APPENDIX D: TERRESTRIAL ECOLOGICAL HABITAT INTEGRITY INVESTIGATION REPORT

TERRESTRIAL ECOLOGICAL HABITAT INTEGRITY INVESTIGATION AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED EXTENSION OF TWO POLLUTION CONTROL DAM FACILITIES, KATHU, NORTHERN CAPE

Prepared for

EXM Advisory Services

November 2017

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EXECUTIVE SUMMARY

Based on the findings of the assessment, it is the opinion of the ecologists that from an ecological perspective, the proposed project be considered favorably. However, all essential mitigation measures and recommendations presented in this report should be adhered to as to ensure that the impact on the receiving environment is minimized.

Scientific Terrestrial Services (STS) was appointed to conduct an investigation into the terrestrial faunal and floral ecology as part of the Environmental impact and authorisation (EIA) process for the construction of a new Pollution Control Dam (PCD) at the Aldag Filling Station and the expansion of the existing approved PCD at the Lylyveld South Mining Areas, as part of the Sishen Mine, near Kathu, Northern Cape Province.

Specific outcomes required from this report include the following:

- To define the Present Ecological State (PES) of the terrestrial ecological resources in the vicinity of the study area;
- To conduct a faunal and floral Species of Conservation Concern (SCC) assessment, including potential for such species to occur or to have occurred within the study area;
- To identify and consider all sensitive landscapes including rocky ridges, natural grasslands, wetlands and any other ecologically important features; and
- To determine the environmental impacts that the construction of the study area might have on the terrestrial ecology associated with the footprint area, and to develop mitigation and management measures for all phases of the development.

TERRESTRIAL RESULTS

- One habitat unit was identified during the field assessment, namely Degraded Kuruman Mountain Bushveld.
- The habitat unit is considered to be degraded, with impacts resulting from land use and mining activities evident;
- One tree species, *Vachellia erioloba*, which is listed as Protected in Section 15 (1) of the National Forest Act (1998, as amended in September 2011) was observed within the study area. All relevant permits pertaining to these species are to be acquired prior to onsite activities;
- The study area was predominantly inhabited by faunal species common to the region, that are widely distributed throughout the surrounding habitat;
- Two faunal species, namely *Neotis ludwigii* (Ludwig's Bustard) and *Ardeotis kori* (Kori Bustard) as listed in the TOPS lists may infrequently visit the area surrounding the PCD; and
- Provided that all mitigation measures are adhered to and that the necessary permitting systems are followed, it is deemed that the proposed development be considered favorably.

TERRESTRIAL IMPACT ASSESSMENT

The tables below summarise the findings indicating the significance of the impacts before mitigation takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation measures it is assumed that a high level of mitigation takes place, but which does not lead to prohibitive costs. From the table, it is evident that prior to mitigation the impacts are of medium-high significance. If mitigation takes place all impacts can be further reduced.

A summary of the impact significance of the construction phase on the terrestrial ecology.

Impact	Unmanaged	Managed
1: Impact on Terrestrial habitat and SCC	Medium-Low	Low

A summary of the impact significance of the operational phase on the terrestrial ecology.

Impact	Unmanaged	Managed
1: Impact on Terrestrial habitat and SCC	Medium-Low	Low

SENSITIVITY

From an ecological perspective, habitat sensitivity is considered to be of a moderately low level. The table below indicates the sensitivity of the habitat units along with an associated conservation objective and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Degraded Kuruman Mountain Bushveld	Moderately Low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat unit is considered to be of moderately low sensitivity and development of the PCD will not lead to a loss of sensitive habitat. However, permits for the removal/destruction of protected plants are to be obtained from the relevant authorities prior to the commencement of construction activities. It is recommended that once the layout/development plans for the proposed PCD have been finalised, that a walk down of the area is conducted, in order to ascertain the exact presence and numbers of protected plant species. Furthermore, during development activities, all mitigation measures are to be strictly enforced so as to ensure that the surrounding environment is not impacted upon through edge effects or careless veld clearing and dumping activities.

DOCUMENT GUIDE

The table below provides the NEMA (2014) Requirements for Biodiversity Assessments and also the relevant sections in the reports where these requirements are addressed.

NEMA Regulations (2014) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	Appendix H
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix H
A declaration that the person is independent in a form as may be specified by the competent authority	Appendix H
An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1.3 Section 2.1
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2 Appendix B Appendix C
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 5
An identification of any areas to be avoided, including buffers	Section 5
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 6
Any mitigation measures for inclusion in the EMPr	Section 6
Any conditions for inclusion in the environmental authorisation	Section 6
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 6
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Section 7
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 7
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

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GLOSSARY OF TERMS

Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
IBA (Important Bird and Biodiversity Area)	The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that: are globally threatened, have a restricted range, are restricted to specific biomes/vegetation types or sites that have significant populations.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
SCC (Species of Conservation Concern)	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.

LIST OF ACRONYMS

BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EN	Endangered
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MFD	Mean Frost Days
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEMWA	National Environmental Management: Waste Act
NT	Near Threatened
PES	Present Ecological State
POC	Probability of Occurrence
POSA	Plants of Southern Africa
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data List
RE	Regionally Extinct
SABAP 2	Southern African Bird Atlas 2
SACAD	South Africa Conservation Areas Database
SANBI	South African National Biodiversity Institute
SAPAD	South Africa Protected Area Database
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services CC
TOPS	Threatened or Protected Species
TSP	Threatened Species Programme
VU	Vulnerable

1. INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct an investigation into the terrestrial faunal and floral ecology as part of the Environmental impact and authorisation (EIA) process for the construction of a new Pollution Control Dam (PCD) at the Aldag Filling Station and the expansion of the existing approved PCD at the Lylyveld South Mining Areas, as part of the Sishen Mine, near Kathu, Northern Cape Province, henceforth referred to as the “Aldag PCD” and the “Lylyveld PCD” respectively, and collectively as the “PCD Infrastructure Areas”.

The Lylyveld PCD is located approximately 1 km south, and the Aldag PCD approximately 16.5 km north of the N14 highway. The town of Kathu is situated approximately 11.3 km northeast of the Aldag PCD, and 26.1 km north of the Lylyveld PCD. The PCD Infrastructure Areas fall within the Gamagara Local Municipality,and the John Taolo Gaetsewe District Municipality.

This report, after consideration and the description of the ecological integrity of the study area, must guide the Environmental Assessment Practitioner (EAP), regulatory authorities and developing proponent, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.

Figure 1: Digital Satellite image depicting the location of the PCD Infrastructure Areas in relation to surrounding areas.

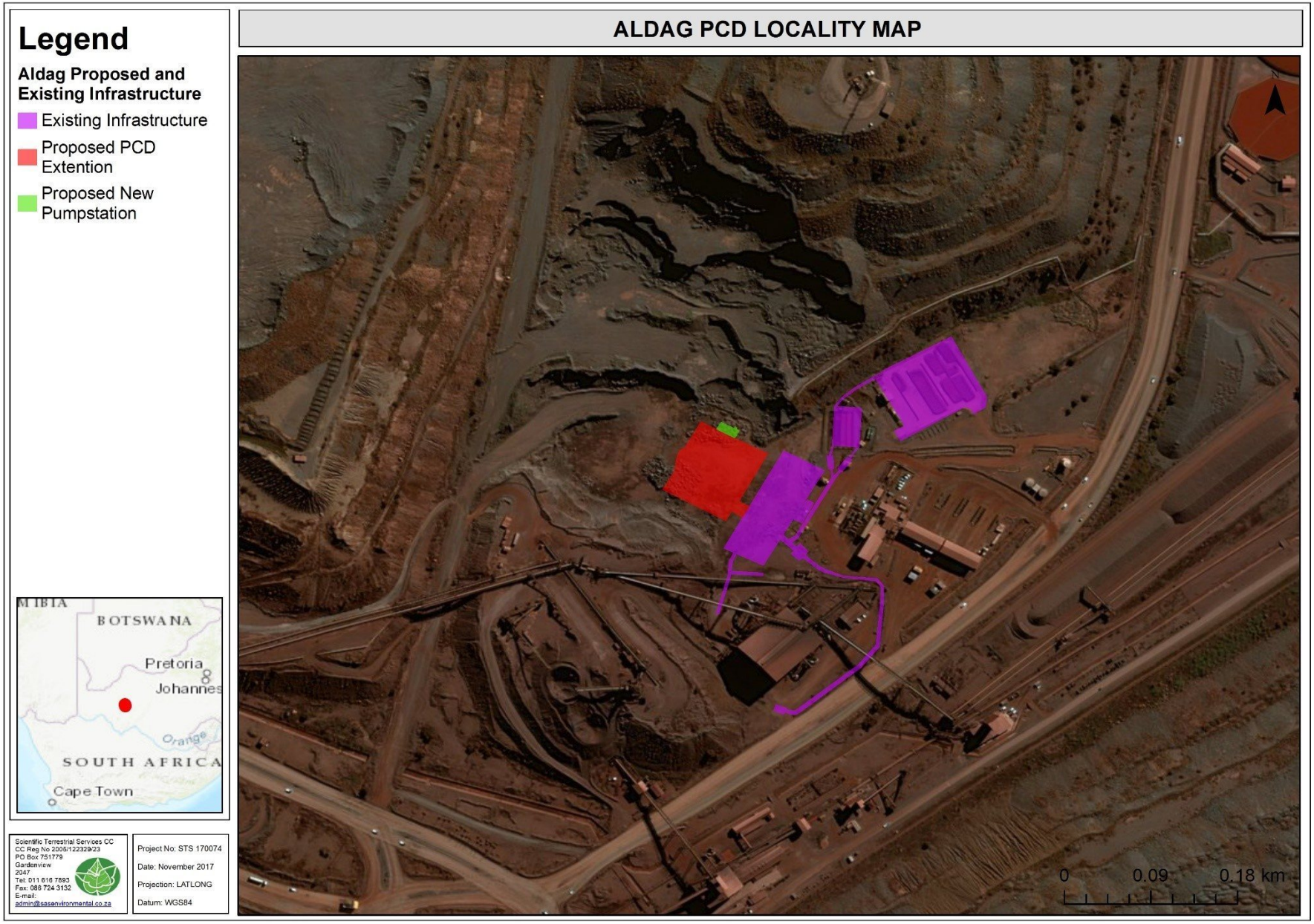


Figure 2: Digital satellite image depicting the location of the Aldag PCD Infrastructure

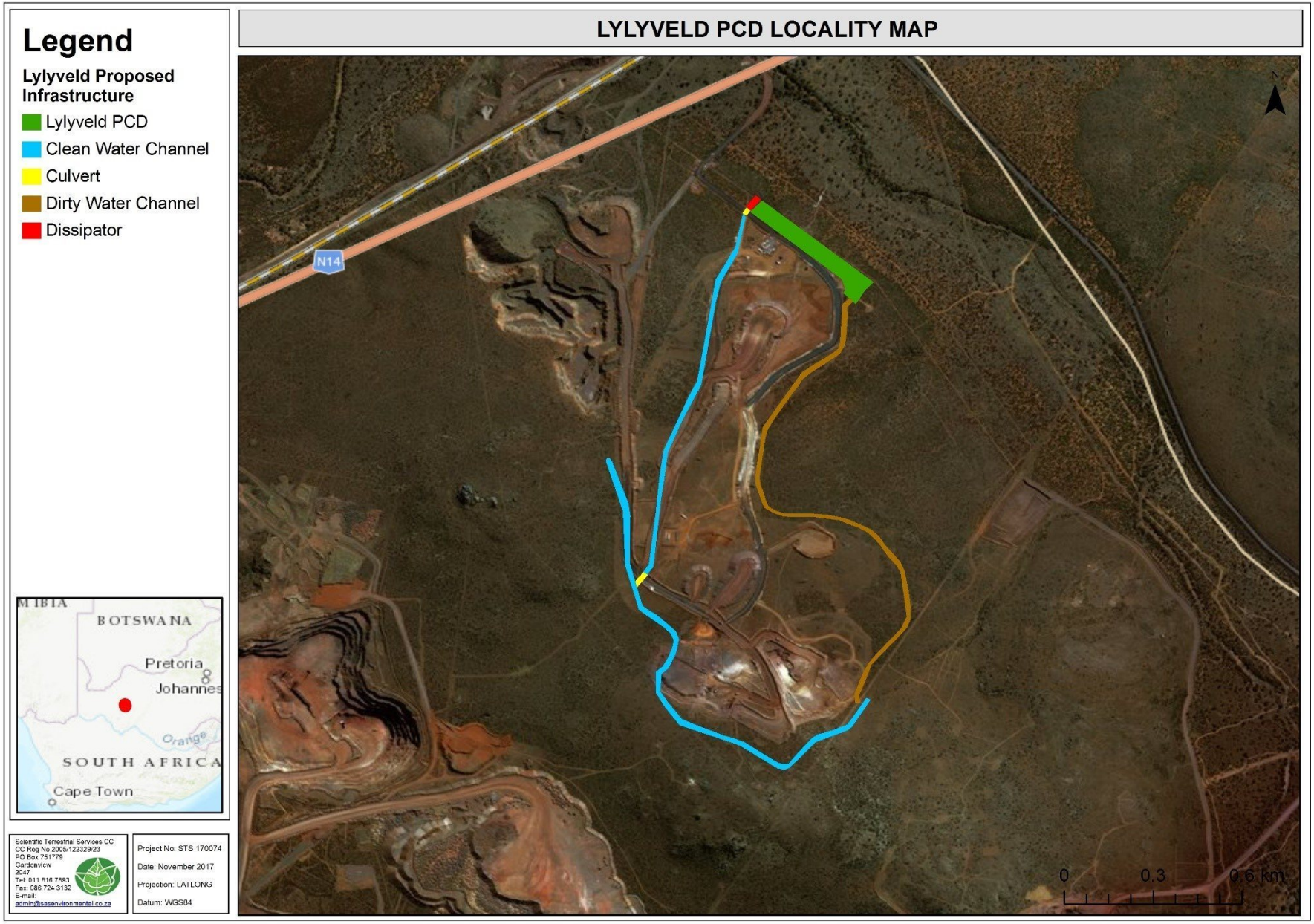


Figure 3 Digital satellite image depicting the location of the Aldag PCD Infrastructure

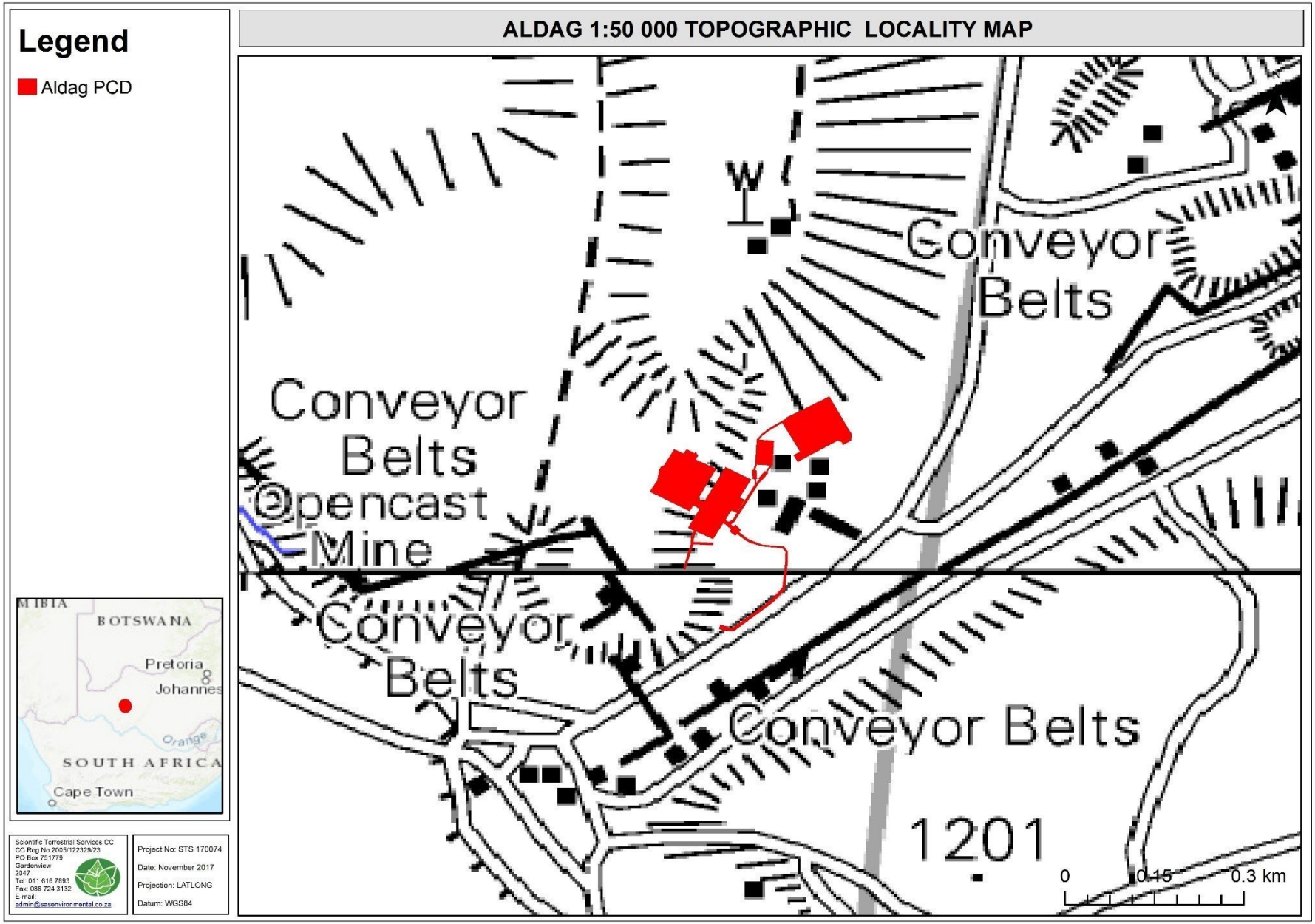


Figure 4: The Aldag PCD depicted on a 1:50 000 topographical map in relation to the surrounding area.

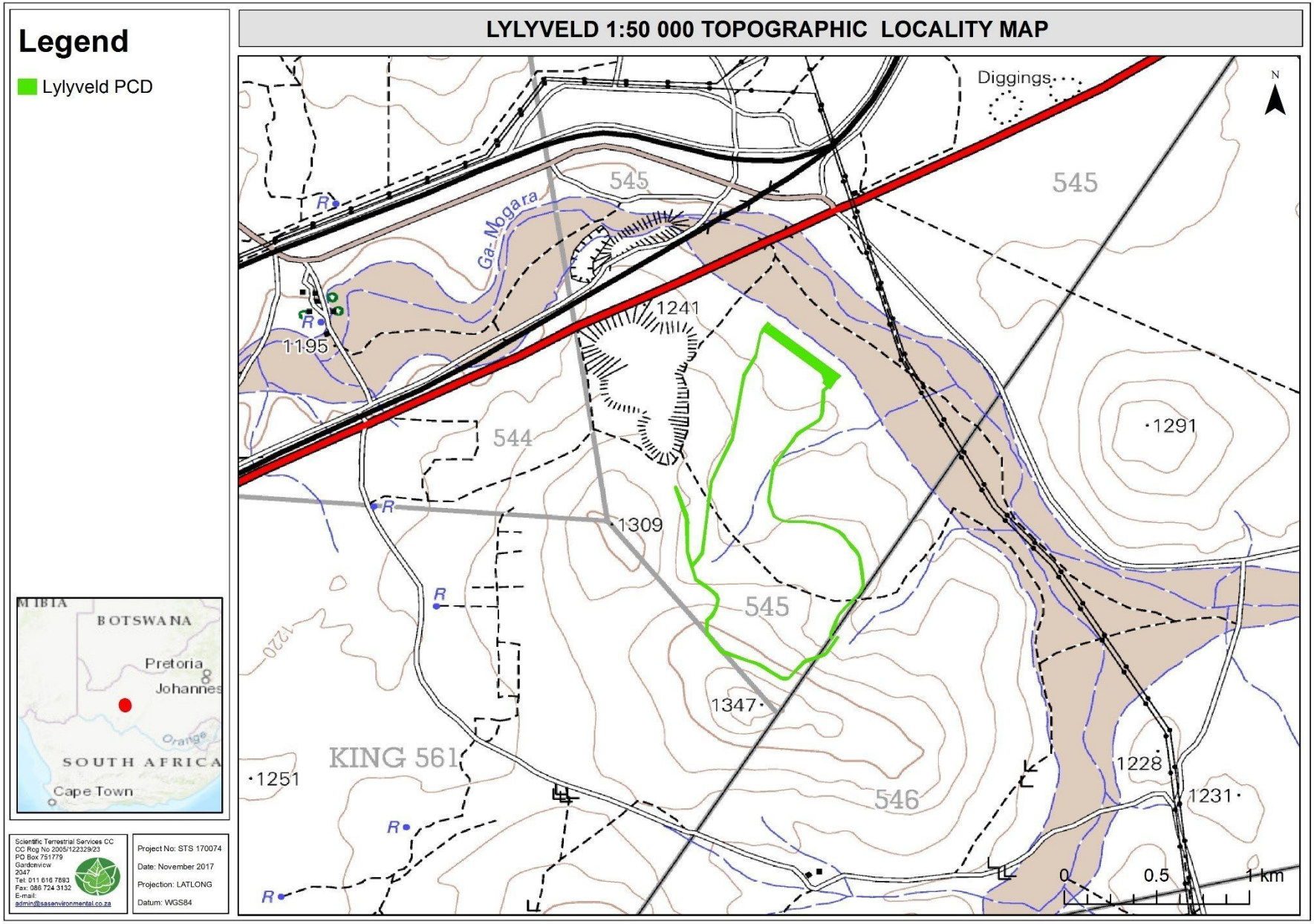


Figure 5: The Lylyveld PCD depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below:

- To define the Present Ecological State (PES) of the terrestrial ecological resources associated with the PCD Infrastructure Areas;
- To determine and describe habitats, communities and the ecological state of the PCD Infrastructure Areas;
- To conduct a faunal and floral Species of Conservation Concern (SCC) assessment, including potential for such species to occur within the PCD Infrastructure Areas;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and any other ecologically important features, if present; and
- To determine the environmental impacts that the construction of the proposed development might have on the terrestrial ecology associated with the PCD Infrastructure Areas, as well as potential impacts on the ecology due to activities related to the proposed development and to develop mitigation and management measures for all phases of the development.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The ecological assessment is confined to the PCD Infrastructure Areas and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral and faunal communities have been accurately assessed and considered;
- Due to the nature and habits of most faunal taxa, the high level of surrounding anthropogenic activities and the time (season) of the assessment, it is unlikely that all species would have been observed during a field assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the PCD Infrastructure Areas might have been missed during the assessment; and
- The data presented in this report are based on a single site visit, undertaken in the middle of November 2017, during summer. A more accurate assessment would require that assessments take place in all seasons of the year. However, on-site data was significantly augmented with all available desktop data and specialist experience in the

area, and the findings of this assessment are considered to be an accurate reflection of the ecological characteristics of the PCD Infrastructure Areas.

1.4 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act (NEMA) (Act 107 of 1998);
- National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004);
- Conservation of Agricultural Resources Act (CARA, Act 43 of 1983); and
- The Northern Cape Nature Conservation Act (NCNCA, Act No 9 of 2009);
- The National Forest Act (1998, as amended in September 2011).

The details of each of the above, as they pertain to this study, are provided in Appendix A of this report.

2. ASSESSMENT APPROACH

2.1 General Approach

In order to accurately determine the PES of the PCD Infrastructure Areas and capture comprehensive data with respect to the terrestrial ecology, the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analyses were then used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;
- A literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment of the PCD Infrastructure Areas included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), the Northern Cape Spatial Development Framework (2012), Mucina and Rutherford (2012), National Biodiversity Assessment (2011), Important Bird Areas in conjunction with the South African Bird Atlas Project (SABAP2), International Union for Conservation of Nature (IUCN), and Pretoria Computer Information Systems (PRECIS);
- A visual on-site assessment of the PCD Infrastructure Areas was conducted during November 2017 in order to confirm the assumptions made during consultation of the

maps and to determine the ecological status of the PCD Infrastructure Areas. A thorough 'walk through' on foot was undertaken in order to identify the occurrence of the dominant floral species and faunal and floral habitat diversities;

- Specific methodologies for the assessment, in terms of field work and data analysis of faunal and floral ecological assemblages will be presented in Appendices B and C; and
- For the methodologies relating to the impact assessment and development of the mitigation measure, please refer to Appendix D of this report.

2.2 Sensitivity Mapping

All the ecological features of the PCD Infrastructure Areas were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). In addition, identified locations of SCC and SANBI protected species were also marked by means of GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps.

3. RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the PCD Infrastructure Areas

The following table contains data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high quality data, the various databases do not always provide an entirely accurate indication of the PCD Infrastructure Area's actual biodiversity characteristics.

Table 1: Summary of the conservation characteristics for the PCD Infrastructure Areas.

Details of the PCD Infrastructure Areas in terms of Mucina & Rutherford (2012)	
Biome	The PCD Infrastructure Areas are situated within the **Savanna Biome.**
Bioregion	The PCD Infrastructure Areas area located within the **Eastern Kalahari Bushveld Bioregion**
Vegetation Type (Figure 3)	The Aldag PCD is situated within the **Kuruman Thornveld,** with the Lylyveld PCD falling within the **Kuruman Mountain Bushveld** Vegetation type.
Conservation details pertaining to the PCD Infrastructure Areas (Various databases)	
NBA (2011)	The PCD Infrastructure Areas fall within an area that is currently not protected.
National Threatened Ecosystems (2011)	The PCD Infrastructure Areas fall within an area that is least threatened.
NPAES (2009) & SAPAD (2016)	There are no protected or conservation areas associated with or in close proximity (within 10km) of either of the PCD Infrastructure Areas
IBA (2015)	Neither of the PCD Infrastructure Areas are located within or near an IBA (within 10km)
Mining and Biodiversity Guidelines (2013)	
Neither of the PCD Infrastructure Areas fall within an area considered to be of biodiversity importance according to the Mining and Biodiversity Guidelines (2013)	

Description of the dominant vegetation type(s) relevant to the PCD Infrastructure Areas (Mucina & Rutherford 2012)		
Vegetation Type	Kuruman Thornveld	Kuruman Mountain Bushveld
Climate	Summer and autumn rainfall, very dry winters	Summer and autumn rainfall, very dry winters
Altitude (m)	1100-1500	1100-1800
MAP* (mm)	368	371
MAT* (°C)	17.5	16.8
MFD* (Days)	36	40
MAPE* (mm)	2786	2728
MASMS* (%)	84	83
Distribution	North-West & Northern Cape Provinces	Northern Cape and North-West Provinces
Geology & Soils	Some Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments, with red wind-blown sand.	Blanded iron formation, with jaspilite, chert and riebeckite-asbestos of the Asbestos Hills Supergroup of the Griqualand West Supergroup (Vaalian)
Conservation	Least threatened. Target 16%. None conserved.	Least threatened. Target 16%. None conserved.
Vegetation & landscape features (Dominant Floral Taxa in Appendix F)	Flat rocky plains and some sloping hills, with very well developed, closed shrub layer and open tree stratum consisting of *Vachellia erioloba*	Rolling hills with gentle to moderate slopes and hill pediment areas with open shrubveld. *Lebeckia macrantha* prominent in places, and well developed grass layer.

Northern Cape Provincial Spatial Development Framework (NPSDF, 2012)
The PCD Infrastructure Areas is situated within the Griqualand West Centre of Endemism (Figure 6). Please refer to Appendix E for further detail. The PCD Infrastructure Areas also falls within the Gamagara corridor (Figure 7). The Gamagara Corridor comprises the mining belt of the John Taolo Gaetsewe and Siyanda districts and runs from Lime Acres and Danielskuil to Hotazel in the north. The corridor focuses on the mining of iron and manganese.

Northern Cape Critical Biodiversity Areas (2016) (Figure 7)	
Ecological Support Area (ESA)	The northern portion of the Lylyveld PCD falls within an area considered to be an ESA. According to the Technical Guidelines for CBA Maps document ESAs are areas which must retain their ecological processes in order to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas; meet biodiversity targets for representation of ecosystem types or Species of special concern when it's not possible to meet them in CBAs; support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017)
Other Natural Areas (ONA)	Various small areas of the Lylyveld PCD falls within areas considered to be other natural areas. According to the Technical Guidelines for CBA Maps document ONA consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).

NBA = National Biodiversity Assessment; NPAES = National Protected Areas Expansion Strategy; SAPAD = South African Protected Areas Database; IBA = Important Bird Area; MAP – Mean annual precipitation; MAT – Mean annual temperature; MAPE – Mean annual potential evaporation; MFD = Mean Frost Days; MASMS – Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply), (d) = dominant species; (k) Kalahari endemic

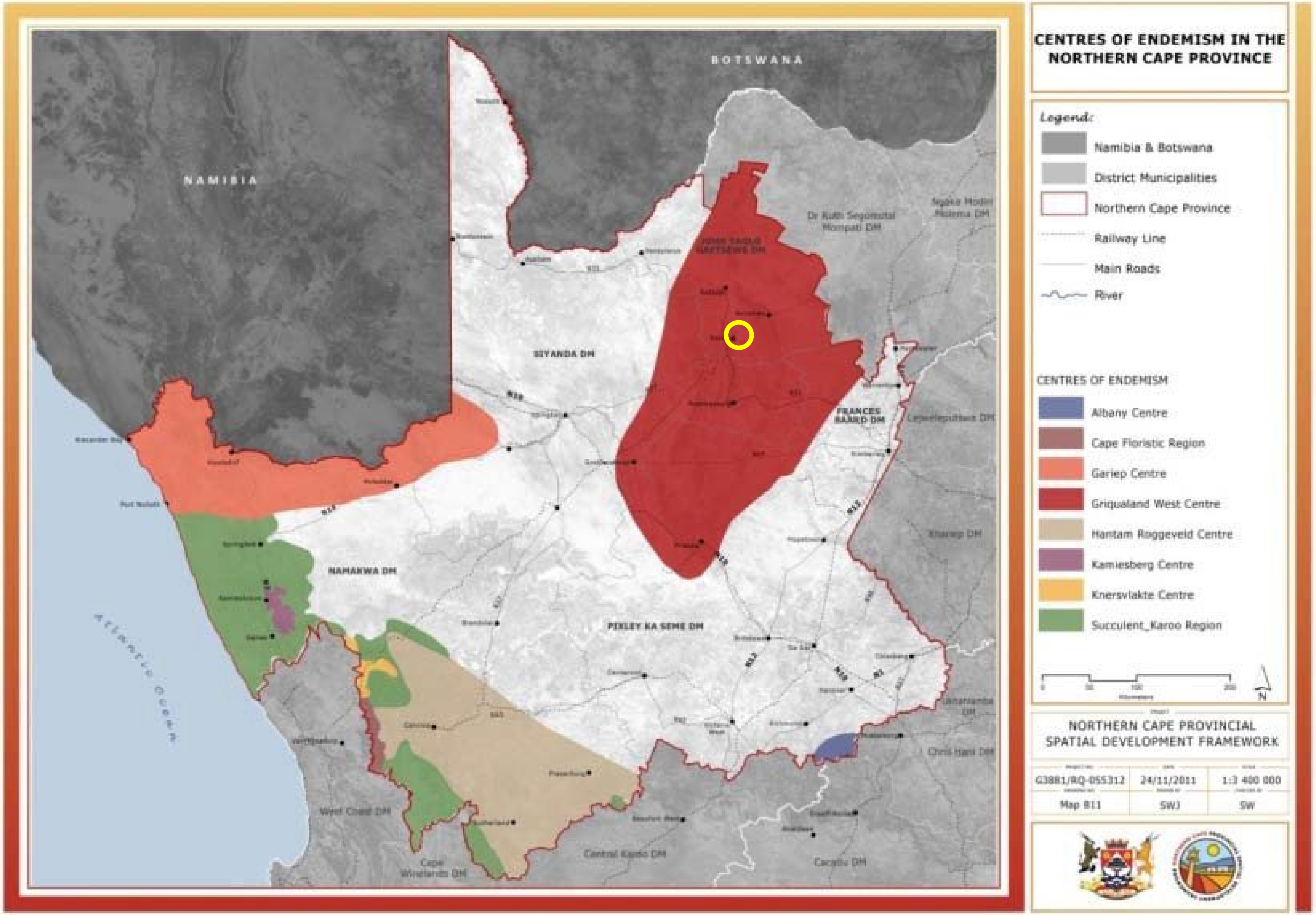


Figure 6: Centers of endemism of the Northern Cape Province: the MRA indicated by a yellow circle (Northern Cape Provincial Spatial Development Framework, 2012).

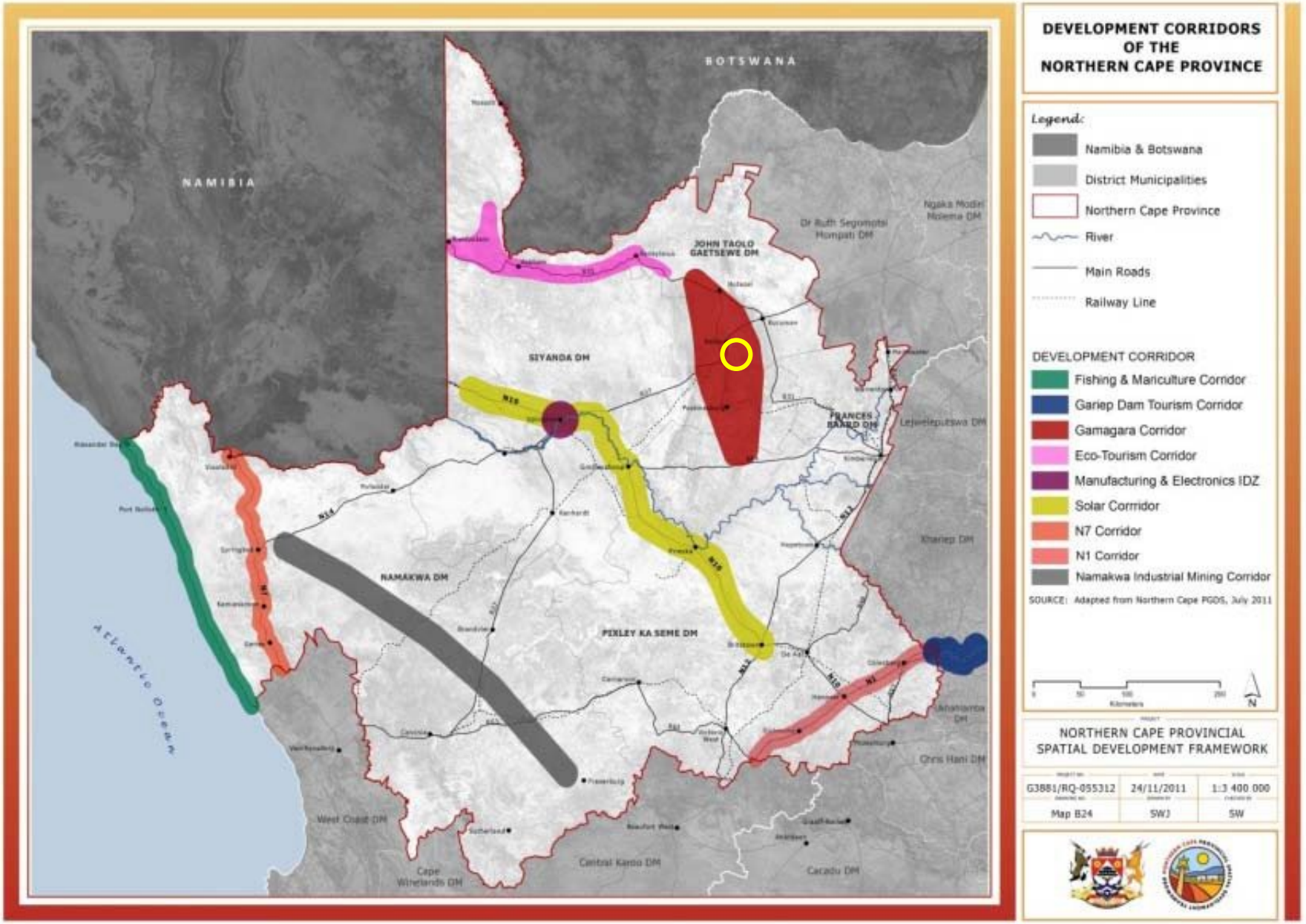


Figure 7: Development regions and corridors of the Northern Cape: the MRA indicated by the yellow circle (NPSDF, 2012).

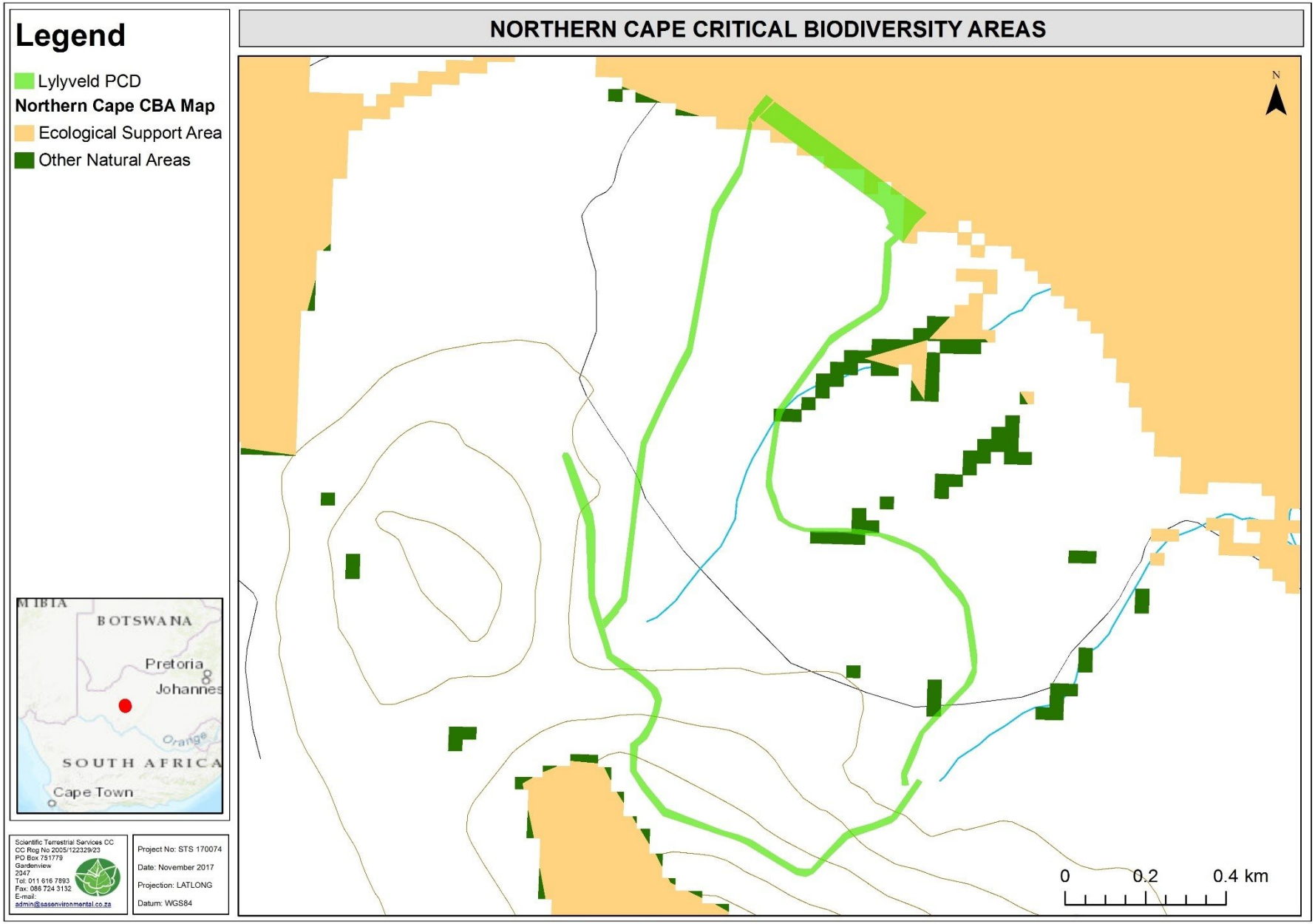


Figure 8: A portion of the Lylyveld PCD falling within an Ecological Support Area (ESA) (Northern Cape CBA Map, 2016)

4. TERRESTRIAL ECOLOGICAL ASSESSMENT RESULTS

Note: As no natural habitat remains at the Aldag Filling Station, it was not further assessed, and it is of low sensitivity.

4.1 Terrestrial Habitat Units

Following the assessment of the PCD Infrastructure Areas and the associated habitat, it has been concluded that a single habitat unit will be affected. The habitat unit is described below:

Degraded Kuruman Mountain Bushveld Habitat Unit

This habitat unit is characteristic of the Kuruman Mountain Bushveld vegetation type as described by Mucina & Rutherford (2006). The Lylyveld PCD Infrastructure Area is undulating with rocky soils throughout. The woody component of the Lylyveld PCD Infrastructure Area is dominated by species such as *Vachellia erioloba*, *Grewia flava* and *Senegalia mellifera subsp. detinens*, with the herbaceous layer dominated by species such as *Fingerhuthia africana*, *Stipagrostis amabilis* and *Eragrostis lehmanniana* amongst others. However, earthworks and edge effects associated with mining have degraded the habitat as was evident through the absence of larger woody species.

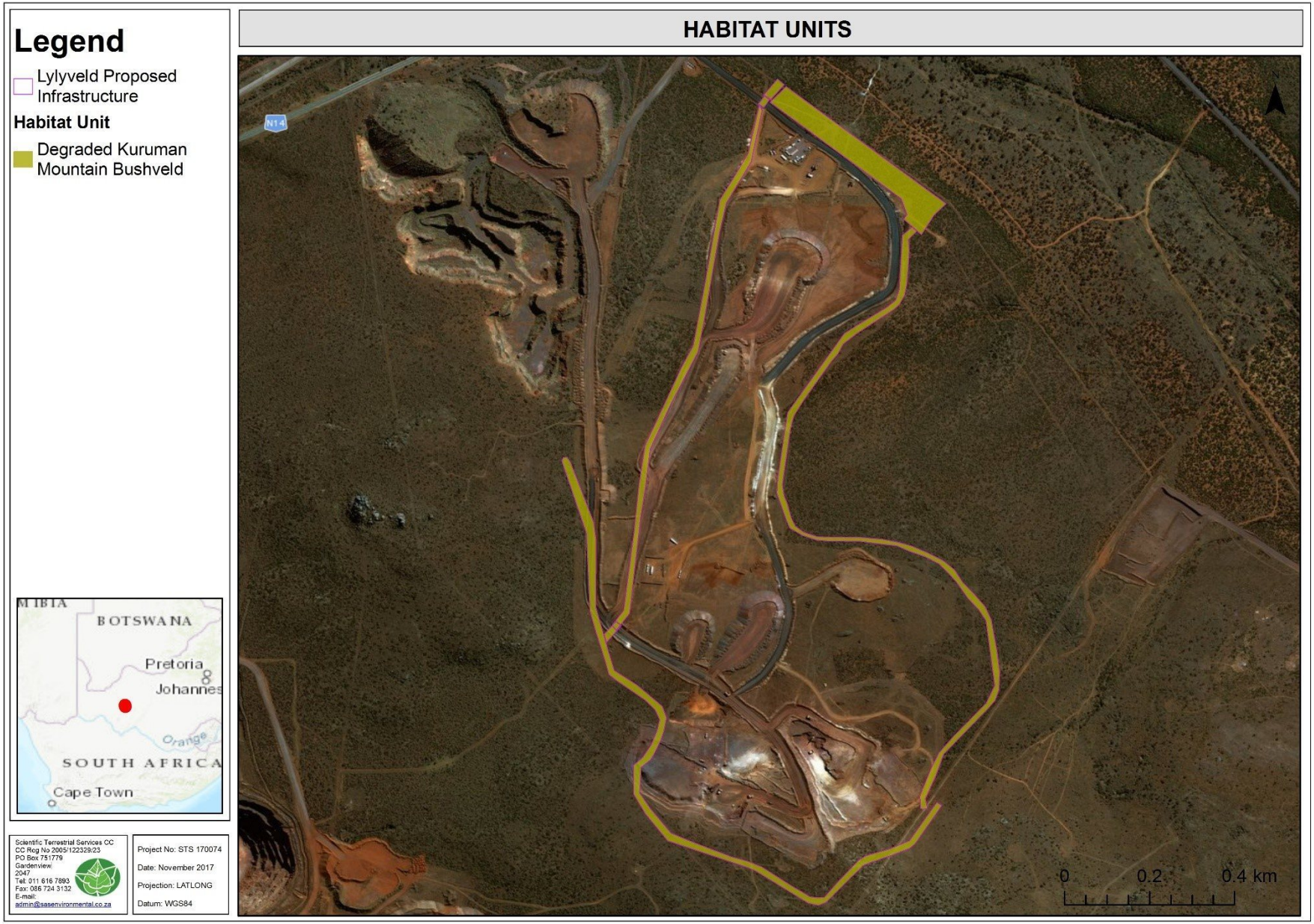
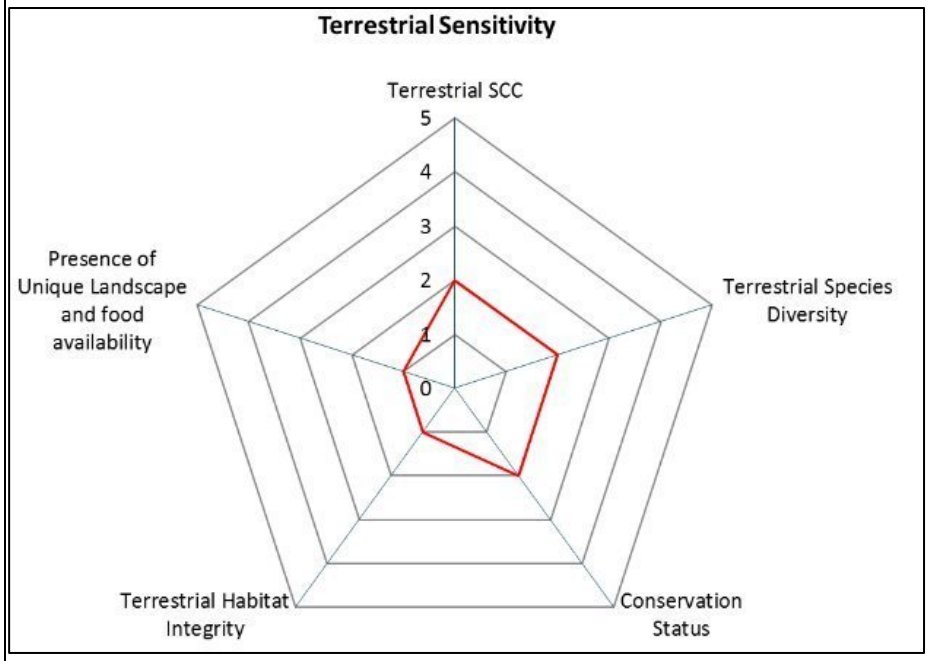


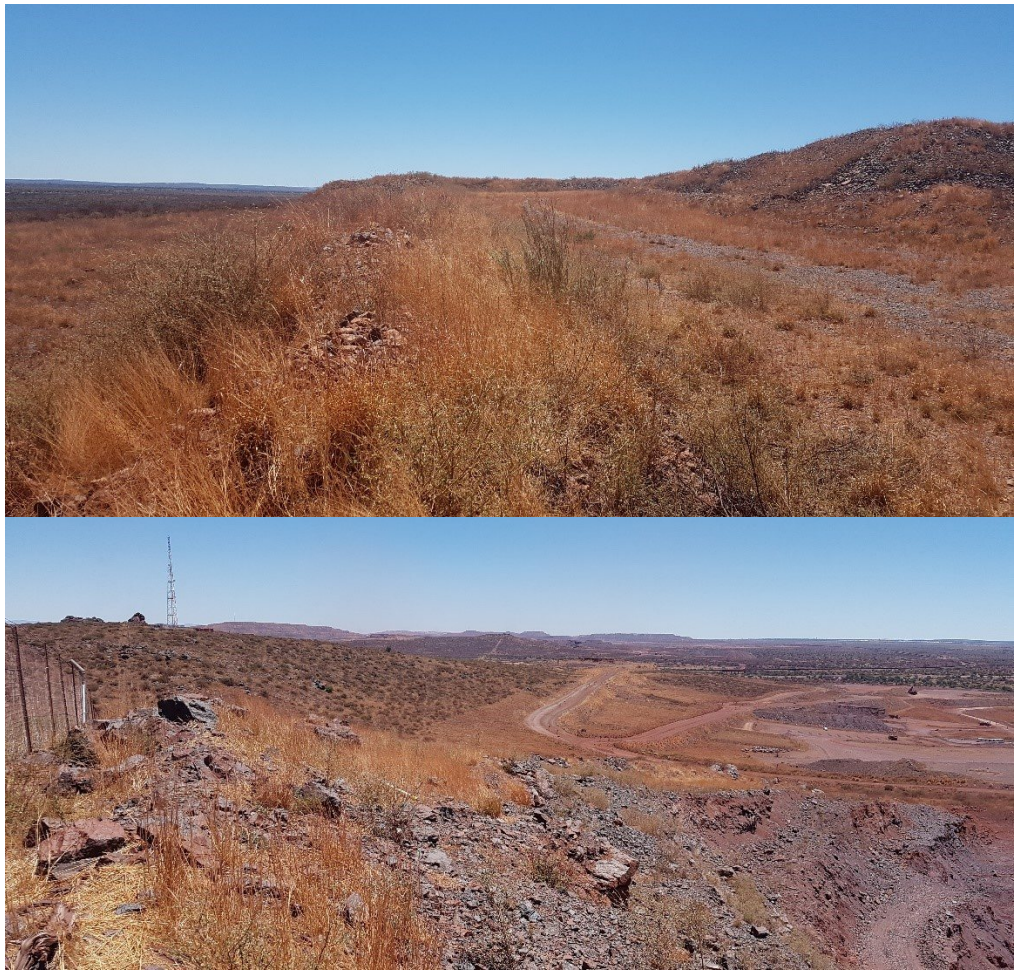
Figure 9: Habitat units encountered within the Lylyveld PCD Infrastructure Area.

Table 2: Summary of results for the Degraded Kuruman Mountain Bushveld Habitat Unit.

Degraded Kuruman Mountain Bushveld Habitat Unit	Terrestrial Sensitivity	Moderately Low
	Notes on Photograph: Typical conditions on-site. Note the absence of larger woody species, indicative of disturbance.	

Terrestrial Sensitivity Graph:





Species of Conservation Concern (SCC)	One floral SCC was observed within the Lylyveld PCD Infrastructure Area, namely *Vachellia erioloba* which is listed as protected in the National Forest Act (1998, as amended in September 2011). Where applicable the relevant permits will be required for the removal or destruction of individual trees. However, it is recommended that where possible trees be relocated to similar suitable habitat close to the Lylyveld PCD Infrastructure Area but outside of the development footprint.	**Terrestrial Habitat Integrity**: Edge effects affecting the study area from the adjacent mining activities are apparent. Habitat integrity is deemed to be moderately low and only slightly representative of the vegetation type in which the study area is situated.	**Business Case, Conclusion and Mitigation Requirements:** This habitat unit is considered to be of moderately low sensitivity and development of the PCD will not lead to a loss of sensitive habitat. However, permits for the removal/destruction of protected plants are to be obtained from the relevant authorities prior to the commencement of construction activities. It is recommended that once the layout/development plans for the proposed PCD have been finalised, that a walk down of the area is conducted, in order to ascertain the exact presence and numbers of protected plant species. Furthermore, during development activities, all mitigation measures are to be strictly enforced so as to ensure that the surrounding environment is not impacted upon through edge effects or careless veld clearing and dumping activities.
Terrestrial Species Diversity	Terrestrial species diversity of the Lylyveld PCD Infrastructure Area is considered to be moderately low. The floral diversity of the Lylyveld PCD Infrastructure Area was characteristic of Degraded Kuruman Mountain Bushveld that has been significantly disturbed. The faunal diversity was mixed, with a moderate representation of insect, avifaunal and small to medium sized mammals, notably species such as *Lepus saxatilis* (Scrub Hare); *Raphicerus campestris* (Steenbok), *Sylvicapra grimmia* (Common Duiker) and *Cynictis penicillata* (Yellow Mongoose).		
Presence of Unique Landscapes and Food Availability	This habitat type is well represented in the region and due to its degraded nature, is not considered to be unique from a habitat or food provision perspective.		
Conservation Status	The Lylyveld PCD Infrastructure Area falls within the Kuruman Mountain Bushveld vegetation type, which is listed as Least Threatened. Increased mining activities, mine expansion and improper veld management practices by farmers are having an impact on this vegetation type, and in time may result in the necessary adjusting of the current conservation status.		

4.2 Floral Species of Conservation Concern Assessment

Threatened/protected species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species. Furthermore, SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken. According to the SANBI PRECIS Red Data Lists there are no floral SCC within the QDS 2723CC and 2723AC. The NCNCA (Act 9 of 2009) and TOPS (NEMBA, 2015) floral species list were taken into consideration, as was the protected tree species listed within Section 15 (1) of the National Forest Act (1998, as amended in September 2011).

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken.

The following protected species were observed within the study are at the time of assessment:

- *Vachellia erioloba*

The Lylyveld PCD Infrastructure Area was observed to contain a small population of *Vachellia erioloba* trees, with individuals ranging from 1m to larger than 4m located in the northern section of the study area. The removal, relocation or destruction of these species will require permits as stipulated within the National Forest Act (1998, as amended in September 2011), and as such development activities cannot commence until such permits are in place. Where feasible, trees should be relocated to suitable habitat in the surrounding area. Destruction of tree species should only be entertained as a last option resort should the abovementioned alternative not be feasible.

Once the PCD footprint has been finalised, a walkdown of the site will be required in order to mark and ascertain the presence of all floral SCC occurring within the footprint site, in order to apply for the necessary permits needed.

4.3 Faunal Species of Conservation Concern Assessment

During field assessments, it is not always feasible to identify or observe all species within an area, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) matrix is used, utilising a number of factors to

determine the probability of faunal SCC occurrence within the Lylyveld PCD Infrastructure Area. Species listed in Appendix H whose known distribution ranges and habitat preferences include the Lylyveld PCD Infrastructure Area were taken into consideration.

The species listed below are considered to have an increased probability of occurring within or being affected by the Lylyveld PCD Infrastructure Area:

- *Neotis ludwigii* (Ludwig's Bustard); and
- *Ardeotis kori (*Kori Bustard)

Although neither of these avifaunal species were observed within the Lylyveld PCD Infrastructure Area, they are known to occur within the region. However, as habitat within the Lylyveld PCD Infrastructure Area has been significantly disturbed, it is unlikely that these species will actively forage, roost or breed within the area. Thus, any significant impact on faunal SCC is unlikely.

4.4 Alien and Invasive Plant Species

During the floral assessment, alien and invasive floral species were identified and are listed in the table below.

Table 3: Dominant alien vegetation species identified during the field assessment.

Trees		
Prosopis glandulosa var. torreyana	Glandular Mesquite	North America

N/L = Not Listed and not categorised
*** National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R586 of 2016**
Category 1a – Invasive species that require compulsory control.
Category 1b – Invasive species that require control by means of an invasive species management programme.
Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
Category 3 – Ornamentally used plants that may no longer be planted. Existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Only one alien invasive plant species was observed within the Lylyveld PCD Infrastructure Area at the time of assessment. However, due to the ongoing impacts and edge effects from the mining activities, there is an increased risk that further alien plant proliferation in disturbed area may occur. As such, in accordance with the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R586 of 2016, all listed alien invasive plant species need to be controlled and removed during operational and rehabilitation activities.

5. SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for floral and faunal SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 4: A summary of sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Degraded Kuruman Mountain Bushveld	Moderately Low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat unit is considered to be of moderately low sensitivity and development of the PCD will not lead to a loss of sensitive habitat. However, permits for the removal/destruction of protected plants are to be obtained from the relevant authorities prior to the commencement of construction activities. It is recommended that once the layout/development plans for the proposed PCD have been finalised, that a walk down of the area is conducted, in order to ascertain the exact presence and numbers of protected plant species. Furthermore, during development activities, all mitigation measures are to be strictly enforced so as to ensure that the surrounding environment is not impacted upon through edge effects or careless veld clearing and dumping activities.

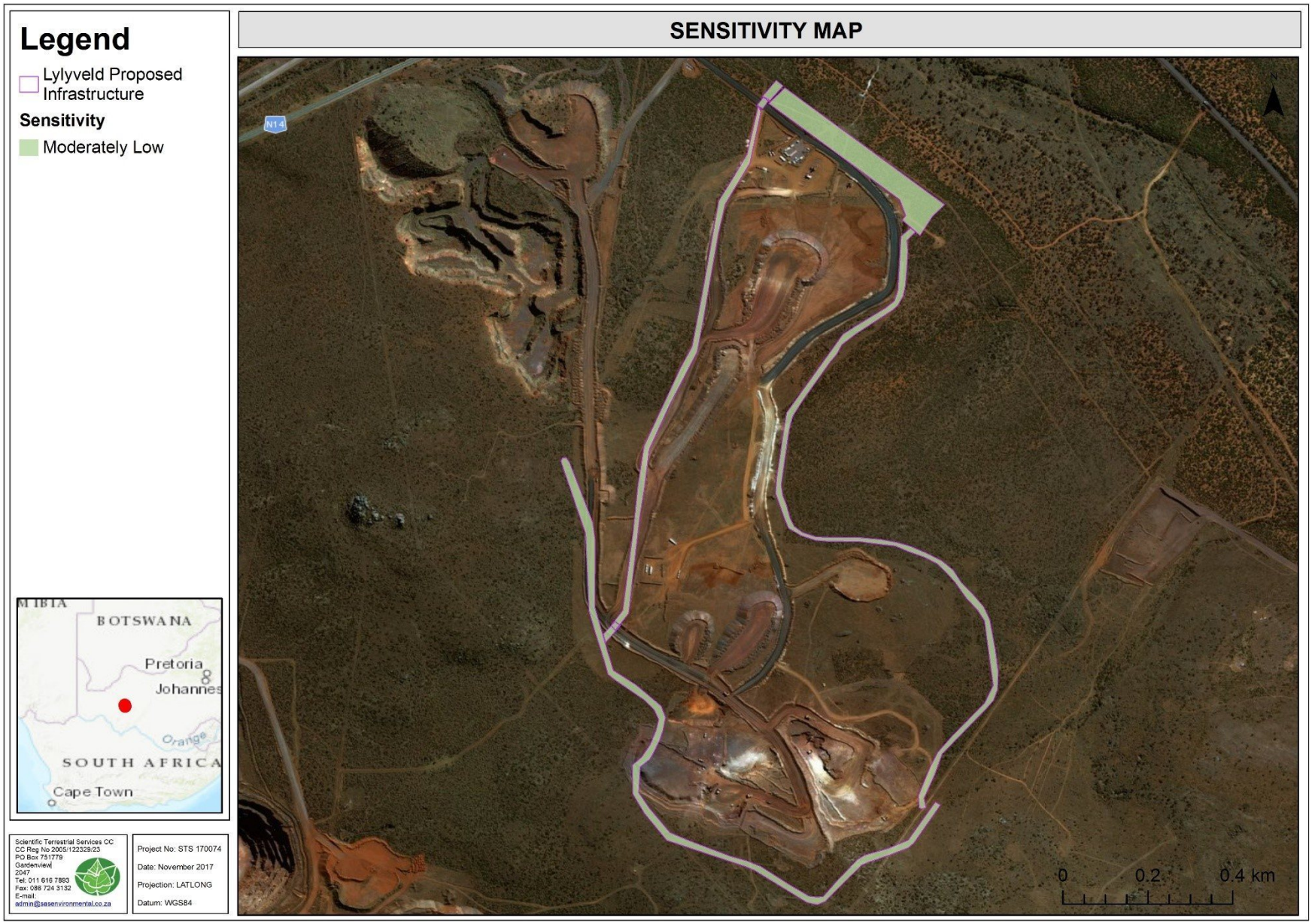


Figure 10: Sensitivity map of the Lylyveld PCD Infrastructure Area.

6. IMPACT ASSESSMENT

The tables below serve to summarise the significance of perceived impacts on the terrestrial ecology and SCC of the Lylyveld PCD Infrastructure Area, with each individual impact identified presented in Section 6.1 and 6.2 of this report. A summary of all potential pre-construction, construction and operational impacts is provided in Section 6.3.

The tables below present the impact assessment according to the method described in Appendix D. All impacts are considered without mitigation taking place as well as with mitigation fully implemented. All the required mitigatory measures needed to minimise the impact is presented in Section 6.3.

6.1 IMPACT 1: Impact on Terrestrial Habitat and SCC

Activities and aspects register

Pre-Construction/Operation	Construction/Operational	Rehabilitation
Possible insufficient planning of infrastructure placement and design leading to terrestrial and SCC habitat loss	Introduction and proliferation of alien plant species and further transformation of natural habitat	Continued proliferation of alien plant species and further transformation of natural habitat due to inadequate rehabilitation
Failure to apply for permits pertaining to the removal/destruction of protected plant species	Dumping of material outside designated areas leading to loss of terrestrial habitat	Loss of faunal and floral SCC
Failure to conduct a walkdown prior to operational phase to mark and relocate SCC where necessary	Risk of increased fire frequency, as well as uncontrolled fires due to increased human activity will impact on plant communities	Permanent loss of terrestrial habitat within the Lylyveld PCD Infrastructure Area
	Unregulated movement of mine vehicles through the Lylyveld PCD Infrastructure Area	
	Increased risk of poaching due to increased personal movement in the Lylyveld PCD Infrastructure Area	
	Permanent loss of SCC foraging and breeding habitat	

Final placement and the operation of the PCD will result in a loss of terrestrial habitat and SCC, notably *Vachellia erioloba*. However, the terrestrial habitat is not of a sensitive nature and individuals of *V. erioloba* which cannot be transplanted, can be replaced from local genetic stock. Prior to the implementation of mitigation measures, impacts are expected to be of medium-low significance during the construction and operational phases, decreasing to a low significance impact with the implementation of mitigation measures.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	4	3	3	7	10	70 (Medium-Low)
Operational phase	4	3	3	2	4	7	9	63 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	3	2	3	7	8	56 (Medium Low)
Operational phase	2	3	1	1	4	5	6	30 (Low)

6.2 Assessment Summary

The tables below serve to summarise the findings indicating the significance of the impact before mitigation takes place and the likely impact if management and mitigation takes place. In the consideration of impact mitigation, it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs. From the tables below, it is evident that prior to mitigation the impacts on terrestrial habitat and SCC are of a medium high significance. If effective mitigation takes place, all impacts may be reduced to medium low significance impacts.

Table 5: A summary of the impact significance of the construction phase.

Impact	Unmanaged	Managed
1: Impact on Terrestrial habitat and SCC	Medium-Low	Low

Table 6: A summary of the impact significance of the operational phase.

Impact	Unmanaged	Managed
1: Impact on Terrestrial habitat and SCC	Medium-Low	Low

6.3 Integrated Impact Mitigation

Mitigation Measures

- A walkdown of the PCD footprint is to be undertaken prior to the commencement of operational activities in order mark individual *Vachellia erioloba* within the PCD footprint;

- The necessary permits need to be acquired pertaining to the removal of floral SCC that are located within the study area prior to the development of the PCD, and the following should be ensured:
  - Where feasible, effective relocation of individuals to suitable similar habitat in the vicinity of the study area;
  - All rescue and relocation plans should be overseen by a suitably qualified specialist;
- It is recommended that construction activities take place in a phased manner, in a uniform direction from one side to the other of the PCD footprint so as to ensure that as far as possible faunal species can naturally disperse out of the area ahead of activities;
- The operational footprint must be kept as small as possible in order to minimise impact on the surrounding environment;
- Edge effects of operational activities need to be actively managed to minimise further impacts to the receiving environment, with specific consideration to erosion control and alien floral species management;
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed PCD;
- No uncontrolled fires whatsoever should be allowed;
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up;
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced preventing the ingress of hydrocarbons into the topsoil;
- No trapping or hunting of any faunal species is to take place;
- Alien vegetation must be removed from the study area during both the construction and operational phases, in line with the NEMBA Alien and Invasive Species Regulations (2016); and

Rehabilitation Plan:

- Disturbed and cleared areas need to be revegetated with indigenous grass species to help stabilise the soil surface
- All alien plants within the study area should be cleared, with follow up activities running concurrently for one year; and
- Soils that has been compacted must be ripped and profiled in line with the surrounding area.

Possible latent impacts:

- Loss of floral and faunal habitat;
- Permanent loss of and altered floral and faunal species diversity;
- Loss of floral and faunal SCC;
- Alien floral invasion;
- Disturbed areas are unlikely to be rehabilitated to pre-development conditions of ecological functioning and as such loss of faunal habitat and species diversity will most likely be permanent.

7. CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct an investigation into the terrestrial faunal and floral ecology as part of the Environmental impact and authorisation (EIA) process for the construction of a new Pollution Control Dam (PCD) at the Aldag Filling Station and the expansion of the existing approved PCD at the Lylyveld South Mining Areas, as part of the Sishen Mine, near Kathu, Northern Cape Province.

The objective of this study was to provide sufficient information on the terrestrial ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the relevant proponents and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement IEM and to ensure that the best long term use of the ecological resources in the study area will be made in support of the principle of sustainable development. It is recommended that, from a terrestrial ecological perspective, the proposed development be considered favorably provided that the recommended mitigation measures for the identified impacts (as outlined in Section 6.3) are adhered to.

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APPENDIX A – Legislative Requirements and Indemnity

National Environmental Management Act, 1998

- The National Environmental Management Act (NEMA; Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the EIA process depending on the nature of the activity and scale of the impact.

National Environmental Management Biodiversity Act (NEMBA, Act No. 10 of 2004)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratify international agreements relating to biodiversity which are binding to the Republic;
- To provide for cooperative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.

Furthermore, a person may not carry out a restricted activity involving either:

a) A specimen of a listed threatened or protected species;
b) Specimens of an alien species; or
c) A specimen of a listed invasive species without a permit.

Conservation of Agricultural Resources Act (CARA, Act 43 of 1983)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

The Northern Cape Nature Conservation Act (NCNCA, Act No 9 of 2009); The National Forest Act (1998, as amended in September 2011). Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and STS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.
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National Environmental Management: Waste Act, (NEMWA; Act 59 of 2008),

NEMWA which reforms the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution; provides for national norms and standards for regulating the management of waste by all spheres of government; and provides for the licensing and control of waste management activities

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The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and STS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B - Method of assessment

B1: Floral Method of assessment

Floral Species of Conservation Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

Distribution						
	Outside of known distribution range					**Inside known distribution range**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					**Habitat available**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 1 score	5	4	3	2	1	0

[Distribution + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

Vegetation Surveys

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition that was recorded during detailed floral assessments using the step point vegetation assessment methodology. Different transect lines were chosen throughout the entire study area within areas that were perceived to best represent the various plant communities. Floral species were recorded and a species list was compiled for each habitat unit. These species lists were also compared with the vegetation expected to be found within the relevant vegetation types as described in Section 4, which serves to provide an accurate indication of the ecological integrity and conservation value of each habitat unit (Evans & Love, 1957; Owensby, 1973).

B2: Faunal Method of Assessment

It is important to note that due to the nature and habits of fauna, varied stages of life cycles, seasonal and temporal fluctuations along with other external factors, it is unlikely that all faunal species will have been recorded during the site assessment. The presence of human habitation nearby the study area and the associated anthropogenic activities may have an impact on faunal behaviour and in turn the rate of observations. In order to increase overall observation time within the study area, as well as increasing the likelihood of observing shy and hesitant species, camera traps were strategically placed within the study area. Sherman traps were also used to increase the likelihood of capturing and observing small mammal species, notably small nocturnal mammals.

Mammals

Small mammals are unlikely to be directly observed in the field because of their nocturnal/crepuscular and cryptic nature. A simple and effective solution to this problem is to use Sherman traps. A Sherman trap is a small aluminium box with a spring-loaded door. Once the animal is inside the trap, it steps on a small plate that causes the door to snap shut, thereby capturing the individual. In the event of capturing a small mammal during the night, the animal would be photographed and then set free unharmed early the following morning. Traps were baited with a universal mixture of oats, peanut butter, and fish paste.

Medium to large mammal species were recorded during the field assessment with the use of visual identification, spoor, call and dung. Specific attention was paid to mammal SCC as listed by the IUCN, 2015.

Avifauna

The Southern African Bird Atlas Project 2 database (http://sabap2.adu.org.za/) was compared with the recent field survey of avifaunal species identified on the study area. Field surveys were undertaken utilising a pair of Bushnell 10x50 binoculars and bird call identification techniques were utilised during the assessment in order to accurately identify avifaunal species. Specific attention was given to avifaunal SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Reptiles

Reptiles were identified during the field survey. Suitable applicable habitat areas (rocky outcrops and fallen dead trees) were inspected and all reptiles encountered were identified. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur on the study area. Specific attention was given to reptile SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Amphibians

Identifying amphibian species is done by the use of direct visual identification along with call identification technique. Amphibian species flourish in and around wetland, riparian and moist grassland areas. It is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which amphibian species are likely to occur within the study area as well as the surrounding area. Specific attention was given to amphibian SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Invertebrates

Whilst conducting transects through the study area, all insect species visually observed were identified, and where possible photographs taken. Furthermore, at suitable and open sites within the study area

sweep netting was conducted, and all the insects captured identified. Due to the terrain, and shallow/ rocky soil structure pitfall traps were not utilised during the site assessment.
It must be noted however that due to the cryptic nature and habits of insects, varied stages of life cycles and seasonal and temporal fluctuations within the environment, it is unlikely that all insect species will have been recorded during the site assessment period. Nevertheless, the data gathered during the assessment along with the habitat analysis provided an accurate indication of which species are likely to occur in the study area at the time of survey. Specific attention was given to insect SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Arachnids

Suitable applicable habitat areas (rocky outcrops, sandy areas and fallen dead trees) where spiders and scorpions are likely to reside were searched. Rocks were overturned and inspected for signs of these species. Specific attention was paid to searching for Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as potential SCC scorpions within the study area.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC was determined using the following four parameters:

- Species distribution;
- Habitat availability;
- Food availability; and
- Habitat disturbance.

The accuracy of the calculation is based on the available knowledge about the species in question. Therefore, it is important that the literature available is also considered during the calculation.
Each factor contributes an equal value to the calculation.

Scoring Guideline				
Habitat availability				
No Habitat	**Very low**	**Low**	**Moderate**	**High**
1	2	3	4	5
Food availability				
No food available	**Very low**	**Low**	**Moderate**	**High**
1	2	3	4	5
Habitat disturbance				
Very High	**High**	**Moderate**	**Low**	**Very Low**
1	2	3	4	5
Distribution/Range				
Not Recorded		**Historically Recorded**		**Recently Recorded**
1		3		5

[Habitat availability + Food availability + Habitat disturbance + Distribution/Range] / 20 x 100 = POC%

B3: Habitat Sensitivity

The habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral and faunal communities and provide an indication of the overall terrestrial ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Terrestrial SCC:** The confirmed presence or potential for floral and/or faunal SCC or any other significant species, such as endemics, to occur within the habitat unit;

- **Unique Landscapes and Food Availability:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region, as well as the availability of food within the habitat unit for faunal species;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Terrestrial Diversity:** The recorded floral and faunal diversity compared to a suitable reference condition such as surrounding natural areas or available floral and faunal databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the terrestrial habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of terrestrial ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table B1: Terrestrial habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX C- Impact Assessment Methodology

Ecological Impact Assessment Method

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[1]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table C2. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[2].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

[1] The definition has been aligned with that used in the ISO 14001 Standard.

[2] Some risks/impacts that have low significance will however still require mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table C1: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Study areas affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Study areas affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Study areas affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Study areas affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Study areas affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table C2: Significance Rating Matrix.

	CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table C3: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately	Maintain current management
High	101-125	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly	Maintain current management
Medium-high	76-100	Consider the viability of proposed projects Improve current management of existing projects	Maintain current management
Medium-low	51-75	Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Low	26-50	Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Very low	1-25	Maintain current management and/or proposed project criteria and strive for continuous improvement	Maintain current management and/or proposed project criteria and strive for continuous improvement

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

According to the DEA *et al.,* (2013) "Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands".

According to the DEA *et al.,* (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.
-

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act), and is fundamental to the notion of sustainable development. In addition, International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DEA *et al.,* 2013).

The primary environmental objective of the Mineral and Petroleum Resources Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".

Pressures on biodiversity are numerous and increasing. According to the DEA *et al.,* (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[3]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DEA *et al.,* 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;

[3] Limpopo Province Environment Outlook. A Report on the State of the Environment, 2002. Chapter 4.

- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.
'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.
The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et al.,* 2013):

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the study area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable

which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[4]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed development.

- Mitigation and performance improvement measures and actions that address the risks and impacts[5] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[4] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

[5] Mitigation measures should address both positive and negative impacts

APPENDIX D – Northern Cape Provincial Spatial Development Framework (NPSDF, 2012)

The study area falls within the Griqualand West Centre of Endemism (GWC). According to van Wyk and Smith (2001), the GWC coincides with the surface outcrops of the Ghaap Group (previously Griqualand West Sequence) and Olifantshoek Supergroup (previously Sequence). However, in floristic terms the outer boundaries of the centre are rather diffuse, as several of the GWC floristic elements spill over onto related substrates, especially alkaline substrates rich in calcium.

The Kalahari Mountain Bushveld covers the mountainous western parts of the GWC, and, both endemic to the centre, covers the eastern plateau area. *Tarchonanthus camphorates* is a particularly common woody species in these two bushveld types. Typical mountain species include *Searsia tridactyla* (formally known as *Rhus tridactyla*), *Croton gratissimus* and *Buddleja saligna*. Pockets of Karoo-type vegetation increase towards the south and west, especially in heavily overgrazed areas.

The vegetation of the GWC is still intact, although extremely poorly conserved. Apparently, the Kalahari Plateau Bushveld is the only Savanna Biome vegetation type, which is not represented in any sizable nature reserve. Bush encroachment by e.g. the indigenous *Senegalia mellifera* (formally known as *Acacia mellifera*), which is due to inappropriate veld management practices (mainly overgrazing by domestic livestock), is a major problem in many parts of the region.

APPENDIX E- Species List

Table E1: Dominant floral species encountered in the three route alternatives. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016.

Grass species	Forb species	Tree/Shrub Species
Stipagrostis amabilis	*Ammocharis coranica*	*Vacehllia hebeclada*
Stipagrostis uniplumis	*Aptosimum elongatum*	*Lycium hirsutum*
Eragrostis pallens	*Chrycosoma ciliata*	*Asparagus laricinus*
Eragrostis trichophora	*Dimorphotheca sp.*	*Grewia flava*
Melenis repens	*Felicia muricata*	*Senegalia mellifera subsp. detinens*
Anthephora pubescens	*Gnidia polycephala*	***Vachellia erioloba***
Pogonarthria squarrosa	*Helichrysum cerastioides*	*Ziziphus micronata*
Cynodon dactylon	*Melolobium candicans*	**Prosopis glandulosa var. torreyana**
Aristida meridionalis	*Nolletia arenosa*	
Cenchrus ciliaris	*Pentzia globosa*	
Aristida congesta	*Pollicha campestris*	
Enneapogon cenchroides	*Pteronia glauca*	
Eragrostis lehmanniana	*Senna italica* subsp. *arachoides*	
Hyparrhenia hirta	*Tribulus zeyheri*	
Brachiaria nigropedata	*Lophiocarpus polystachyus*	
Centropedia glauca	*Elephantorrhiza elephantina*	
Schmidtia pappophoroides		

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Mammal species observed

Scientific name	Common Name	IUCN Red List Status
Sylvicapra grimmia	Common Duiker	LC
Galerella sanguinea	Slender Mongoose	LC
Hystrix africaeaustralis	African Porcupine	LC
Lepus saxatilis	Scrub Hare	LC
Galerella sanguinea	Slender Mongoose	LC
Cryptomys hottentotus	Common Mole-rat	LC
Tragelaphus strepsiceros	Kudu	LC
Raphicerus campestris	Steenbok	LC

LC = Least Concern, NT = Near Threatened

Avifaunal species observed

Streptopelia capicola	Cape turtle-dove	LC
Pycnonotus nigricans	Red-eyed Bulbul	LC
Serinus flaviventris	Yellow Canary	LC
Passer melanurus	Cape Sparrow	LC
Streptopelia capicola	Cape Turtle-Dove	LC
Sporopipes squamifrons	Scaly-feathered Finch	LC
Spreo bicolor	Pied Starling	LC
Saxicola torquata	African Stonechat	LC
Anthus cinnamomeus	African Pipit	LC
Cisticola fulvicapillus	Neddicky	LC
Elanus caeruleus	Black-shouldered Kite	LC
Tockus nasutus	African Grey Hornbill	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Hirundo fuligula	Rock Martin	LC
Parus cinerascens	Ashy Tit	LC
Batis pririt	Pririt Batis	LC
Sigelus silens	Fiscal Flycatcher	LC
Emberiza flaviventris	Golden-breasted Bunting	LC
Parisoma subcaeruleum	Chestnut-vented Titbabbler	LC

LC = Least concerned. NT = Near Threatened, NYBA = Not yet been assessed by the IUCN.

Insect species observed

Scientific Name	Common Name	IUCN 2015 Status
Junonia hierta	Yellow Pansy	LC
Calidea dregii	Rainbow Shield Bug	NYBA
Catopsilia florella	African Migrant	NYBA
Belenois aurota	Brown-veined White	NYBA
Junonia orithya	Eyed Pansy	NYBA
Danaus chrysippus	African Monarch	NYBA
Colotis euippe	Smokey Orange Tip	NYBA
Eurema brigitta	Broad-bordered Grass Yellow	NYBA
Spalia sp	Sandman	NYBA
Loxostege frustalis	Karoo Moth	NYBA
Conistica saucia	Rock Grasshopper	NYBA
Sphingonotus scabriculus	Blue-wing	NYBA
Acanthacris ruficornis	Garden Locust	NYBA
Gastrimargus sp.	N/A	NYBA
Rhachitopis sp	N/A	NYBA
Systophlochius palochius	Orange wing	NYBA
Anterhynchium fallax	N/A	NYBA
Camponotus fulvopilosus	Bal-byter	NYBA
Crematogaster peringueyi	Cocktail Ant	NYBA
Pantala flavescens	Wandering Glider	LC
Mylabris oculata	CMR Bean Beetle	NYBA

NYBA = Not Yet Been Assessed, LC = Least Concern

APPENDIX F – Floral SCC

Table F1: TOPS plant list for the floral species expected to occur within the Northern Cape.

Family	Scientific Name	Habitat	Growth Form	Threat Status
Aizoaceae	*Cheiridopsis peculiaris*	Gravels and shale derived from metamorphic rocks of the Namaqualand Complex	Succulent	CR
Aizoaceae	*Conophytum herreanthus subsp. Herreanthus*	Quartz patches	Succulent	CR
Asphodelaceae	*Aloidendron pillansii*	Succulent Karoo shrubland on dry, rocky dolomite and gneiss hillsides.	Succulent, Tree	EN
Amaryllidaceae	*Haemanthus granitcus*	Namaqualand Klipkoppe Shrubland or Namaqualand Granite Renosterveld.	Geophyte	EN
Aizoaceae	*Lithops dorotheae*	Fine-grained, sheared, feldspathic quartzite	Succulent	EN
Asphodelaceae	*Aloidendron dichotomum*	On north-facing rocky slopes (particularly dolomite) in the south of its range. Any slopes and sandy flats in the central and northern parts of range.	Succulent, Tree	VU
Amaryllidaceae	*Brunsvigia herrei*	Succulent Karoo Shrubland, granitic soils on flats and sometimes in deposits of fairly large stones.	Geophyte	VU
Aizoaceae	*Conophytum bachelorum*	Rocky outcrops	Succulent	VU
Aizoaceae	*Conophytum ratum*	Spongy quartz soil.	Succulent	VU
Amaryllidaceae	*Gethyllis grandiflora*	Sandy and or stony soils in arid karroid shrubland.	Geophyte	VU
Amaryllidaceae	*Gethyllis namaquensis*	Coastal dunes and gravelly mountain slopes in succulent karoo shrubland.	Geophyte	VU
Amaryllidaceae	*Brunsvigia josephinae*	Heavy clay soils.	Geophyte	VU
Asphodelaceae	*Aloe krapohliana*	Occurs in the extremely arid northern regions of the Succulent Karoo, on clay, stony (mostly quarzitic) and sandy soils on flats and slopes.	Herb, Succulent	P
Amaryllidaceae	*Cyrtanthus herrei*	Deeply shaded rock ledges on south-facing rocky slopes.	Bulb	P
Aizoaceae	*Sceletium tortuosum*	Quartz patches and is usually found growing under shrubs in partial shade.	Succulent	P
Pedaliaceae	*Harpagophytum procumbens*	Well drained sandy habitats in open savanna and woodlands.	Herb	P

CR= Critically Endangered, EN= Endangered, VU= Vulnerable, P= Protected

APPENDIX G – Faunal SCC

Table G1: TOPS list of faunal species expected to occur within the Northern Cape.

Scientific Name	Common Name	Threat Status
Chrysoritis thysbe schloszae	Schlosz's Opal Butterfly	CR
Trimenia malagrida	Scarce Mountain Copper Butterfly	CR
Trimenia wallengrenii	Wallengren's Silver-spotted Copper Butterfly	CR
Bitis schneideri	Namaqua Dwarf Adder	P
Bitis xeropaga	Desert Mountain Adder	P
Bitis caudalis	Horned Adder	P
Lamprophis fiski	Fisk's House Snake	P
Neophron percnopterus	Egyptian Vulture	CR
Neotis ludwigii	Ludwig's Bustard	EN
Ardeotis kori	Kori Bustard	P
Bunolagus monticularis	Riverine Rabbit	CR
Pelea capreolus	Grey Rhebok	P

CR= Critically Endangered, EN=Endangered, P=Protected

South African Bird Atlas Project 2 list for quadrant 2722BD

Avifaunal Species for the pentads 2740_2300, 2745_2300, and 2750_2300 within the QD2723AC and 2723CC

http://sabap2.adu.org.za/pentad_info.php?pentad=_2740_2300#menu_top
http://sabap2.adu.org.za/pentad_info.php?pentad=_2745_2300#menu_top
http://sabap2.adu.org.za/pentad_info.php?pentad=_2750_2300#menu_top

APPENDIX H – Declaration and Specialists CV's

Declaration

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Emile van der Westhuizen, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

Signature of the Specialist

SCIENTIFIC TERRESTRIAL SERVICES (STS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF EMILE BASSON VAN DER WESTHUIZEN

PERSONAL DETAILS

Position in Company	Ecologist, Botanist
Date of Birth	30 May 1984
Nationality	South African
Languages	English, Afrikaans
Joined STS	2008

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Council for Natural Scientific Professions (SACNASP) (Reg. Number 100008/15).

EDUCATION

Qualifications

BSc (Hons) Plant Science (University of Pretoria)	2012
B.Sc. Botany and Environmental Management (University of South Africa)	2010

Short Courses

Grass Identification – Africa Land Use Training	2009
Wild Flower Identification – Africa Land Use Training	2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State, Eastern Cape.
Mozambique (Tete, Sofala and Manica Provinces)
Democratic Republic of the Congo (Katanga and Kivu Provinces)
Ghana (Western and Greater Accra Provinces)
Sierra Leone
Angola
Cabinda

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment for the proposed Modikwa Platinum Mine South 2 Shaft Project, Burgersfort, Limpopo Province.
- Floral assessment for the proposed New Clydesdale Colliery Stoping Project, Vandyksdrift, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Harriet's Wish PGM Project, Limpopo Province.
- Floral assessment as part of the environmental authorisation process for the proposed Shanduka Coal Argent Colliery in the vicinity of Argent, Mpumalanga.
- Floral assessment for the Auroch Resources Manica Gold Mining Project, Manica, Mozambique.
- Floral assessment for the Namoya Gold Mine project in Namoya, Democratic Republic of Congo.
- High level floral risk assessment and alternatives analysis for the proposed new Tete Airport, Tete, Mozambique.
- Floral assessment for the proposed Richardsbay Harbour Compactor Slab development, Richardsbay, Kwa-Zulu-Natal Province.
- Site walkdown and floral ecological input prior to the construction of the proposed 180km Mfolozi-Mbewu powerline, Richardsbay, Kwa-Zulu-Natal Province.
- Floral assessment as part of the EIA process for the proposed Peerboom Colliery, Lephalale, Limpopo Province.

- Floral assessment as part of the EIA process for the proposed Overvaal Underground Coal Mine Project, Ermelo, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed King's City Takoradi 3000 hectare development, Takoradi, Ghana
- Floral assessment as part of the EIA process for the proposed Aquarius Platinum Fairway Platinum Mine, Steelpoort, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Geniland Lubumbashi City 4000 hectare development, Likasi, Katanga Province, Democratic Republic of Congo.
- Floral, faunal, aquatic and wetland assessment as part of the EIA process for the proposed Appollonia City Accra 3000 hectare development, Accra, Ghana.
- Floral assessment as part of the EIA process for the proposed Leeuw Colliery, Utrecht, Kwa-Zulu Natal Province.
- Floral assessment as part of the EIA process for the proposed Lubembe Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Kinsenda Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Lonshi Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Jozini Shopping Mall, Jozini, Kwa-Zulu Natal Province.
- Floral assessment as part of the Biodiversity Action Plan for the Assmang Chrome Dwarsrivier Mine, Steelpoort, Mpumalanga Province.