aloe arenicola	NT
ASPHODELACEAE	Aloe krapohliana	DDD
ASPHODELACEAE	Aloe melanacantha	LC

Family Name	Species Name	Status
ASPHODELACEAE	Aloe microstigma subsp. framesii	NT
ASPHODELACEAE	Gasteria sp.	
ASTERACEAE	Amellus alternifolius subsp. alternifolius	LC
ASTERACEAE	Amellus flosculosus	LC
ASTERACEAE	Amellus microglossus	LC
ASTERACEAE	Amellus sp.	
ASTERACEAE	Amellus tenuifolius	LC
ASTERACEAE	Arctotheca calendula	LC
ASTERACEAE	Arctotis auriculata	LC
ASTERACEAE	Arctotis decurrens	DDT
ASTERACEAE	Arctotis diffusa	LC
ASTERACEAE	Arctotis fastuosa	LC
ASTERACEAE	Arctotis revoluta	LC
ASTERACEAE	Arctotis sp.	
ASTERACEAE	Athanasia flexuosa	LC
ASTERACEAE	Berkheya fruticosa	LC
ASTERACEAE	Chrysanthemoides incana	LC
ASTERACEAE	Chrysocoma ciliata	LC
ASTERACEAE	Chrysocoma longifolia	LC
ASTERACEAE	Chrysocoma schlechteri	LC
ASTERACEAE	Cotula coronopifolia	LC
ASTERACEAE	Cotula leptalea	LC
ASTERACEAE	Didelta carnosa var. carnosa	LC
ASTERACEAE	Dimorphotheca pluvialis	LC
ASTERACEAE	Dimorphotheca sinuata	LC
ASTERACEAE	Eriocephalus microphyllus var. pubescens	LC
ASTERACEAE	Eriocephalus racemosus var. affinis	LC
ASTERACEAE	Eriocephalus racemosus var. racemosus	LC
ASTERACEAE	Euryops dregeanus	LC
ASTERACEAE	Felicia dregei	LC
ASTERACEAE	Felicia dubia	LC
ASTERACEAE	Felicia merxmuelleri	LC
ASTERACEAE	Gazania leiopoda	LC
ASTERACEAE	Gazania rigida	LC
ASTERACEAE	Gazania sp.	
ASTERACEAE	Gorteria diffusa subsp. diffusa	LC
ASTERACEAE	Helichrysum hebelepis	LC
ASTERACEAE	Helichrysum marmarolepis	NT
ASTERACEAE	Helichrysum micropoides	LC
ASTERACEAE	Hirpicium echinus	LC
ASTERACEAE	Lasiopogon muscoides	LC
ASTERACEAE	Leucoptera nodosa	VU
ASTERACEAE	Leysera gnaphalodes	LC
ASTERACEAE	Leysera tenella	LC
ASTERACEAE	Monoculus hyoseroides	LC

Family Name	Species Name	Status
ASTERACEAE	Monoculus monstrosus	LC
ASTERACEAE	Norlindhia amplectens	LC
ASTERACEAE	Oncosiphon grandiflorum	LC
ASTERACEAE	Oncosiphon suffruticosum	LC
ASTERACEAE	Osteospermum grandiflorum	LC
ASTERACEAE	Othonna carnosa	LC
ASTERACEAE	Othonna coronopifolia	LC
ASTERACEAE	Crassothonna cylindrica	LC
ASTERACEAE	Othonna floribunda	LC
ASTERACEAE	Othonna perfoliata	LC
ASTERACEAE	Othonna retrorsa var. spektakelensis	RARE
ASTERACEAE	Crassothonna sedifolia	LC
ASTERACEAE	Pteronia divaricata	LC
ASTERACEAE	Pteronia glabrata	LC
ASTERACEAE	Pteronia incana	LC
ASTERACEAE	Pteronia onobromoides	LC
ASTERACEAE	Pteronia undulata	LC
ASTERACEAE	Rhynchopsidium pumilum	LC
ASTERACEAE	Senecio abbreviatus	LC
ASTERACEAE	Senecio aloides	LC
ASTERACEAE	Senecio cakilefolius	LC
ASTERACEAE	Senecio corymbiferus	??
ASTERACEAE	Senecio laxus	LC
ASTERACEAE	Senecio sarcoides	LC
ASTERACEAE	Senecio scapiflorus	LC
ASTERACEAE	Tripteris microcarpa subsp. microcarpa	LC
ASTERACEAE	Osteospermum oppositifolium	LC
ASTERACEAE	Ursinia calenduliflora	LC
ASTERACEAE	Ursinia chrysanthemoides	LC
BORAGINACEAE	Lobostemon pearsonii	LC
BRASSICACEAE	Brassica tournefortii	??
BRASSICACEAE	Heliophila arenaria var. glabrescens	LC
BRASSICACEAE	Heliophila juncea (was Brachycarpaea juncea)	LC
BRASSICACEAE	Heliophila lactea	LC
BRASSICACEAE	Heliophila seselifolia var. seselifolia	LC
CAMPANULACEAE	Wahlenbergia annularis	LC
CAMPANULACEAE	Wahlenbergia capensis	LC
CAMPANULACEAE	Wahlenbergia oxyphylla	LC
CAMPANULACEAE	Wahlenbergia thunbergiana	LC
CARYOPHYLLACEAE	Dianthus namaensis	LC
CARYOPHYLLACEAE	Dianthus namaensis var. dinteri	LC
CARYOPHYLLACEAE	Dianthus namaensis var. junceus	LC
CARYOPHYLLACEAE	Silene burchellii var. angustifolia	??
CARYOPHYLLACEAE	Silene cretica	??
CARYOPHYLLACEAE	Spergularia media	??

Family Name	Species Name	Status
CELASTRACEAE	Gymnosporia buxifolia	LC
CHENOPODIACEAE	Atriplex cinerea subsp. bolusii var. adamsonii	LC
CHENOPODIACEAE	Atriplex cinerea subsp. bolusii var. genuina	??
CHENOPODIACEAE	Atriplex eardleyae	??
CHENOPODIACEAE	Atriplex lindleyi subsp. inflata	??
CHENOPODIACEAE	Atriplex semibaccata var. appendiculata	LC
CHENOPODIACEAE	Atriplex vestita var. appendiculata	LC
CHENOPODIACEAE	Chenopodium murale var. murale	??
CHENOPODIACEAE	Manochlamys albicans	LC
CHENOPODIACEAE	Salsola aphylla	LC
CHENOPODIACEAE	Salsola sericata	LC
CHENOPODIACEAE	Salsola sp.	
CHENOPODIACEAE	Salsola zeyheri	LC
CHENOPODIACEAE	Sarcocornia natalensis var. natalensis	LC
CHENOPODIACEAE	Sarcocornia pillansii var. pillansii	LC
CRASSULACEAE	Adromischus alstonii	LC
CRASSULACEAE	Cotyledon cuneata	LC
CRASSULACEAE	Cotyledon orbiculata var. orbiculata	LC
CRASSULACEAE	Crassula brevifolia subsp. brevifolia	LC
CRASSULACEAE	Crassula campestris	LC
CRASSULACEAE	Crassula elegans	LC
CRASSULACEAE	Crassula elegans subsp. elegans	LC
CRASSULACEAE	Crassula expansa subsp. expansa	LC
CRASSULACEAE	Crassula expansa subsp. pyrifolia	LC
CRASSULACEAE	Crassula nudicaulis var. herrei	LC
CRASSULACEAE	Crassula subaphylla var. subaphylla	LC
CRASSULACEAE	Crassula tomentosa var. tomentosa	LC
CRASSULACEAE	Crassula whiteheadii	LC
CRASSULACEAE	Tylecodon buchholzianus subsp. buchholzianus	LC
CRASSULACEAE	Tylecodon decipiens	RARE
CRASSULACEAE	Tylecodon pygmaea	THR*
CRASSULACEAE	Tylecodon racemosus	LC
CRASSULACEAE	Tylecodon reticulatus subsp. phyllopodium	??
CRASSULACEAE	Tylecodon reticulatus subsp. reticulatus	LC
CYPERACEAE	Ficinia sp.	
EBENACEAE	Euclea tomentosa	LC
EUPHORBIACEAE	Euphorbia chersina	LC
EUPHORBIACEAE	Euphorbia decussata	LC
EUPHORBIACEAE	Euphorbia ramiglans	LC
EUPHORBIACEAE	Euphorbia rectirama	LC
EUPHORBIACEAE	Euphorbia sp.	
EUPHORBIACEAE	Euphorbia tuberculata var. tuberculata	LC
FABACEAE	Acacia karroo	LC
FABACEAE	Argyrolobium velutinum	EN
FABACEAE	Calobota angustifolia	??

Family Name	Species Name	Status
FABACEAE	Calobota halenbergensis	??
FABACEAE	Calobota lotononoides	??
FABACEAE	Crotalaria excisa subsp. excisa	LC
FABACEAE	Indigofera nigromontana	LC
FABACEAE	Lebeckia sericea	LC
FABACEAE	Lessertia diffusa	LC
FABACEAE	Lessertia falciformis	LC
Fabaceae	Lessertia frutescens (syn. Sutherlandia frutescens)	LC
FABACEAE	Lessertia sp.	
FABACEAE	Medicago laciniata var. laciniata	??
FABACEAE	Melolobium adenodes	LC
FABACEAE	Sutherlandia frutescens	LC
FABACEAE	Wiborgia monoptera	LC
FABACEAE	Wiborgia sericea	LC
FRANKENIACEAE	Frankenia repens	LC
GERANIACEAE	Erodium cicutarium	??
GERANIACEAE	Erodium moschatum	??
GERANIACEAE	Pelargonium adriaanii	??
GERANIACEAE	Pelargonium crithmifolium	LC
GERANIACEAE	Pelargonium dasyphyllum	LC
GERANIACEAE	Pelargonium echinatum	LC
GERANIACEAE	Pelargonium fulgidum	LC
GERANIACEAE	Pelargonium gibbosum	LC
GERANIACEAE	Pelargonium pulchellum	LC
HYACINTHACEAE	Albuca namaquensis	LC
HYACINTHACEAE	Albuca sp.	
HYACINTHACEAE	Albuca spiralis	LC
HYACINTHACEAE	Lachenalia anguinea	LC
HYACINTHACEAE	Lachenalia barkeriana	RARE
HYACINTHACEAE	Lachenalia sp.	
HYACINTHACEAE	Lachenalia valeriae	RARE
HYACINTHACEAE	Lachenalia violacea var. violacea	LC
HYACINTHACEAE	Lachenalia xerophila	LC
HYACINTHACEAE	Ornithogalum canadense (syn. Albuca canadensis)	LC
HYACINTHACEAE	Ornithogalum pruinosum	LC
HYACINTHACEAE	Ornithogalum unifolium	LC
HYACINTHACEAE	Veltheimia capensis	LC
IRIDACEAE	Babiana curviscapa	LC
IRIDACEAE	Babiana hirsuta	??
IRIDACEAE	Babiana lanata	VU
IRIDACEAE	Babiana namaquensis	LC
IRIDACEAE	Babiana sp	
IRIDACEAE	Babiana thunbergii	NT
IRIDACEAE	Ferraria divaricata subsp. divaricata	LC
IRIDACEAE	Ferraria schaeferi	LC

Family Name	Species Name	Status
IRIDACEAE	Ferraria variabilis	LC
IRIDACEAE	Gladiolus scullyi	LC
IRIDACEAE	Gladiolus sp	
IRIDACEAE	Lapeirousia macrospatha	LC
IRIDACEAE	Lapeirousia silenoides	LC
IRIDACEAE	Lapeirousia tenuis	RARE
IRIDACEAE	Moraea gawleri	LC
IRIDACEAE	Moraea miniata	LC
IRIDACEAE	Moraea rivulicola	RARE
JUNCACEAE	Juncus acutus subsp. leopoldii	LC
LAMIACEAE	Ballota africana	LC
LAMIACEAE	Salvia africana-lutea	LC
LAMIACEAE	Salvia dentata	LC
LAMIACEAE	Salvia lanceolata	LC
LOBELIACEAE	Monopsis debilis var. gracilis	LC
LORANTHACEAE	Tapinanthus oleifolius	LC
LYTHRACEAE	Nesaea sp.	??
MALVACEAE	Hermannia amoena	LC
MALVACEAE	Hermannia cuneifolia var. cuneifolia	LC
MALVACEAE	Hermannia disermifolia	LC
MALVACEAE	Hermannia incana	LC
MALVACEAE	Hermannia pfeilii	LC
MALVACEAE	Hermannia trifurca	LC
MELIANTHACEAE	Melianthus elongatus	LC
MESEMBRYANTHEMACEAE	Amphibolia laevis	LC
MESEMBRYANTHEMACEAE	Amphibolia rupis-arcuatae	LC
MESEMBRYANTHEMACEAE	Amphibolia succulenta	LC
MESEMBRYANTHEMACEAE	Antimima compacta	LC
MESEMBRYANTHEMACEAE	Antimima dolomitica	??
MESEMBRYANTHEMACEAE	Antimima maleolens	LC
MESEMBRYANTHEMACEAE	Antimima sp.	
MESEMBRYANTHEMACEAE	Aridaria brevicarpa	LC
MESEMBRYANTHEMACEAE	Aspazoma amplectens	LC
MESEMBRYANTHEMACEAE	Astridia cf. citrina	LC
MESEMBRYANTHEMACEAE	Astridia sp.	
MESEMBRYANTHEMACEAE	Brownanthus sp.	??
MESEMBRYANTHEMACEAE	Cephalophyllum ebracteatum	LC
MESEMBRYANTHEMACEAE	Cephalophyllum fulleri	RARE
MESEMBRYANTHEMACEAE	Cephalophyllum herrei	LC
MESEMBRYANTHEMACEAE	Cephalophyllum inaequale	LC
MESEMBRYANTHEMACEAE	Cephalophyllum rigidum	LC
MESEMBRYANTHEMACEAE	Cephalophyllum sp.	
MESEMBRYANTHEMACEAE	Cheiridopsis denticulata	LC
MESEMBRYANTHEMACEAE	Cheiridopsis namaquensis	LC
MESEMBRYANTHEMACEAE	Cheiridopsis robusta	LC

Family Name	Species Name	Status
MESEMBRYANTHEMACEAE	Cheiridopsis sp.	
MESEMBRYANTHEMACEAE	Conicosia elongata	LC
MESEMBRYANTHEMACEAE	Conicosia pugioniformis subsp. alborosea	LC
MESEMBRYANTHEMACEAE	Conophytum bilobum subsp. bilobum	LC
MESEMBRYANTHEMACEAE	Conophytum flavum subsp. flavum	LC
MESEMBRYANTHEMACEAE	Conophytum hians	LC
MESEMBRYANTHEMACEAE	Conophytum meyeri	RARE
MESEMBRYANTHEMACEAE	Conophytum sp.	
MESEMBRYANTHEMACEAE	Drosanthemum floribundum	LC
MESEMBRYANTHEMACEAE	Drosanthemum luederitzii	LC
MESEMBRYANTHEMACEAE	Drosanthemum oculatum	LC
MESEMBRYANTHEMACEAE	Drosanthemum sp.	
MESEMBRYANTHEMACEAE	Eberlanzia dichotoma	LC
MESEMBRYANTHEMACEAE	Fenestraria rhopalophylla subsp. aurantiaca	LC
MESEMBRYANTHEMACEAE	Jordaaniella cuprea	LC
MESEMBRYANTHEMACEAE	Jordaaniella spongiosa	LC
MESEMBRYANTHEMACEAE	Lampranthus brachyandrus	DDT
MESEMBRYANTHEMACEAE	Lampranthus suavissimus	DDT
MESEMBRYANTHEMACEAE	Lampranthus uniflorus	LC
MESEMBRYANTHEMACEAE	Leipoldtia frutescens	VU
MESEMBRYANTHEMACEAE	Leipoldtia sp.	
MESEMBRYANTHEMACEAE	Malephora framesii	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum amplectens	Not listed
MESEMBRYANTHEMACEAE	Mesembryanthemum arenosum	Not listed
MESEMBRYANTHEMACEAE	Mesembryanthemum hypertrophicum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum nodiflorum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum pellitum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum sp.	
MESEMBRYANTHEMACEAE	Meyerophytum meyeri	LC
MESEMBRYANTHEMACEAE	Mitrophyllum clivorum	LC
MESEMBRYANTHEMACEAE	Mitrophyllum dissitum	LC
MESEMBRYANTHEMACEAE	Mitrophyllum sp.	
MESEMBRYANTHEMACEAE	Phyllobolus sinuosus	LC
MESEMBRYANTHEMACEAE	Phyllobolus spinuliferus	LC
MESEMBRYANTHEMACEAE	Phyllobolus trichotomus	LC
MESEMBRYANTHEMACEAE	Psilocaulon dinteri	LC
MESEMBRYANTHEMACEAE	Psilocaulon foliosum	LC
MESEMBRYANTHEMACEAE	Psilocaulon subnodosum	LC
MESEMBRYANTHEMACEAE	Ruschia cymosa	LC
MESEMBRYANTHEMACEAE	Ruschia festiva	??
MESEMBRYANTHEMACEAE	Ruschia fugitans	DDT
MESEMBRYANTHEMACEAE	Ruschia muelleri	LC
MESEMBRYANTHEMACEAE	Ruschia paripetala	LC
MESEMBRYANTHEMACEAE	Ruschia sp.	
MESEMBRYANTHEMACEAE	Ruschia versicolor	LC

Family Name	Species Name	Status
MESEMBRYANTHEMACEAE	Ruschia viridifolia	LC
MESEMBRYANTHEMACEAE	Stoeberia beetzii	LC
MESEMBRYANTHEMACEAE	Stoeberia frutescens	LC
MESEMBRYANTHEMACEAE	Stoeberia utilis	LC
MESEMBRYANTHEMACEAE	Vanzijlia annulata	LC
MESEMBRYANTHEMACEAE	Wooleya farinosa	VU
MOLLUGINACEAE	Adenogramma glomerata	LC
MOLLUGINACEAE	Hypertelis salsoloides	LC
MOLLUGINACEAE	Hypertelis salsoloides var. salsoloides	LC
MOLLUGINACEAE	Hypertelis sp.	
MOLLUGINACEAE	Limeum africanum subsp. africanum	LC
MOLLUGINACEAE	Limeum africanum subsp. canescens	LC
MOLLUGINACEAE	Pharnaceum albens	LC
MOLLUGINACEAE	Pharnaceum confertum var. confertum	LC
MOLLUGINACEAE	Pharnaceum microphyllum var. microphyllum	LC
MORACEAE	Ficus ilicina	LC
NEURADACEAE	Grielum grandiflorum	LC
NEURADACEAE	Grielum humifusum var. humifusum	LC
NEURADACEAE	Grielum sinuatum	LC
OROBANCHACEAE	Hyobanche glabrata	LC
OROBANCHACEAE	Hyobanche sanguinea	LC
PLUMBAGINACEAE	Limonium dregeanum	LC
POACEAE	Bromus sp.	??
POACEAE	Chaetobromus involucratus subsp. dregeanus	LC
POACEAE	Chaetobromus involucratus subsp. involucratus	LC
POACEAE	Chaetobromus involucratus subsp. sericeus	LC
POACEAE	Cladoraphis cyperoides	LC
POACEAE	Cladoraphis spinosa	LC
POACEAE	Ehrharta brevifolia var. cuspidata	LC
POACEAE	Ehrharta delicatula	LC
POACEAE	Ehrharta longiflora	LC
POACEAE	Ehrharta longifolia	LC
POACEAE	Eragrostis curvula	LC
POACEAE	Fingerhuthia africana	LC
POACEAE	Hordeum murinum subsp. glaucum	??
POACEAE	Karroochloa schismoides	LC
POACEAE	Pentaschistis tomentella	LC
POACEAE	Phalaris minor	??
POACEAE	Phragmites australis	LC
POACEAE	Schismus barbatus	LC
POACEAE	Schmidtia kalahariensis	LC
POACEAE	Sporobolus virginicus	LC
POACEAE	Stipagrostis ciliata var. capensis	LC
POACEAE	Stipagrostis geminifolia	LC
POLYGONACEAE	Emex australis	??

Family Name	Species Name	Status
PORTULACACEAE	Anacampseros albissima	??
PORTULACACEAE	Anacampseros filamentosa subsp. namaquensis	LC
PTYCHOMITRIACEAE	Ptychomitrium crispatum	??
RUBIACEAE	Galium spurium-aparine	LC
RUBIACEAE	Nenax arenicola	LC
RUTACEAE	Diosma acmaeophylla	LC
SANTALACEAE	Thesium lineatum	LC
SAPINDACEAE	Dodonaea angustifolia	LC
SCROPHULARIACEAE	Diascia batteniana	LC
SCROPHULARIACEAE	Hebenstretia repens	LC
SCROPHULARIACEAE	Hebenstretia sp.	
SCROPHULARIACEAE	Jamesbrittenia fruticosa	LC
SCROPHULARIACEAE	Jamesbrittenia merxmuelleri	LC
SCROPHULARIACEAE	Lyperia tristis	LC
SCROPHULARIACEAE	Nemesia bicornis	LC
SCROPHULARIACEAE	Nemesia sp.	
SCROPHULARIACEAE	Peliostomum virgatum	LC
SCROPHULARIACEAE	Phyllopodium pumilum	LC
SCROPHULARIACEAE	Zaluzianskya affinis	LC
SCROPHULARIACEAE	Zaluzianskya benthamiana	LC
SOLANACEAE	Lycium amoenum	LC
SOLANACEAE	Lycium cinereum	LC
SOLANACEAE	Lycium decumbens	??
SOLANACEAE	Nicotiana glauca	EXOTIC
TECOPHILAEACEAE	Cyanella hyacinthoides	LC
TELOSCHISTACEAE	Xanthoria flammea	??
THYMELAEACEAE	Passerina truncata subsp. truncata	LC
URTICACEAE	Forsskaolea candida	LC
VISCACEAE	Viscum capense	LC
ZYGOPHYLLACEAE	Sisyndite spartea	LC
ZYGOPHYLLACEAE	Zygophyllum cordifolium	LC
ZYGOPHYLLACEAE	Zygophyllum morgsana	LC
ZYGOPHYLLACEAE	Zygophyllum spinosum	LC

APPENDIX A2: Curriculum Vitae

Dr David Jury McDonald Pr.Sci.Nat.

Name of Company: Bergwind Botanical Surveys & Tours CC. (Independent consultant)

Work and Home Address: 14 A Thomson Road, Claremont, 7708

Tel: (021) 671-4056 **Mobile:** 082-8764051 **Fax:** 086-517-3806

E-mail: dave@bergwind.co.za

Website: www.bergwind.co.za

Profession: Botanist / Vegetation Ecologist / Consultant / Tour Guide

Date of Birth: 7 August 1956

Employment history:

- 19 years with National Botanical Institute (now SA National Biodiversity Institute) as researcher in vegetation ecology.
- Five years as Deputy Director / Director Botanical & Communication Programmes of the Botanical Society of South Africa
- Ten years as private independent Botanical Specialist consultant (Bergwind Botanical Surveys & Tours CC)

Nationality: South African (ID No. 560807 5018 080)
Languages: English (home language) – speak, read and write
Afrikaans – speak, read and write

Membership in Professional Societies:

- South Africa Association of Botanists
- International Association for Impact Assessment (SA)
- South African Council for Natural Scientific Professions (**Ecological Science, Registration No. 400094/06**)
- Field Guides Association of Southern Africa

Key Qualifications:

- Qualified with a M. Sc. (1983) in Botany and a PhD in Botany (Vegetation Ecology) (1995) at the University of Cape Town.
- Research in Cape fynbos eco systems and more specifically mountain ecosystems.
- From 1995 to 2000 managed the Vegetation Map of South Africa Project (National Botanical Institute)
- Conducted botanical survey work for AfriDev Consultants for the Mohale and Katse Dam projects in Lesotho from 1995 to 2002. A large component of this work was the analysis of data collected by teams of botanists.
- **Director: Botanical & Communication Programmes** of the Botanical Society of South Africa (2000—2005), responsible for communications and publications;

involved with conservation advocacy particularly with respect to impacts of development on centres of plant endemism.

- Further tasks involved the day-to-day management of a large non-profit environmental organisation.
- **Independent botanical consultant** (2005 – to present) over 300 projects have been completed related to environmental impact assessments in the Western, Southern and Northern Cape, Karoo and Lesotho. A list of reports (or selected reports for scrutiny) is available on request.

Higher Education

Degrees obtained
and major subjects passed:

B.Sc. (1977), University of Natal, Pietermaritzburg
Botany III
Entomology II (Third year course)

B.Sc. Hons. (1978) University of Natal, Pietermaritzburg
Botany (Ecology /Physiology)

M.Sc - (Botany), University of Cape Town, 1983.
Thesis title: 'The vegetation of Swartboschkloof, Jonkershoek, Cape Province'.

PhD (Botany), University of Cape Town, 1995.
Thesis title: 'Phytogeography endemism and diversity of the fynbos of the southern Langeberg'.

Certificate of Tourism: Guiding (Culture: Local)
Level : 4 Code: TGC7 (Registered Tour Guide: WC 2969).

Employment Record :

January 2006 – present: Independent specialist botanical consultant and tour guide in own company: **Bergwind Botanical Surveys & Tours CC**
August 2000 - 2005 : Deputy Director, later Director Botanical & Communication Programmes, Botanical Society of South Africa
January 1981 – July 2000 : Research Scientist (Vegetation Ecology) at National Botanical Institute
January 1979—Dec 1980 : National Military Service

Further information is available on my company website: www.bergwind.co.za

B. FAUNAL ASSESSMENT OF THE KOINGNAAS MINING RIGHTS AREAS

Authors: Simon Todd, Christy Bragg and Eric Herrmann

B1. STUDY APPROACH

B1.1 ASSESSMENT APPROACH & PHILOSOPHY

The assessment was conducted according to the EIA Regulations, published by the Department of Environmental Affairs (2014) as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers *et al.* (2005). The requirements of the Department of Environment and Nature Conservation of the Northern Cape Province were observed and particular note was taken of the Northern Cape Conservation Act, 2009 (Act No. 9 of 2009) and Regulations (2011).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
- Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should.
    - In order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;
    - Pursue the best practicable environmental option by means of integrated environmental management;
    - Protect the environment as the people's common heritage;
    - Control and minimise environmental damage; and

- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

The study will include data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:

- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species);
    - or, are of cultural significance.
- Provide monitoring requirements as input into the Environmental Management Plan (EMP) for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.

- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

B1.2 Relevant Aspects of the Development

B 1.2.1 Limitations & Assumptions

The site visit for the current study took place during the spring season, during an optimal time of year as the vegetation was on a good state following the winter rains and this is when the majority of fauna of the area are active. However, as the site visit was only of a few days duration, only a small fraction of those species present could be confirmed present. However, as it can take months or even years to confirm the presence of rare fauna within an area, the lists of fauna are those observed on site, as well as those known to occur in the wider area based on their known distributions and

habitat preferences. This represents a sufficiently conservative and cautious approach which takes the study limitations into account.

B2. METHODOLOGY

B2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

- Information on animal species recorded for the Quarter Degree Squares (QDS) 3220DB 3220DD 3221CA 3221CC was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).
- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2016 (See Figure 1) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

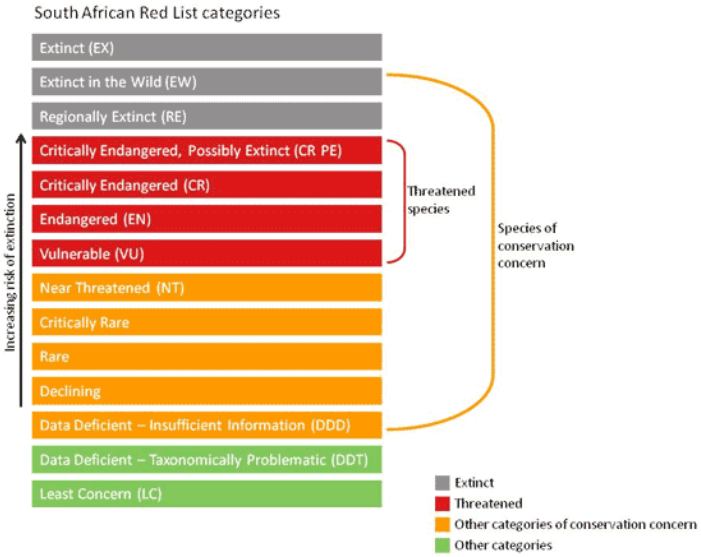


Figure 1. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

A number of data sources were consulted for the compilation of the avifaunal information, pertaining to the distribution (Harrison *et al*., 1997), biology (Hockey *et al*., 2005) and conservation status (Taylor *et al*., 2015) of relevant species.

- The Southern African Bird Atlas Project 1 (SABAP 1; Harrison *et al*., 1997) was consulted to determine the bird species likely to occur within the study area and the broader impact zone. The relevant quarter-degree squares that cover the study area are as follows: 3017AA and 3017AB (11 cards, 92 species) and 3017AD (21 cards, 119 species). More recent distribution data (SABAP 2; http://sabap2.adu.org.za/index.php) were obtained for the following pentads: 3005_1710 (9 cards, 75 species), 3010_1710 (1 card, 18 species), 3010_1715 (18 cards, 91 species), 3015_1715 (15 cards, 97 species), 3020_1715 (2 cards, 24 species), and 3025_1720 (6 cards, 68 species).
- The Important Bird Areas of South Africa (IBA; Marnewick *et al*., 2015) was consulted to determine the location of the nearest IBAs to the study area.
- The data from the Coordinated Avifaunal Roadcounts (CAR; Young *et al*., 2003) were consulted to determine the location of the nearest CAR routes to the study area.
- The data from the Coordinated Waterbird Counts (CWAC; Taylor *et al.,* 1999) were consulted to determine the location of the nearest CWAC sites to the study area.

- The conservation status (Red Listing) and endemism of all species recorded for the study area and surrounds was obtained from the most recent avifaunal red list for South Africa (Taylor *et al,.* 2015).
- The description of vegetation types occurring within the study area were obtained from Mucina & Rutherford (2006).
- The Red List assessment for South Africa's mammal species, compiled by the Endangered Wildlife Trust (EWT; https://www.ewt.org.za/Reddata/accessment.html) was consulted to determine the Red Listing for mammal species.

B2.2 SITE VISIT

The site was visited from 29 June to 1 July 2016 and again from 20-21 August 2016. During the site visit, the different fauna-related biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. Specific features visible on the satellite imagery of the site were also marked for field inspection and were verified and assessed during the site visit. Walk-through-surveys were conducted within representative areas across the different habitats units identified and terrestrial fauna species directly or indirectly (spoor, scat etc) observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. Observations of birds both on the shore and offshore were made from regular vantage points using binoculars. All marine bird species identified were also counted, with special attention paid to group sizes of communal roosts. Geographical coordinates were taken of notable features, such as seal haul outs and large cormorant roosts. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS for mapping if necessary.

B3. Description of the Affected Environment

B3.1FAUNAL COMMUNITIES

Mammals

Approximately 40 mammal species potentially occur at the site (Appendix 2). Larger mammals observed or likely to occur at the site include Steenbok *Raphicerus campestris*, Common Duiker *Sylvicapra grimmia*, Jackal *Canis mesomelas*, Caracal *Caracal caracaI,*

Porcupine *Hystrix africaeaustralis* and Aardvark *Orycteropus afer*. Due to the mobility and broad habitat tolerances of these species, they are not likely to be highly sensitive to the development of the area. Three listed species, the Brown Hyaena *Hyaena brunnea* (Near Threatened), Honey Badger *Mellivora capensis* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable) may occur in the area. As parts of the site are used for extensive sheep farming, predators are usually persecuted under these circumstances and so it is unlikely that the Brown Hyaena is abundant within the site. The Honey Badger and Black-footed Cat may occur at the site, but the loss of habitat that may result from the development would not be highly significant given the wide distribution of this species.

The site contains a diverse small mammal community and a relatively large number of rodents, shrews, moles and mole rats occur in the area. Common species observed within the site include Brants's Whistling Rat *Parotomys brantsii*, Namaqua Rock Mouse *Micaelamys namaquensis* and the Bush Vlei Rat *Otomys unisulcatus*. These species are important agents of disturbance in the area due to their high densities and burrowing activities. Golden mole tracks were common across most of the site and belong to either the endemic Cape Golden Mole *Chrysochloris asiatica* or Grant's Golden Mole *Eremitalpa granti* (Vulnerable). Mining has been identified as one of the major threats to Grant's Golden Mole and as it is restricted to soft sands along the coastal strip it is vulnerable to habitat fragmentation due to mining activities and the current mining expansion will likely further fragment the habitat for this species. Similarly, the Namaqua Dune Molerat *Bathyergus janetta* (Near Threatened) is also known from the area, and numerous mole-rat mounds were observed at the site, mainly within the areas of white sands. Based on their large size, these mounds are most likely from the Namaqua Dune Molerat as they were too larger for the smaller South African Mole Rat *Cryptomys hottentotus* which also occurs in the area. As this species has relatively specialized habitat requirements and is endemic to the Namaqualand area, it is vulnerable to habitat loss and fragmentation.

Overall, the impact of the current mining expansion activities on mammals are likely to be relatively low, due largely to the highly disturbed nature of the area already and any remaining species are likely to be habituated to or tolerant of mining activity. Restricted access to the area is also likely to be favourable for some species which are either persecuted on farmland or are sensitive to the presence of livestock and may benefit from the exclusion of livestock from the mining areas. However, overall the impact is likely to be negative and manifested as habitat loss, fragmentation and additional disturbance to fauna in the area.

Reptiles

As many as 60 different reptiles are known from the wider area around the site. However some of these are associated with habitats that are not found at the site and the actual number of species present is likely to be about half this number. This does however include several listed species as well as a number of narrow endemics. The most important habitats for reptiles within the site are likely to be the rocky areas along the coastal zone which provide refuge for geckos and other species associated with rocky shelter and then the areas of soft sands which are likely to be important for the legless skinks which occur in the area, including the listed Lomi's Blind Legless Skink *Typhlosaurus lomiae* as well as the endemic Pink Blind Legless Skink *Typhlosaurus vermis*.

Species observed at the site include the Variable Skink *Mabuya varia*, Giant Desert Lizard *Meroles ctenodactylus* and Angulate Tortoise *Chersina angulata* which were common throughout the site, while the Spotted Desert Lizard *Meroles suborbitalis* was common on the firmer lowland substrates slightly further away from the coast. Other species observed in the area include the Namaqua Day Gecko *Phelsuma ocellata*, Namaqua Gecko *Pachydactylus namaquensis* and Southern Rock Agama *Agama atra*, all of which were associated with rocky outcrops.

Table 2. Reptile species of conservation concern which may occur in the vicinity of the study site.

Scientific Name	Common Name	Distribution	Status	Likelihood
Homopus signatus	Speckled Padloper	Endemic	Vulnerable	High
Typhlosaurus lomiae	Lomi's Blind Legless Skink	Narrow Endemic	NT	High
Cordylus macropholis	Large-scaled Girdled Lizard	Endemic	NT	High

In general, the predominant potential impact associated with the additional mining development would be habitat loss and fragmentation for reptiles. Some of these impacts are likely to extend beyond the direct footprint of the development as some species such as the legless skinks are sensitive to soils vibrations are and likely to move away from areas with heavy machinery operating.

The Giant Desert Lizard *Meroles ctenodactylus* is a common endemic lizard from the study area, which favours sandy areas along the coastline and in the Strandveld.

Amphibians

The site lies within the known distribution range of seven frog and toad species. However as there is very little perennial water in the area, many of these are not likely to occur at the site. Although the Swartlintjies River runs through the site, the water in this area is generally very saline and is not likely to be used by amphibians for breeding purposes and most species present are likely to be independent of water or able to use pools in rocky outcrops or similar ephemeral environments. Species likely to be present include the Desert Rain Frog *Breviceps macrops*, Namaqua Rain Frog *Breviceps namaquensis* and Karoo Toad *Vandijkophrynus gariepensis*. The Desert Rain Frog occurs along the coast, in Strandveld vegetation up to 10 km from the coastline and is listed as Vulnerable due in large part to habitat loss from mining activities. The current development will contribute to some additional habitat loss and disturbance in the area. However, given the existing disturbance at the site, amphibian abundance is likely to be low in most of the disturbed parts of the site and the extent of additional impact is likely to be relatively low. The greatest threat to amphibians associated with the development is probably chemical and fuel/oil spills related to mining activities and the operation of heavy machinery.

Avifauna

A total of 154 terrestrial and coastal bird species have been recorded in the study area and surrounds (Table 1), based on data obtained from the Southern African Bird Atlas Project 1 (SABAP 1; Harrison *et al.*, 1997), and more recently the Southern African Bird Atlas Project 2 (SABAP 2, http://sabap2.adu.org.za/). Of these, 11 are listed as threatened and five as near-threatened, while 18 species are considered endemic and 38 near-endemic to South Africa (Taylor *et al*., 2015). During the site visit, a total of 71 bird species were recorded within the study area.

The overall landscape of the area is dominated by a flat to slightly undulating coastal peneplain, bordered to the west by the cold Benguela coast. Three avifaunal habitats could be distinguished based on the primary habitat preferences by birds, namely (i) the coastal shore (high-water mark to the offshore surf), (ii) succulent shrubland of the interior sandy plains, and (iii) small pans and water bodies (mostly artificial slimes dams and rain-filled mining voids).

The interior plains of the study area support a succulent-dominated shrubland, described as Namaqualand Coastal Duneveld (Mucina & Rutherford, 2006). Within the study area, this habitat has been largely altered by mining, with numerous mining voids, tailings and slimes dams scattered throughout. Nonetheless, this habitat still supports a significant diversity of bird species (102) comprising mostly small passerines (63 species). While none of these passerines are Red Listed, 14 species are endemic and 22 are near-endemic to South Africa (Taylor *et al*., 2015). The most commonly encountered and typical species include the following: Pied Starling (*Lamprotornis bicolor*), African Stonechat (*Saxicola torquatus*), Bokmakierie (*Telophorus zeylonus*), Yellow Canary (*Crithagra flaviventris*), Karoo Scrub-robin (*Cercotrichas coryphoeus*), Anteating Chat (*Myrmecocichla formicivora*), Grey-backed Cisticola (*Cisticola subruficapilla*), Cape Long-billed Lark (*Certhilauda curvirostris*), Karoo Prinia (*Prinia maculosa*), Malachite Sunbird (*Nectarinia famosa*), Southern Double-collared Sunbird (*Cinnyris chalybeus*), White-throated Canary (*Crithagra albogularis*), Cape Bunting (*Emberiza capensis*), Tractrac Chat (*Cercomela tractrac*), Cape Weaver (*Ploceus capensis*), Cape Bulbul (*Pycnonotus capensis*), Karoo Lark (*Calendulauda albescens*), and Chat Flycatcher (*Bradornis infuscatus*).

Species of special concern within the succulent shrubland include large terrestrial birds (5 species) and raptors (11 species), with the following species being of particular importance (with Red List status): the Endangered Ludwig's Bustard (*Neotis ludwigii*), Martial Eagle (*Polemaetus bellicosus*), Black Harrier (*Circus maurus*), the Vulnerable Secretarybird (*Sagittarius serpentarius*), Lanner Falcon (*Falco biarmicus*), Southern Black Korhaan (*Afrotis afra*), and the Near-threatened Kori Bustard (*Ardeotis kori*).

Besides Ludwig's Bustard and Southern Black Korhaan, these species all appear to be rare to uncommon in the study area owing to low SABAP 2 reporting rates. Kori Bustard, for example, was only recorded during the SABAP 1 period and not during SABAP 2. Further, no sensitive avifaunal areas such as communal breeding or foraging sites were identified within this shrubland habitat.

The study area is rather distant from the nearest Important Bird Areas (Marnewick *et al.,* 2015), Coordinated Avifaunal Roadcount routes (CAR; Young *et al*., 2003) and Coordinated Waterbird Count sites (CWAC; Taylor *et al.,* 1999). However, much of the area's shrubland lies within the Critical Biodiversity Area Two of the Northern Cape Critical Biodiversity Map (Oosthuysen & Holness, 2016). The areas surrounding Hondeklip Bay and Noup fall within the Critical Biodiversity Area One, and are therefore considered to be of an even higher conservation priority.

The coastal shore is characterized mainly by low rocky shores and associated kelp beds, interspersed by a number of small sandy beaches and a small bay (Rooiwal/Mitchell's Bay). A very narrow strip of Namaqualand Seashore Vegetation (Mucina & Rutherford, 2006) exists between the high-tide zone and the Namaqualand Coastal Duneveld. This upper-beach habitat occupies shell beds and low dunes, and is composed of hummock-forming and spreading dwarf succulent shrubs and herbs. A portion of this vegetation is included in the Namaqua National Park, and while only 5% has been previously transformed, coastal diamond mining still remains a threat (Mucina & Rutherford, 2006). The most common bird species include African Stonechat, Mountain Wheatear (*Oenanthe monticola*), Cape Wagtail (*Motacilla capensis*) and White-fronted Plover (*Charadrius marginatus*).

Approximately 35 species of birds are almost exclusively associated with the coastal shore, including cormorants, gulls, terns, and resident and migratory shorebirds. The most commonly encountered species throughout the year include the Endangered Cape Cormorant (*Phalacrocorax capensis*) and Bank Cormorant (*Phalacrocorax neglectus*), the Vulnerable Cape Gannet (*Morus capensis*), the Near Threatened Crowned Cormorant (*Phalacrocorax coronatus*), and several species that are not red listed, such as White-breasted Cormorant (*Phalacrocorax carbo*), Hartlaub's Gull (*Larus hartlaubii*), Kelp Gull (*Larus dominicanus*), White-fronted Plover (*Charadrius marginatus*), Swift Tern (*Sterna bergii*), Grey Heron (*Ardea cinerea*), and African Black Oystercatcher (*Haematopus moquini*). The latter is no longer red listed as numbers have increased by 37% since 1980, while its population has experienced an eastward range expansion (Taylor *et al*., 2015). In summer the local avifauna is augmented by a number of migratory shorebirds, the most common being Little Stint (*Calidris minuta*), Sanderling (*Calidris alba*), Curlew Sandpiper (*Calidris ferruginea*), Ruddy Turnstone (*Arenaria interpres*), and Ruff (*Philomachus pugnax*).

Red listed species such as the Critically Endangered Damara Tern (*Sterna balaenarum*), the Endangered African penguin (*Spheniscus demersus*), and the Vulnerable Caspian

Tern (*Sterna caspia*) have no nearby breeding colonies (Taylor *et al.*, 2015). The former has never been recorded in the region, though it was known as a very low density breeder near Kleinzee in the past (Taylor *et al.,* 2015). The other species have not been recorded in the study area during the SABAP 2, which suggests that they rare to uncommon temporary visitors to the shores of the study area, and may therefore remain unaffected by changes to the coastal habitat.

There are no known breeding colonies for any of the three cormorant species in the vicinity of the study area (Taylor *et al.*, 2015), with the closest colonies being located near Kleinzee to the north. Cormorant roosts noted during the site visit were recorded mostly on low rocks near breaking waves. Only five notable cormorant roosts were detected, with an average of 32 birds (range 15 to 50), with Cape Cormorant being more numerous than Crowned Cormorant. No Bank Cormorants were observed roosting on rocks, but a few individuals were possibly detected flying with Cape Cormorants just offshore. No highly sensitive avifaunal habitats therefore appear to exist within the coastal zone, particularly with respect to breeding sites. Most large coastal birds appear to use the coast for foraging and roosting. The absence of large boulders, separated from the mainland by inter-tidal waters at low tide, is perhaps the primary reason for the absence of cormorant breeding sites in the study area.

At the southern end of the coastal zone of the study area is a small embayment/indentation known as Rooiwal (also referred to as Mitchell's Bay). Considering that bays and indentations along the mostly linear west coast of South Africa are uncommon (Talkenberg, 1982), it may be probable that the Rooiwal Bay represents a unique ecological feature. The mouth of the bay is over 600 m wide, flanked to the north and south by rocky platforms, and over 600 m deep, culminating in a small beach backed by a steep red-soiled sand cliff (hence the name "Rooiwal"). Although no sensitive avifaunal features could be identified during the site visit, aside from a small cormorant roost on the south side of the bay mouth, the potential value of Rooiwal Bay should not be dismissed. The area lies within a coastal upwelling cell, at the extreme north of a spawning zone for common pelagic fish species (Hutchings *et al.,* 2002). The embayment may therefore serve as an important spawning or nursery microhabitat for fish, and hence foraging habitat for coastal birds at certain times of the year.

Three primary types of inland water bodies occur at the site, these being natural salt pans, slimes dams, and rain-filled mining voids. Only one natural pan is known from within the study area, located at the mouth of the Swartlintjies River. This pan is the only representative of the vegetation type known as Arid Estuarine Salt Marshes (Mucina &

Rutherford, 2005), which is considered Least Threatened despite 15% being transformed by cultivation and mining. The most abundant water bodies in the study area were the partially filled mining voids, which supported very low numbers of South African Shelduck (*Tadorna cana*) and Black-necked Grebe (*Podiceps nigricollis*). Additional species such as Pied Avocet (*Recurvirostra avosetta*), Black-winged Stilt (*Himantopus himantopus*), Blacksmith Lapwing (*Vanellus armatus*), and the Near Threatened Greater Flamingo (*Phoenicopterus ruber*) and Lesser Flamingo (*Phoenicopterus minor*) were only present at a few operational slimes dams. These slimes dams were located in highly disturbed areas, surrounded by mine tailings, voids and back-filling, suggesting that birds were accustomed to disturbances caused by general mining operations. No evidence was found to suggest that any of these species breed colonially in the area, and hence no sensitive avifaunal microhabitats were identified.

B3.2 FAUNAL HABITATS

In this section the different faunal habitats prevalent at the site are described and illustrated.

Rocky Shore

The coastline within the study area is largely a rocky shore with occasional sandy beaches. The rocky shore below the highwater mark, is important for birds as well as such some mammals such as seals which come to shore in some areas along the coast. It is considered relatively resistant and resilient to impact as the rocky shore itself is not easily impacted and wave action tends to restore the character of these areas once disturbed. Large changes in the amount of sand and sediment availability and movement due to beach and bay-mining activities can however create significant impact up to several kilometres from the impact source. Increases in sediment deposition rates can smother marine life and impact the value of these areas for shore-based birds and marine mammals. Within context of the site, Mitchell's Bay is considered to be sensitive area that is well-used by birds and probably mammals as well and mining of the bay will be certain to significantly change the character of this area and probably its long-term biodiversity value as well.

The rocky shore at Mitchell's Bay, showing the rocky shoreline as well as the 'Rooiwal' which is not unique and similar coastal embankments are relatively common on the West Coast.

Terrestrial Rocky Habitat

At the site, terrestrial rocky habitats are restricted to above the shoreline and its immediate vicinity. These areas are important for fauna associated with rocky habitats, including many reptiles and small mammals. As this is a restricted habitat that is not widely available and is likely to contain several listed species, it is considered relatively sensitive. Although some parts of this habitat have been significantly impacted by mining activities, some areas, such as in the vicinity of Mitchell's Bay are still largely intact. Apart from direct habitat loss, this habitat is relatively resilient to disturbance provided that the structure of the rocks is maintained. In addition, large rocks are often extracted from the mining voids and placed in mounds creating artificial habitats similar to the rocky areas. These areas are likely to be colonised by some of the same species, especially is they are big enough.

The rocky shore near to Mitchell's Bay. Such rocky habitats above the shoreline are not common at the site and restricted to the vicinity of the coastline.

Namaqualand Coastal Duneveld

The majority of the affected area consists of Namaqualand Coastal Duneveld, dominated by low and medium-height succulent shrubs, with a high seasonal abundance of annuals and geophytes. This is generally a fairly homogenous habitat with moderate faunal species richness. There are however several areas of more mobile coastal sands of marine origin that can be recognised by the white rather than red sands. These areas are considered more sensitive than the areas of red sands as the loose sands are favourable for a variety of subterranean species such as legless skinks, golden moles and molerats. The activity of such species was noticeably higher in these areas than in the areas of red sands. It is possible that beach mining activities can significantly impact these areas given the marine origin of the sands. The sand in these areas is constantly supplied from the sea and changes to the local currents or supply of sand could significantly alter the character and nature of these areas, either because the amount of sand increases significantly or if it is reduced.

Typical Namaqualand Coastal Duneveld at the site, which is considered moderate sensitivity from a faunal perspective as the faunal community in these areas is generally dominated by fairly common and widespread species.

Namaqualand Coastal Duneveld on sands of recent marine origin. Soil mounds made by the Namaqua Dune Molerat are conspicuous and indicate the high levels of activity in this area. These areas are considered more important for fauna than the more typical duneveld illustrated above.

Namaqualand Strandveld

Away from the coast on more stable soils, the vegetation consists of Namaqualand Strandveld. As the structure of these areas is largely similar to the coastal duneveld, the majority of fauna present is also similar and consists largely of more common and widespread species such as steenbok, gerbils and bush rats. However, these areas have not been impacted to the same extent as the areas towards the coast and at a broad level are still largely intact. Although there are sensitive areas present within the strandveld, there are few such areas present within the study area and the majority of the affected area is considered moderate sensitivity. The potential for disruption of ecological processes in these areas is significantly less than along the coast itself as the strandveld extends for some distance inland and the connectivity of this habitat has not been significantly disrupted.

Typical Namaqualand Strandveld within the site, this is generally lower and more open than the coastal duneveld.

Disturbed & Mined Areas

Large parts of the site consist of mine dumps, mining voids and other recent and historical mining-related disturbance. While there is some active rehabilitation at the site which contributes to restoring some biodiversity value to these areas, the majority of the mining footprint remains impacted. The value of most of these areas for fauna is very low. The slimes dams and water-filled mining voids are however used by water birds and waders and as such have some value in this regard. However, these are far in excess of what might be considered to contribute to local habitat diversity and are generally considered negative features of the landscape in that they disrupt connectivity of the landscape and probably also have negative hydrological effects on the surrounding areas.

Typical mining void, partially filled with water and being used by flamingos. The water in these voids is generally fairly saline and is not used by amphibians, although some mammals and birds appear to drink from these areas.

B4. CRITICAL BIODIVERSITY AREAS & BROAD SCALE ECOLOGICAL PROCESSES

The entire study area is located within an Ecological Support Area within the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2006). Connectivity along the coastline is of primary concern as there are many species present in the area that are restricted to the coastline and mining development is the main contributing cause of habitat fragmentation in the area. Although the connectivity of the coastal strip is naturally fragmented to some extent by rivers and other features, these are of limited extent and mining along the coastline has significantly fragmented the coastal strip for associated species. The additional contribution of the current developments would be relatively low, given the large amount of existing disturbance within the site. The cumulative impact of all the existing and planned disturbance is however likely to be high for some species at least. The major opportunity to reduce this impact would be to improve the condition of habitat within the site, through rehabilitation of disturbed areas. There are many unnecessary roads and unfilled mining voids present at the site and some connectivity within the site can be restored through remedial measures and rehabilitation of these areas.

Linkages between the marine and terrestrial environment are important as illustrated by this picture, showing large amounts of sand being blown inland from the sea. This creates specific habitats inland that are important for fauna, many of which are listed and local endemics.

B5. IMPACTS AND ISSUES IDENTIFICATION

B5.1 IDENTIFICATION OF POTENTIAL IMPACTS

The likely impacts on the faunal ecology of the site resulting from the development of the additional mining activity are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarized below before the impacts are assessed

Impact 1. *Direct Faunal Impacts*

The development will result in the transformation and loss of currently intact faunal habitat, while increased levels of noise, pollution, disturbance and human presence during mining will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the mining as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the mining activities and might be killed if proper management and monitoring is not in place. Increased traffic at the site would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible.

Cumulative Impact 1. *Impacts on Critical Biodiversity Areas and broad-scale ecological processes*

The site lies within an Ecological Support Area aimed at ensuring the connectivity of the landscape along the coastline. Extensive development within these areas would impact this function of the ESA. Apart from direct habitat loss, the presence and associated disturbance created by the mining activity at the site would deter certain species from the area, increasing the extent of habitat loss and fragmentation for such species. It is also possible that beach mining activities will impact on broad-scale physical and ecological processes such as sand movement corridors with resulting degradation or changes in habitat quality and character.

B5.2 IMPACT ASSESSMENT

Impact 1. *Direct faunal impacts during mining*

<table>
<tr><td colspan="7">Impact Description: Direct faunal impacts would occur due to mining-related habitat loss, noise and physical disturbance. .</td></tr>
<tr><td></td><td>Extent</td><td>Duration</td><td>Severity</td><td>Probability</td><td>Status</td><td>Significance</td></tr>
<tr><td>Without Mitigation</td><td>Medium</td><td>Long-term</td><td>Medium</td><td>Highly Probable</td><td>-‘tve</td><td>Medium</td></tr>
<tr><td>With Mitigation</td><td>Low</td><td>Long-term</td><td>Medium-Low</td><td>Probable</td><td>-‘tve</td><td>Medium-Low</td></tr>
<tr><td></td><td colspan="6">Mitigation:
6) New and existing mining voids should be backfilled in a more coordinated manner.
7) New soil dumps should not be within intact areas adjacent to mining pits, but should be used to backfill or rehabilitate existing disturbed areas.
8) The amount of access roads at the site should be reduced and these should be constructed in a more regular manner.
9) If the new processing plant or other infrastructure needs to be lit at night, this should be with low-UV emitting lights that do not attract insects, such as most LED-type lights.
10) There should be a long-term monitoring program developed for the site which monitors both fauna at the site as well as key ecological processes such as sand movement.</td></tr>
<tr><td></td><td colspan="2">Impact to be addressed/ further investigated and assessed in Impact Assessment Phase?</td><td colspan="4">Yes, the fauna present at the site will be characterized in the field and sensitive habitats identified and delineated.</td></tr>
</table>

Impact 2. *Impact on CBAs and Broad-Scale Ecological Processes*

Impact Description: Cumulative impact on ESA's and broad scale ecological processes. Cumulative impacts on the ESA along the coast is a significant concern at the site due to the large amount of mining activity that has taken place. Habitat loss due to ongoing mining activity may impact the ecological functioning of the ESA and result in increased habitat fragmentation and reduced landscape connectivity.						
	Extent	**Duration**	**Severity**	**Probability**	**Status**	**Significance**
Without Mitigation	Local	Long-term	Medium	Probable	-'tve	Medium
With Mitigation	Loca	Long-term	Medium	Probable	-'tve	Medium-Low
	Mitigation: 4) Minimise the development footprint, especially with regards to roads which should be planned in a more systematic manner. 5) Ensure that waste-rock and soil dumps are not in currently intact areas, but are rather used to fill existing mining voids or used to aid rehabilitation of previously disturbed areas. 6) An integrated monitoring plan should be developed for the site which includes key faunal and ecological indicators.					

B6. Conclusions & Recommendations

Although large parts of the current mining activities are within previously disturbed areas, significant impact on fauna and ecological processes is still likely to occur if the appropriate mitigation and avoidance measures are not implemented. Historic mining activities at the site took place in a very haphazard manner and the footprint of mining activities can be significantly reduced through better planning and coordination. There are many soil dumps at the site which should have been used to fill existing mining voids rather than impact on additional intact areas. There are a variety of listed and local endemic fauna species present in the area and the extensive mining-related disturbance in the area threatens habitat availability and connectivity for such species. A monitoring plan including key faunal and ecosystem indicators should be developed for the site, especially to monitor the potential impacts of the beach mining and related activities at Mitchell's Bay which may affect sand movement in the area and change input levels from the marine into the terrestrial environment.

B7. LITERATURE CITED

Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & de Villiers, M. (eds.). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria.

Branch W.R. 1998. *Field guide to snakes and other reptiles of southern Africa*. Struik, Cape Town.

Brownlie, S. 2005. Guideline for Involving Biodiversity Specialists in EIA Processes: Edition 1. CSIR Report No ENV-S-C 2005 053 C. Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town. 63 pp.

Desmet, P and Marsh A. 2008. Namakwa District Biodiversity Sector Plan. Available from BGIS at http://bgis.sanbi.org/namakwa/project.asp.

De Villiers CC, Driver A, Clark B, Euston-Brown DIW, Day EG, Job N, Helme NA, Holmes PM, Brownlie S and Rebelo AB (2005) *Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape.* Fynbos Forum and Botanical Society of South Africa, Kirstenbosch.

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Nature., Cape Town.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds). 1997. *The atlas of southern African birds*. Vol. 1 & 2. BirdLife South Africa, Johannesburg.

Marnewick, M.D., Retief, E.F., Theron, N.T., Wright, D.R., & Anderson, T.A. 2015. *Important Bird and Biodiversity Areas of South Africa*. Birdlife South Africa, Johannesburg.

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C

Mucina L. & Rutherford M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Passmore, N.I. & Carruthers, V.C. 1995. *South African Frogs: A complete guide*. Witwatersrand University Press, Johannesburg. 322 pp.

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

Talkenberg, W.F.M. 1982. An investigation of the environmental impact of surface diamond mining along the arid west coast of South Africa. Unpublished MSc Thesis, University of Cape Town, Cape Town.

Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. & Kieswetter, S.L. (eds) 1999. TOTAL CWAC Report: Coordinated Waterbird Counts in South Africa, 1992-1997. Avian Demography Unit, University of Cape Town, Cape Town.

Taylor, M.R., Peacock, F., Wanless, R.W. (eds) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.A. & Colahan, B.D. 2003. Big birds on farms: Mazda CAR report 1993-2001. Avian Demography Unit, Cape Town.

APPENDIX B1. LIST OF TERRESTRIAL MAMMALS

List of mammals which are likely to occur in the vicinity of the study site. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2015 and South African Red Data Book for Mammals (Friedmann & Daly 2004).

Scientific Name	Common Name	Status	Habitat Notes	Likelihood
Afrosoricida (Golden Moles):				
Chrysochloris asiatica	Cape Golden Mole	LC	Coastal parts of the Northern and Western Cape	High
Eremitalpa granti	Grant's Golden Mole	Vulnerable	West coast of South Africa and Namibia in sand dunes	High
Cryptochloris wintoni	De Winton's Golden Mole	Vulnerable	Sandy areas of the Namaqualand coastal plain	Low
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus ruprestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	High
Elephantulus edwardii	Cape Rock Elephant Shrew	LC	From rocky slopes, with or without vegetation, from hard sandy ground bearing little vegetation, quite small rocky outcrops	High
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Definite
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Definite
Lagomorpha (Hares and Rabbits):				
Lepus capensis	Cape Hare	LR/LC	Dry, open regions, with palatable bush and grass	Definite

Rodentia (Rodents):				
Bathyergus janetta	Namaqua Dune Mole Rat	LC	Sandy sunstrates along the coast or alluvium	High
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Definite
Petromus typicus	Dassie Rat	LC	Mountainous regions and inselbergs, where they are confined to rocky outcrops and live in crevices or piles of boulders	Low
Graphiurus platyops	Rock Dormouse	LC	Rocky terrain, under the exfoliation on granite bosses, and in piles of boulders	Low
Micaelamys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Definite
Parotomys brantsii	Brants's Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	Definite
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Otomys unisulcatus	Bush Vlei Rat	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Definite
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus babouri	Barbour's Rock Mouse	LC	Associated with rocky areas.	Low
Primates:				
Papio hamadryas	Chacma Baboon	LR/LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low

Eulipotyphla (Shrews):				
Myosorex varius	Forest Shrew	LC	Prefers moist, densely vegetated habitat	Low
Suncus varilla	Lesser Dwarf Shrew	LC	Often associated with termitaria, little else known	Medium
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Crocidura flavescens	Greater Red Musk Shrew	LC	Wide habitat tolerance	High
Carnivora:				
Proteles cristatus	Aardwolf	LR/LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Parahyaena brunnea	Brown Hyaena	NT	Nama and Succulent Karoo and the drier parts of the Grassland and Savanna Biomes	Low
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	Low
Genetta genetta	Small-spotted genet	LR/LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LR/LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Definite
Galerella pulverulenta	Cape Grey Mongoose	LR/LC	Wide habitat tolerance	Definite
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Definite

Ictonyx striatus	Striped Polecat	LR/LC	Widely distributed throughout the sub-region	High
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LR/LC	Presence of bushes is essential	High
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Low
Raphicerus campestris	Steenbok	LR/LC	Inhabits open country,	Definite
Oreotragus oreotragus	Klipspringer	LR/cd	Closely confined to rocky habitat.	Low

APPENDIX B2. LIST OF REPTILES

List of reptiles which are likely to occur at the site, based on the SARCA database. Conservation status is from Bates *et al.* (2014).

Family	Genus	Species	Subspecies	Common name	Red list category	No. records
Agamidae	Agama	atra		Southern Rock Agama	Least Concern	13
Agamidae	Agama	hispida		Spiny Ground Agama	Least Concern	7
Agamidae	Agama	knobeli		Knobel's Rock Agama	Not listed	1
Chamaeleonidae	Bradypodion	occidentale		Western Dwarf Chameleon	Least Concern	10
Chamaeleonidae	Chamaeleo	namaquensis		Namaqua Chameleon	Least Concern	1
Colubridae	Dipsina	multimaculata		Dwarf Beaked Snake	Least Concern	1
Colubridae	Philothamnus	semivariegatus		Spotted Bush Snake	Least Concern	2
Colubridae	Telescopus	beetzii		Beetz's Tiger Snake	Least Concern	2
Cordylidae	Cordylus	macropholis		Large-scaled Girdled Lizard	Near Threatened	3
Cordylidae	Karusasaurus	polyzonus		Karoo Girdled Lizard	Least Concern	27
Cordylidae	Namazonurus	peersi		Peers' Girdled Lizard	Least Concern	15
Cordylidae	Platysaurus	capensis		Namaqua Flat Lizard	Least Concern	3
Elapidae	Aspidelaps	lubricus	lubricus	Coral Shield Cobra	Not listed	2
Elapidae	Naja	nivea		Cape Cobra	Least Concern	1

Gekkonidae	Chondrodactylus	angulifer	angulifer	Common Giant Ground Gecko	Least Concern	2
Gekkonidae	Chondrodactylus	bibronii		Bibron's Gecko	Least Concern	18
Gekkonidae	Goggia	lineata		Striped Pygmy Gecko	Least Concern	2
Gekkonidae	Pachydactylus	austeni		Austen's Gecko	Least Concern	8
Gekkonidae	Pachydactylus	barnardi		Barnard's Rough Gecko	Least Concern	3
Gekkonidae	Pachydactylus	labialis		Western Cape Gecko	Least Concern	28
Gekkonidae	Pachydactylus	latirostris		Quartz Gecko	Least Concern	1
Gekkonidae	Pachydactylus	namaquensis		Namaqua Gecko	Least Concern	3
Gekkonidae	Pachydactylus	weberi		Weber's Gecko	Least Concern	2
Gekkonidae	Phelsuma	ocellata		Namaqua Day Gecko	Least Concern	3
Gerrhosauridae	Cordylosaurus	subtessellatus		Dwarf Plated Lizard	Least Concern	3
Gerrhosauridae	Gerrhosaurus	typicus		Karoo Plated Lizard	Least Concern	1
Lacertidae	Meroles	ctenodactylus		Giant Desert Lizard	Least Concern	7
Lacertidae	Meroles	knoxii		Knox's Desert Lizard	Least Concern	22
Lacertidae	Meroles	suborbitalis		Spotted Desert Lizard	Least Concern	2
Lacertidae	Nucras	tessellata		Western Sandveld Lizard	Least Concern	6
Lacertidae	Pedioplanis	lineoocellata	lineoocellata	Spotted Sand Lizard	Least Concern	1

Lacertidae	Pedioplanis	lineoocellata	pulchella	Common Sand Lizard	Least Concern	1
Lacertidae	Pedioplanis	namaquensis		Namaqua Sand Lizard	Least Concern	3
Lamprophiidae	Boaedon	capensis		Brown House Snake	Least Concern	5
Lamprophiidae	Lamprophis	guttatus		Spotted House Snake	Least Concern	1
Lamprophiidae	Prosymna	frontalis		Southwestern Shovel-snout	Least Concern	3
Lamprophiidae	Prosymna	sundevallii		Sundevall's Shovel-snout	Least Concern	1
Lamprophiidae	Psammophis	crucifer		Cross-marked Grass Snake	Least Concern	10
Lamprophiidae	Psammophis	namibensis		Namib Sand Snake	Least Concern	3
Lamprophiidae	Psammophis	notostictus		Karoo Sand Snake	Least Concern	4
Lamprophiidae	Psammophylax	rhombeatus	rhombeatus	Spotted Grass Snake	Least Concern	9
Lamprophiidae	Pseudaspis	cana		Mole Snake	Least Concern	2
Scincidae	Acontias	lineatus		Striped Dwarf Legless Skink	Least Concern	1
Scincidae	Acontias	litoralis		Coastal Dwarf Legless Skink	Least Concern	45
Scincidae	Acontias	namaquensis		Namaqua Legless Skink	Least Concern	2
Scincidae	Acontias	tristis		Namaqua Dwarf Legless Skink	Least Concern	7
Scincidae	Scelotes	caffer		Cape Dwarf Burrowing Skink	Least Concern	1

Scincidae	Scelotes	capensis		Western Dwarf Burrowing Skink	Least Concern	1
Scincidae	Scelotes	sexlineatus		Striped Dwarf Burrowing Skink	Least Concern	7
Scincidae	Trachylepis	capensis		Cape Skink	Least Concern	3
Scincidae	Trachylepis	sulcata	sulcata	Western Rock Skink	Least Concern	7
Scincidae	Trachylepis	variegata		Variegated Skink	Least Concern	31
Scincidae	Typhlosaurus	lomiae		Lomi's Blind Legless Skink	Near Threatened	20
Scincidae	Typhlosaurus	vermis		Pink Blind Legless Skink	Least Concern	41
Testudinidae	Chersina	angulata		Angulate Tortoise	Least Concern	15
Testudinidae	Homopus	signatus		Speckled Padloper	Vulnerable	8
Testudinidae	Psammobates	tentorius	trimeni	Namaqua Tent Tortoise	Not listed	2
Typhlopidae	Rhinotyphlops	lalandei		Delalande's Beaked Blind Snake	Least Concern	1
Viperidae	Bitis	arietans	arietans	Puff Adder	Least Concern	1

APPENDIX B3. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in the vicinity of the site. Based on the Frogmap database of the ADU, while conservation status is from the IUCN Red Lists 2014 and Minter et al. (2004).

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Breviceps macrops	Desert Rain Frog	Vulnerable	Up to 10km inland from the Namaqualand coast in Strandveld vegetation	Endemic	High
Breviceps namaquensis	Namaqua Rain Frog	Not Threatened	Arid sandy habitats from the coast to inland mountains	Endemic	High
Vandijkophrynus gariepensis	Karoo Toad	Not Threatened	Karoo Scrub	Widespread	High
Vandijkophrynus robinsoni	Paradise Toad	Not Threatened	Natural springs and waterholes in the arid areas of the Richtersveld	Endemic	Medium
Xenopus laevis	Common Platanna	Not Threatened	Any more or less permanent water	Widespread	Not likely
Cacosternum namaquense	Namaqua Caco	Not Threatened	Upland Succulent Karoo. Breeds in temporary or permanent natural or man-made pools	Endemic	Medium
Strongylopus springbokensis	Namaqua Stream Frog	Vulnerable	Mountainous areas of Namaqualand associated with seeps and springs	Endemic	Not likely

GENERAL CONCLUSIONS

The biodiversity assessment presented here is a collaborative effort between Bergwind Botanical Surveys & Tours CC and Simon Todd Consulting. Four authors were involved. For the most part, the botanical assessment (Section A) was conducted independently of the faunal assessment (Section B). It was only after field-work was completed and draft versions of the respective botanical and faunal reports were in preparation that David McDonald and Simon Todd 'compared notes'. Since the fauna rely on a healthy habitat it stands to reason that negative impacts on habitat (vegetation) directly influence the faunal component of the ecosystem and ecological processes. It was gratifying, therefore, that the conclusions reached by both parties were much the same in terms of overall impacts on the environment in the WCR study area and that recommended mitigation for the potential impacts of future mining are much the same.

Report submitted 6 September 2016