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**BIODIVERSITY ASSESSMENT AS PART OF THE
ENVIRONMENTAL IMPACT ASSESSMENT AND
AUTHORISATION PROCESS FOR THE PROPOSED
EXPANSION ACTIVITIES AT THE MAMATWAN MINE, NEAR
HOTAZEL, NORTHERN CAPE PROVINCE**

Prepared for

SLR Consulting (South Africa) (Pty) Ltd

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Part B: Floral Assessment

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DOCUMENT GUIDE

The following table indicates the requirements for Specialist Studies as per Appendix 6 of Government Notice 326 as published in Government Notice 40772 of 2017, amendments to the Environmental Impact Assessment (EIA) Regulations, 2014 as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Part A: Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Part A: Appendix E
b)	A declaration that the specialist is independent	Part A: Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Part A: Section 1.2 Part B: Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Part A: Section 2.1 and 3.1 Part B: Section 2
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Part B: Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Part A: Section 1.2 and 2 Part B: Section 1.2
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Part B: Appendix A
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Part B: Section 4
g)	An identification of any areas to be avoided, including buffers	Part B: Section 4
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Part B: Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Part A: Section 1.3 Part B: Section 1.2
j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Part B: Section 3 and 5
k)	Any mitigation measures for inclusion in the EMPr	Part B: Section 5
l)	Any conditions for inclusion in the environmental authorisation	Part B: Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Part B: Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Part B: Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Part B: Section 5
(ii)	If the opinion is that the proposed activity, activities 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	Part B: Section 5
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A



TABLE OF CONTENTS

DOCUMENT GUIDE	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	iv
LIST OF TABLES	iv
LIST OF ACRONYMS	i
GLOSSARY OF TERMS	ii
1 INTRODUCTION	1
1.1 Background.....	1
1.2 Scope of Work	1
1.3 Assumptions and Limitations	2
2 ASSESSMENT APPROACH	3
2.1 Sensitivity Mapping	3
3 RESULTS OF THE FLORAL ASSESSMENT	4
3.1 Previous Floral Assessments (NSS, 2018).....	4
3.2 Field Assessment Results (2019).....	6
3.3 Kathu Bushveld.....	9
3.4 Degraded Bushveld	11
3.5 Floral Species of Conservation Concern Assessment.....	13
3.6 Medicinal Plant Species.....	16
3.7 Alien and Invasive Plant (AIP) Species	16
4 SENSITIVITY MAPPING	18
5 IMPACT ASSESSMENT	21
5.1 Activities and Aspect Register.....	21
5.3 Floral Impact Assessment Results	24
5.4 Impact Discussion.....	26
5.4.1 Impact on Floral Habitat and Diversity.....	26
5.4.2 Impacts on Floral SCC.....	27
5.4.3 Probable Latent Impacts	28
5.4.4 Cumulative Impacts	28
5.5 Integrated Impact Mitigation	28
5.6 Floral Monitoring	32
6 CONCLUSION.....	33
7 REFERENCES	35
APPENDIX A: Floral Method of Assessment.....	36
APPENDIX B: Floral SCC.....	38
APPENDIX C: Floral Species List.....	40



LIST OF FIGURES

Figure 1:	Vegetation units identified by NSS (2018) within the Mamatwan Mine.	5
Figure 2:	Conceptual illustration of the habitat units associated with the proposed expansion activities.	8
Figure 3:	Protected species encountered within the study: <i>Vachellia haematoxylon</i> (Top left); <i>Vachellia erioloba</i> (Top Right), <i>Harpagophytum procumbens</i> (Middle Left), <i>Tridentea</i> sp. (Middle Right), and <i>Boophone disticha</i> (Bottom).	15
Figure 4:	Sensitivity map for the study area.	20

LIST OF TABLES

Table 1:	Habitat units identified within the study area, and the extent of each habitat unit.	6
Table 2:	SCC/ Protected species observed within the study area at the time of assessment or within increased likelihood to utilise the study area	13
Table 3:	Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009). Alien species are indicated with an asterisk (*).	16
Table 4:	Dominant alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.	17
Table 5:	A summary of the sensitivity of each habitat unit and implications for development.	19
Table 6:	Activities and aspects likely to impact on the floral resources of the study area. Blocks with a more red colour were regarded as having a higher impact significance and were rated higher in the impact assessment.	22
Table 7:	Impact on the floral habitat, diversity and SCC arising from the proposed development activities.	24
Table 8:	A summary of the mitigatory requirements for floral resources.	28



LIST OF ACRONYMS

CBA	Critical Biodiversity Area
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EN	Endangered
ESA	Ecological Support Area
GIS	Geographic Information System
GPS	Global Positioning System
IUCN	International Union for the Conservation of Nature
MPRDA	Mineral and Petroleum Resource Development Act
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
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 Listed
SABAP 2	Southern African Bird Atlas 2
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services CC
TOPS	Threatened or Protected Species
TSP	Threatened Species Programme
VU	Vulnerable



GLOSSARY OF TERMS

Alien and Invasive species	A species that is not an indigenous species; or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
CBA (Critical Biodiversity Area)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
ESA (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Indigenous vegetation (as per the definition in (NEMA))	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Least Threatened	Least threatened ecosystems are still largely intact.
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 threatened species as well as protected species of relevance to the project.



1 INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a Biodiversity Assessment as part of the environmental impact assessment and authorisation process for the proposed Mamatwan Mine Project, near Hotazel, Northern Cape Province. The Mamatwan Mine (MMT) is located within the John Taolo Gaetsewe District Municipality and the Joe Morolong Local Municipality.

The MMT is situated approximately 17 km south of the town of Hotazel, 32.6 km north of the town of Kathu and 43 km west of the town of Kuruman. The R380 runs directly adjacent to the MMT in a north-south direction from Hotazel to Kathu, the M31 roadway is located approximately 14 km east of MMT and the N14 highway is located approximately 24 km southeast. The location and extent is indicated in Figures 1 & 2 of Part A.

The proposed MMT expansion activities include the following, and will henceforth collectively be referred to as the “study area”:

- Development of a top-cut stockpile; and crushing and screening plant;
- Construction and operation of a railway loop and associated infrastructure; and
- Installation of a pipeline: Three alternatives are proposed, with alternative 1 considered as the preferred alternative by the proponent.

For a detailed Project description of all expansion activities, please refer to Part A.

The purpose of this report is to define the floral ecology of the study area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas, and to describe the Present Ecological State (PES) of the study area.

1.2 Scope of Work

Specific outcomes in terms of the report are as follows:

- To provide inventories of floral species as encountered within the study area;
- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including the potential for such species to occur within the study area;



- To provide detailed information to guide the activities associated with the proposed development activities within the study area; and
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The floral assessment is confined to the study area and does not include the neighbouring and adjacent properties or the entire MMT;
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. The most limiting condition was the extreme drought still experienced at the time of the assessment, with the majority of forbs reduced to underground plant parts or died back to unidentifiable parts. On-site data were augmented with historic studies undertaken for the Mamtwan Mine (NSS, 2018). On this basis, the floral ecology associated with the study area is considered to be adequately assessed and considered, and the information provided is sufficient to allow for informed decision making and to facilitate integrated environmental management;
- Sampling by its nature means that not all individuals are assessed and identified. Some species and taxa within the study area may, therefore, have been missed during the assessment;
- A field assessment was undertaken from the 5th to the 7th of November 2019 (spring season), to determine the floral ecological status of the study area, and to “ground-truth” the results of the desktop assessment (presented in Part A). A more accurate assessment would require that assessments take place in all seasons of the year, especially within the flowering season of most floral species. On-site data was significantly augmented with all available desktop data and previous studies undertaken for the Mamtwan Mine (NSS, 2018), and together with project experience in the area, the findings of this assessment are considered to be an accurate reflection of the ecological characteristics of the study area.
- Herbaceous floral SCC during the site assessment were reduced to underground parts, with a few remnant leaves/ seeds identified. The abundance of herbaceous SCC is therefore anticipated to be higher than what was observed during the field assessment. It is recommended that a summer walkdown (January to February) be undertaken and all herbaceous SCC marked, in order to accurately determine the



number of individuals that need to be rescued and relocated during the proposed mining development, as part of the requirements for the permit application.

2 ASSESSMENT APPROACH

The field assessment was undertaken from the 5th to the 7th of November 2019 (spring season), to determine the floral ecological status of the study area. To accurately determine the ecological state of the study area and to capture comprehensive data with respect to floral ecology, the following methodology was followed:

- Maps and digital satellite imagery were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of these analyses were used to guide the fieldwork component;
- All relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (<http://bgis.sanbi.org>), including the Northern Cape Critical Biodiversity Areas (2016) was consulted to gain background information on the physical habitat and potential floral diversity associated with the study area; and
- For the field assessments, a reconnaissance 'walkabout' was undertaken to determine the general habitat types found throughout the study area - with special emphasis being placed on areas that may potentially support floral SCC. The field assessments took place on foot in order to identify the occurrence of the dominant plant species and habitat diversities. A detailed explanation of the method of assessment is provided in **Appendix A** of this report; and
- For the methodologies relating to the impact assessment and development of the mitigation measure, please refer to **Appendix C of Part A** of the report.

2.1 Sensitivity Mapping

All the ecological features of the study area were considered, and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto satellite imagery and/or topographic maps. The sensitivity map should guide the final design and layout of the proposed expansion activities.



3 RESULTS OF THE FLORAL ASSESSMENT

3.1 Previous Floral Assessments (NSS, 2018)

A baseline biodiversity assessment for MMT has been undertaken during 2013 by Natural Scientific Services CC (NSS). This assessment was updated in July 2018 (NSS, 2018). During the 2018 assessment all natural vegetation was classified as *Acacia* Thornveld (include both *Acacia* Thornveld and Degraded *Acacia* Thornveld), with all mining and infrastructure areas as well as disturbed patched classified as Transformed habitat. The habitat units were divided into the following vegetation units (NSS, 2018) (Figure 1 below):

- *Acacia* Thornveld:
 - *Acacia haematoxylon*¹ – *Grewia flava* Thornveld;
 - *Acacia mellifera*² - *Acacia haematoxylon* – *Grewia flava* Thornveld; and
 - *Acacia mellifera* – *Stipagrostis* Open Thornveld;
- Degraded *Acacia* Thornveld:
 - Dense *Acacia mellifera* Thornveld;
 - *Acacia mellifera* Bushclumps; and
 - *Acacia* dominated vegetation in recovery;
- Transformed Habitat:
 - Disturbed Patched; and
 - Mining and Infrastructure.

¹ Now referred to as *Vachellia haematoxylon*

² Now referred to as *Senegalia mellifera*



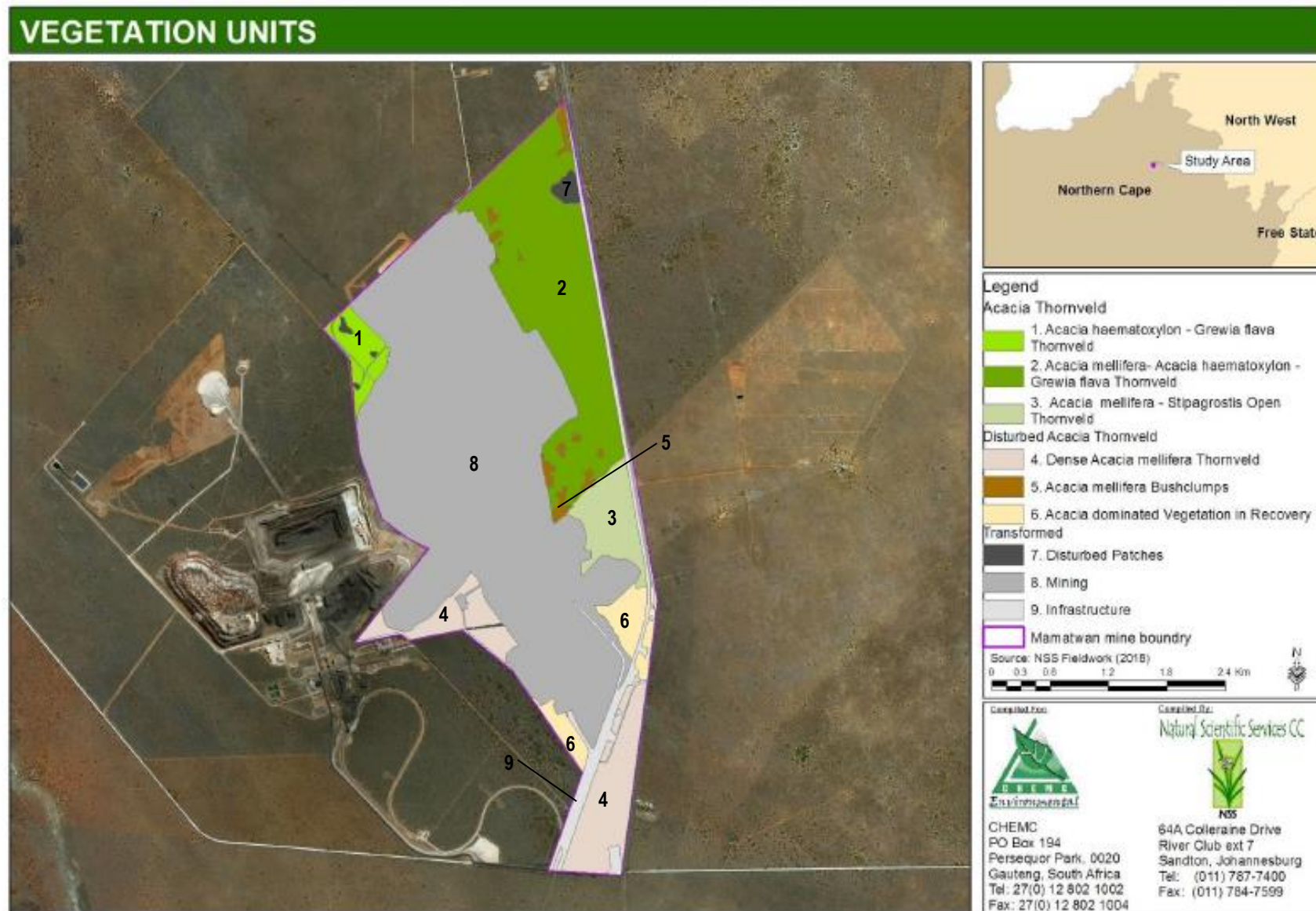


Figure 1: Vegetation units identified by NSS (2018) within the Mamatwan Mine.



3.2 Field Assessment Results (2019)

The November 2019 assessment distinguishes between three broad habitat units namely the Kathu Bushveld (previous *Acacia* Thornveld), Degraded Bushveld (previous Degraded *Acacia* Thornveld) and Transformed Habitat. The table below indicate the habitat units identified during the field assessment, together with the extent of each habitat unit.

Table 1: Habitat units identified within the study area, and the extent of each habitat unit.

Habitat Unit	Area (ha)	% of Total Area
Kathu Bushveld	257.8	75%
Degraded Bushveld	53.87	16%
Transformed Habitat	31.25	9%

Kathu Bushveld

The Kathu Bushveld Habitat unit include those areas previously defined by NSS (2018) as *Acacia* Thornveld; and includes the vegetation communities *Acacia mellifera* - *Acacia haematoxylon* – *Grewia flava* Thornveld and *Acacia mellifera* – *Stipagrostis* Open Thornveld.

During the field assessment two vegetation communities in line with the NSS (2018) assessment could be distinguished namely:

- *Senegalia (Acacia) mellifera* - *Vachellia (Acacia) haematoxylon* – *Grewia flava* Kathu Bushveld - largely associated with the top-cut stockpile, crushing and screening plant, and all of the proposed pipeline alternatives; and
- *Senegalia (Acacia) mellifera* – *Stipagrostis* Open Kathu Bushveld - largely associated with the eastern portion of the railway loop.

Although individual species abundance differed for these vegetation communities, the species composition was similar, and both vegetation communities can be considered representative of the Kathu Bushveld vegetation type. Both vegetation communities further provide habitat for Northern Cape Nature Conservation Act, 2009 (Act No 9 of 2009) protected floral species. These vegetation communities will henceforth be considered as a single habitat unit, namely the Kathu Bushveld.

Degraded Bushveld

The study area is largely confined to the natural areas situated to the east and west of the existing Mamatwan Mine, with few portions of the study area overlapping within existing mining areas. This habitat unit comprises the NSS (2018) vegetation unit formerly referred to as Degraded *Acacia* Thornveld - *Acacia* dominated vegetation in recovery. Also included are all



mining areas associated with vegetated areas, such as the rehabilitated historic mine dumps, as well as the outer slopes of currently utilised dumps, where vegetation has managed to re-establish. Although these areas were classified as transformed habitat by NSS (2018), they can also be considered as vegetation in recovery and as such were included in the Degraded Bushveld habitat unit.

Transformed Habitat

Areas falling within the study area that was utilised on a regular basis for mining, or where ground clearing activities has resulted in no vegetation to remain or where vegetation was limited to Alien Invasive Plant (AIP) species was classified as transformed. Due to the lack of natural vegetation within these areas, the floral ecological importance and sensitivity is considered to be low and these areas were not further assessed.


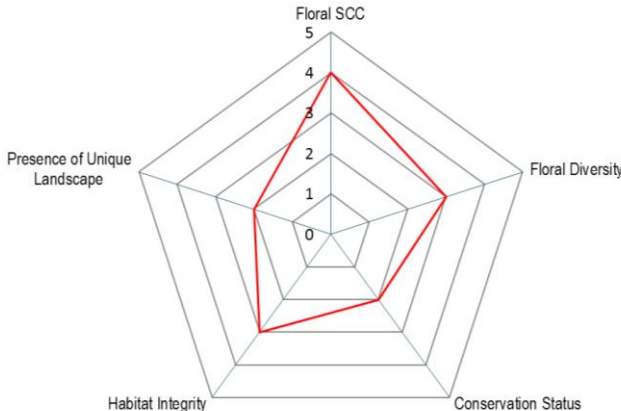




Figure 2: Conceptual illustration of the habitat units associated with the proposed expansion activities.



3.3 Kathu Bushveld



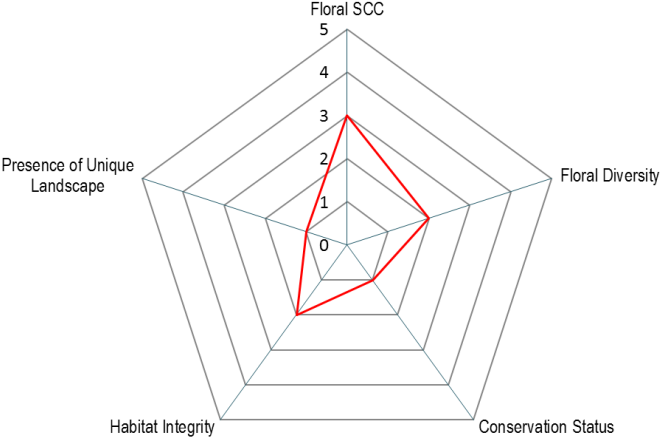

Kathu Bushveld Habitat Sensitivity		Intermediate	Typical view of the Kathu bushveld habitat unit associated with the study area.	
<p>Habitat Description: The Kathu Bushveld Habitat unit can be classified as open Savanna, with a prominent well-developed shrub layer. The woody layer was dominated within this vegetation community, often occurring clumped together. The grass layer is variable in cover, with bare soil patches notable throughout the habitat unit. The herbaceous layer was also limited and can largely be attributed to the time of the assessment, whereby herbaceous species have died back.</p> <p>Notes of Photographs: Above: <i>Vachellia haematoxylon</i> in the foreground, with stands of <i>Senegalia mellifera</i> evident in the background; Below: Variable grass layer with bare soil patches evident in the foreground, with the well-developed shrub layer comprising a few taller trees (<i>Vachellia erioloba</i>) in the background.</p>				
<p style="text-align: center;">FLORAL HABITAT SENSITIVITY GRAPH</p> 				
Floral Species of Conservation Concern (SCC)	<p>During the field assessment, no floral SCC were observed within the Kathu Bushveld. One floral SCC <i>Hoodia gordonii</i> (Data deficient – Insufficient Information) have an increased probability to occur within the study area. A number of national and provincial protected species were however observed within this habitat unit: The high significance attributed to the SCC score is as a result of the high abundance of individuals encountered within this habitat unit, particularly for the NFA protected species.</p> <ul style="list-style-type: none">➤ National Forest Act, 1998, (Act 84 of 1998, amended in September 2011) (NFA):<ul style="list-style-type: none">• <i>Vachellia erioloba</i> and <i>V. haematoxylon</i>;➤ Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) (NCNCA):<ul style="list-style-type: none">• Schedule 1: <i>Harpagophytum procumbens</i>; and• Schedule 2: <i>Boophone disticha</i> and <i>Tridentea</i> sp;➤ National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004) Threatened or Protected Species (TOPS):<ul style="list-style-type: none">• <i>Harpagophytum procumbens</i>. <p>A number of other protected floral species have an increased probability to occur within this habitat unit. Refer to Section 3.5 for a detailed discussion.</p> <p>Prior to any ground clearing activities, permits will have to be obtained from the Department of Environment, Forestry and Fisheries (DEFF) (formerly the Department of Agriculture, Forestry and Fisheries (DAFF)) and the Northern Cape Department of Environment and Nature Conservation (NCDENC).</p>			



Conservation Status of Vegetation Type/Ecosystem	The National Biodiversity Assessment (2018), indicates that this habitat unit falls within the remaining extent of the Kathu Bushveld. This vegetation type is however considered to be Least Threatened. The study area is not located within an area considered to be of biodiversity importance according to the Mining and Biodiversity Guidelines. The Northern Cape CBA map (2016) classifies the habitat unit as Other Natural Areas, however there are no Critical Biodiversity Areas (CBA), nor any Ecological Support Areas (ESA) associated with the study area. The habitat unit is considered to be of moderately low conservation importance.	Habitat integrity/Alien and Invasive species
		Habitat degradation of this habitat unit has taken place as a result of vegetation clearing along the boundary fence to deter criminal activity (NSS, 2018), as well as for prospecting activities. Edge effects from mining activities as well as grazing by game and livestock has also led to increased pressure on this habitat unit, which has resulted in bush encroachment by the indigenous <i>Senegalia mellifera</i> in areas, particularly adjacent to mining activities and current infrastructure. A number of individuals of the AIP tree <i>Prosopis glandulosa</i> were also noted within this habitat unit, however proliferation of this species was not extensive. The habitat integrity of the Kathu Bushveld is considered to be of an intermediate level.
		Presence of Unique Landscapes
		The habitat unit is not considered unique within the landscape but is represented within the larger Kathu- Kuruman region. This vegetation type is further considered Least Threatened. This can largely be attributed to the low percentage of the vegetation type considered transformed (over 1% according to Mucina & Rutherford, 2012).
Floral Diversity	<p>The Kathu Bushveld vegetation type is not considered a highly diverse vegetation unit, with a limited number of woody, graminoid and forb species expected to occur. The woody layer associated with the Kathu Bushveld Habitat unit comprised of a prominent tall shrub layer dominated by <i>Senegalia mellifera</i>, <i>Vachellia haematoxylon</i>, and <i>Grewia flava</i>. Several dwarf shrubs were also observed and included amongst others <i>Lagera decurrens</i> and <i>Lasiosiphon polycephalus</i>. The forb layer was largely died-back to underground plant parts, however a number of succulent and bulbous species associated with the understory were noted such as <i>Sansevieria aethiopica</i>, <i>Tridentea</i> sp. and <i>Boophone disticha</i>. A number of additional species such as <i>Kalanchoe thyrsiflora</i>, <i>Bulbine</i> sp. and <i>Ruschia cf. griquensis</i> were also noted during previous studies (NSS, 2018). These species were not observed during the current assessment as a result of the extenuating dry period, limiting plant growth. The grass layer was dominated by <i>Stipagrostis uniplumis</i>, <i>Eragrostis lehmanniana</i> and <i>Aristida meridionalis</i>.</p> <p>The floral diversity associated with the Kathu Bushveld are considered to be of an intermediate level. Refer to Appendix C for a comprehensive species list encountered during the current assessment as well as recorded by NSS (2018).</p>	
Business Case, Conclusion and Recommendations:		
<p>The floral ecological importance and sensitivity of this habitat unit is considered Intermediate. The habitat unit is not considered of conservation importance according to the various datasets assessed. The habitat unit nonetheless, provides suitable habitat for a number of national and provincially protected species. Although these species are not considered threatened as defined by the Threatened Species Programme: Red List of South African Plants, updated 2017, these species are still protected and require permits to be removed/ destroyed. During the field assessment all protected individuals encountered were marked, however it is highly likely that individuals of the forb species recorded, i.e <i>B. disticha</i>, <i>H. procumbens</i>, and <i>Tridentea</i> sp. may have been missed. Other NCNCA protected species are likely to utilise this habitat unit as discussed in Section 3.5 below. Once designs have been finalised for infrastructure associated with a specific expansion activity, but prior to commencement of construction activities, a floral walkdown will need to be undertaken in the correct flowering season in order to mark all herbaceous protected floral species. This should preferably be undertaken during February/March when the majority of species will be in flower.</p> <p>Development within this habitat unit is unlikely to unacceptably impact on provincial and conservation targets for the Kathu Bushveld vegetation type. The proposed expansion activities will result in the loss of protected species individuals, and the development footprint should be minimised to what is essential. All herbaceous protected floral species should be rescued and relocated to similar habitat outside of the development footprint, or be used for landscaping within the existing mine boundary. All natural areas outside of the development footprint areas should also be preserved and enhanced where possible.</p> <p>In order to minimise post-development rehabilitation and AIP control costs, it is recommended that all areas where bare soils are exposed as a result of the development activities should immediately be rehabilitated and reseeded with an indigenous grassland seed mixture. Removal of AIP species to a registered waste facility as well as implementation of AIP control and maintenance measures at the onset of construction will limit the spread of AIP species to surrounding natural habitat, and subsequently limit the footprint area for which AIP control management will have to be implemented during the operational activities.</p>		



3.4 Degraded Bushveld

Degraded Bushveld Habitat Sensitivity	Moderately Low	
<p>Habitat Description: The degraded bushveld habitat unit comprised predominantly of grasses, with a number of trees and shrubs observed. These areas were, however, subject to more severe and extensive anthropogenic related activities which have resulted in decreased species diversity as well as the establishment of an increased number of AIP individuals.</p>		
<p>Note on Photographs: Above: Mine dumps immediately west of the proposed top-cut stockpile area; Middle: Rehabilitated historic mine dumps, comprising predominantly of graminoids. Below: Degraded bushveld associated with the southern portion of the railway loop.</p>		
<p>Floral Habitat Sensitivity Graph:</p> 		
<p>Floral Species of Conservation Concern (SCC)</p> <p>During the field assessment a number of individuals of the NFA protected species i.e. <i>V. erioloba</i> and <i>V. haematoxylon</i>, as well as a single individual of the NCNCA protected species <i>B. disticha</i> were observed. The abundance of NFA protected species were significantly lower as opposed to the Kathu Bushveld, which can be ascribed to the degraded nature of this habitat unit. Removal of individuals within this habitat unit will require permits from the relevant authorities prior to ground clearing activities. It is less likely for other protected species listed in Section 3.5 to utilise this habitat unit due to the severely degraded nature of the habitat.</p>		



Floral Diversity	The floral diversity of this habitat unit is considered to be moderately low, largely as a result of anthropogenic related activities associated with this habitat unit, which has resulted in the removal of a large number of woody species. This habitat unit comprised predominantly of grass species often associated with disturbance such as <i>Stipagrostis uniplumis</i> , <i>Schmidtia kalahariensis</i> and <i>Pennisetum setaceum</i> . The dominant tree species observed was <i>Searsia lancea</i> , with a few Kathu bushveld endemics such as <i>Vachellia erioloba</i> and <i>Vachellia mellifera</i> noted. Herbaceous species observed include species often associated with exposed soils and include amongst others <i>Argemone ochroleuca</i> , and <i>Helichrysum argyrosperum</i>	Presence of Unique Landscapes
		No unique landscapes important to flora were present due to the severely degraded nature of this habitat unit resulting from mining activities.
		Habitat integrity/Alien and Invasive species
		Habitat integrity is diminished due to mining and development activities which have severely altered the soil profile through dumping of waste material discard dumps as well as manganese rock in areas. This has not only altered the floral species composition but has also allowed for the establishment of AIP species such as <i>Prosopis glandulosa</i> , <i>Nicotiana glauca</i> , <i>Argemone ochroleuca</i> , and <i>Pennisetum setaceum</i> .
Conservation Status of Vegetation Type/Ecosystem	According to the various datasets assessed, the areas falling within this habitat unit is no longer considered as Kathu Bushveld (NBA, 2018), nor to be of natural vegetation (Northern Cape CBA map, 2016). This habitat unit is subsequently of low conservation importance.	
Business Case, Conclusion and Recommendations:		
This habitat unit is of moderately low ecological importance and sensitivity. The sensitivity can largely be attributed to the habitat unit still supporting protected floral species despite the severely degraded habitat. The abundance of individuals was significantly lower as compared to the Kathu Bushveld Habitat Unit. There are no developmental constraints associated with this habitat unit due to the highly degraded nature of this habitat unit, and activities within this habitat unit must be optimised. Prior to any ground clearing activities, a permit will however need to be obtained for all protected floral species that will be removed during construction activities.		
Due to the area already being exposed to disturbances and showing signs of being susceptible to AIP proliferation, care must be taken to limit edge effects on the surrounding natural areas. Furthermore, it is recommended that an alien and invasive floral species management plan be developed to manage alien floral species proliferation within this habitat unit and the transformed habitat unit. All infrastructure not geographically specific should be situated within the Degraded Bushveld and Transformed Habitat unit, in order to limit the impact on the natural surrounding Kathu Bushveld.		



3.5 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. A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA).

The SCC assessment not only considers floral SCC recorded on site during the field assessment but also includes a Potential of Occurrence (POC) assessment where the assessment takes suitable habitat to support any such species into consideration. Thus, for the POC assessment, the following protected species lists were utilised:

- The Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009);
- Government Notice 256 Threatened or Protected Species (TOPS) as published in the Government Gazette 38600 of 2015 as it relates to the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004); and
- Government Notice 908 List of Protected Tree Species as published in the Government Gazette 38215 as it relates to the National Forest Act, 1998, (Act 84 of 1998, amended in September 2011).

The following SCC/ protected species obtained a POC of 60% or more, with a number of species also recorded within the study area at the time of the assessment. During the POC assessment, the known distribution range of the species, suitable habitat within the study area as well as the level of habitat degradation are taken into consideration. Refer to Appendix A for the method of assessment:

Table 2: SCC/ Protected species observed within the study area at the time of assessment or within increased likelihood to utilise the study area

Species	Threat Status	Habitat Unit	POC	Recorded by NSS (2018)
NFA				
<i>Vachellia erioloba</i>	LC	Recorded within all habitat units during the assessment	100%	Yes
<i>Vachellia haematoxylon</i>	LC	Recorded within all habitat units during the assessment	100%	Yes
<i>Boscia albitrunca</i>	LC	Suitable habitat within the Kathu Bushveld, and observed in the surrounding region during the field assessment	67%	No



NCNCA				
Schedule 1				
<i>Harpagophytum procumbens</i>	LC	Recorded within the Kathu Bushveld Habitat Unit	100%	No
<i>Hoodia gordonii</i>	DDD	Suitable habitat within the Kathu Bushveld	60%	No
<i>Lessertia frutescens</i> subsp. <i>frutescens</i>	LC	Suitable habitat within the Kathu Bushveld	60%	No
Schedule 2				
<i>Boophone disticha</i>	LC	Observed within the Kathu Bushveld and Degraded Bushveld Habitat	100%	Yes
<i>Tridentea</i> sp. likely <i>T. gemmiflora</i> (<i>Stapelia gemmiflora</i>)	LC	Recorded within the Kathu Bushveld	100%	No
<i>Babiana hypogaea</i>	LC	Previously recorded by STS in the vicinity of the study area. Suitable habitat within the Kathu Bushveld	80%	Yes
<i>Boscia albitrunca</i>	LC	Suitable habitat within the Kathu Bushveld, and observed in the surrounding region during the field assessment	67%	No
<i>Nerine laticoma</i>	LC	Suitable habitat within the Kathu Bushveld habitat unit	60%	No
TOPS				
<i>Harpagophytum procumbens</i>	LC	Recorded within the Kathu Bushveld Habitat Unit	100%	No

From the table above it is evident that a number of protected floral species have been recorded within the study area or have a high probability of occurring within the study area, particularly the Kathu Bushveld. Removal of the species listed above during the proposed expansion activities is considered unavoidable from both the Kathu Bushveld and Degraded Bushveld habitat units. It is however considered possible to rescue and relocate the herbaceous species, and subsequently, a rescue and relocation plan should be designed and implemented for such species. The rescue and relocation plan should be overseen by a suitable qualified botanist/ horticulturalist, with experience in rescue and relocation of floral species. Once designs have been finalised and prior to any ground clearing activities, a floral walkdown will need to be undertaken in the correct flowering season in order to mark all herbaceous protected floral species. This should preferably be undertaken during February/March when the majority of species will be in flower. Permits should be obtained from the relevant authorities for the removal/ destruction of all protected species falling within the development footprint.





Figure 3: Protected species encountered within the study: *Vachellia haematoxylon* (Top left); *Vachellia erioloba* (Top Right), *Harpagophytum procumbens* (Middle Left), *Tridentea* sp. (Middle Right), and *Boophone disticha* (Bottom).

3.6 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of dominant plant species with traditional medicinal value and the plant parts traditionally used, which were identified during the field assessment.

Table 3: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009). Alien species are indicated with an asterisk (*).

Species	Name	Plant parts used
<i>Asparagus suaveolens</i>	Wild Asparagus	Rhizomes and flashy roots
<i>Dichrostachys cinerea</i>	Sickle Bush	Roots
<i>Elephantorrhiza elephantina</i>	Eland's Bean	Roots
<i>Tarchonanthus camphoratus</i>	Camphor Bush	Leaves
<i>Vachellia erioloba</i>	Camel Thorn	Pods, Gum, Bark, Roots
<i>Ziziphus mucronata</i>	Buffalo Thorn	Roots, Bark and Leaves
<i>Dicoma</i> sp.		Leaves and Twigs
<i>Harpagophytum procumbens</i>	Devil's Claw	Roots
<i>Salvia runcinata</i>	Wild Sage	Leaves
<i>Sansevieria aethiopica</i>	Bowstring Hemp	Rhizomes and Leaves
<i>Senna italica</i> subsp. <i>arachoides</i>	Wild Senna	Leaves
<i>Boophone disticha</i>	Poison Bulb	Bulb Scales

A moderately low abundance of medicinal species was encountered during the field assessment and can be attributed to the limited floral diversity associated with the study area and the Kathu Bushveld in general. The species listed in the table above are common, widespread species and not confined to the study area; nor are they unique within the region. *Boophone disticha* and *Harpagophytum procumbens* are however protected within the Northern Cape Province. Several individuals of *B. disticha* and *H. procumbens* were found within the Kathu Bushveld habitat. These species would need to be rescued and relocated to suitable habitat outside of the disturbance footprint area, which should be undertaken by an aptly qualified contractor. Thus, if rescue and relocation is implemented for these species no other risks to their populations within the larger region, or locally, are foreseen for medicinal plants.

3.7 Alien and Invasive Plant (AIP) Species

Alien and invasive floral species are floral species of exotic origin which are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. They are often the most dominant and noticeable within an



area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

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

Table 4: Dominant alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.

Scientific name	Common name	Origin	NEMBA Category	Habitat Unit
WOODY SPECIES				
<i>Nicotiana glauca</i>	Wild Tobacco	Argentina	1b	Degraded Bushveld Transformed
<i>Prosopis glandulosa</i>	Mesquite	Mexico	3	Degraded Bushveld Transformed
FORB SPECIES				
<i>Argemone ochroleuca</i>	Mexican Poppy	Central America	1b	Degraded Bushveld Transformed
GRAMINOID SPECIES				
<i>Pennisetum setaceum</i>	Fountain Grass	North Africa	1b	Degraded Bushveld

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).

Of the alien species recorded during the field investigation (Table 3), three are listed as NEMBA Category 1b species, with one species recorded as NEMBA 3. Alien species located within the proposed development areas need to be removed regularly as part of maintenance activities - according to the NEMBA: Alien and Invasive Species Regulations, GN R864 of 2016.



Although the table indicates a low diversity of alien species observed in the study area, a variety of indigenous species commonly associated with bush encroachment were present throughout the study area. As such the low diversity of alien invasive species within the study area is not an indication that the study area is in a good ecological condition, as portions of the study area were also subject to bush encroachment, forming dense bush clumps. Species associated with bush encroachment noted include:

- *Senegalia mellifera* (Black Thorn),
- *Senegalia hebeclada* (Candle Thorn);
- *Grewia flava* (Wild Rasin); and
- *Tarchonanthus camphoratus* (Camphor Bush).

The above-listed species should also be managed to prevent any further bush encroachment in the surrounding area. The mining expansion footprint should as far as possible be kept free from weeds and alien vegetation. As part of rehabilitation activities, it is recommended that monitoring of the study area occurs bi-annually for the duration the operational phase of the mine, so as to ensure that no new alien vegetation growth occurs.

4 SENSITIVITY MAPPING

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



Table 5: A summary of the sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Development Implications
Kathu Bushveld	<p>INTERMEDIATE</p> <p><u>Conservation Objective</u></p> <p>Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential.</p>	<p>This habitat unit is of intermediate ecological sensitivity. Based on the desktop assessment, this habitat unit is not of high conservation importance, however this habitat unit is associated with an intermediate floral diversity, and support a number of protected floral species with a high abundance of protected individuals observed, contributing to the sensitivity of this habitat unit. Permits will have to be obtained from DEFF and NCDENC prior to removal/destruction of any protected individuals. All herbaceous protected floral species should be rescued and relocated by a suitably qualified contractor prior to any ground disturbance activities. Development within this habitat unit is not prohibited from a floral resource management perspective, although the development footprint should be minimised, and care should be taken not to disturb the surrounding natural habitat. A rehabilitation and AIP control and Management Plan should also be implemented at the onset of the commencement of the expansion activities, to limit spread and further degradation of the surrounding floral habitat.</p>
Degraded Bushveld	<p>MODERATELY LOW</p> <p><u>Conservation Objective</u></p> <p>Optimise development potential while improving biodiversity intactness of surrounding natural habitat and managing edge effects.</p>	<p>This habitat unit is not considered ecologically important from a floristic perspective. The Degraded Bushveld habitat unit is no longer considered representative of the reference vegetation type, i.e. the Kathu Bushveld, and provides limited suitable habitat for floral SCC and native floral species. A number of protected floral species were observed in these areas during the field assessment, however individual abundance was significantly lower as opposed to the Kathu Bushveld Habitat Unit. The necessary permits will have to be obtained for the removal of all protected species prior to ground disturbance activities taking place. The habitat unit is of moderately low conservation significance.</p> <p>To reduce opportunities for AIPs to be exchanged between the Degraded Bushveld habitat and surrounding natural areas i.e. Kathu Bushveld habitat unit during all phases of the development, an AIP management plan should be implemented for the clearance of listed alien species before expansion activities commence.</p>
Transformed	<p>LOW</p> <p><u>Conservation Objective</u></p> <p>Optimise development potential.</p>	<p>The Transformed Habitat is of low ecological importance and sensitivity due to the modified floral species composition of these areas comprising predominantly of bare soils or AIP species. Ecological functioning and habitat integrity are significantly compromised, and these areas should be optimised for development. Edge effect impacts on the surrounding natural vegetation should be well managed to limit the spread of AIP species to the surrounding areas.</p>



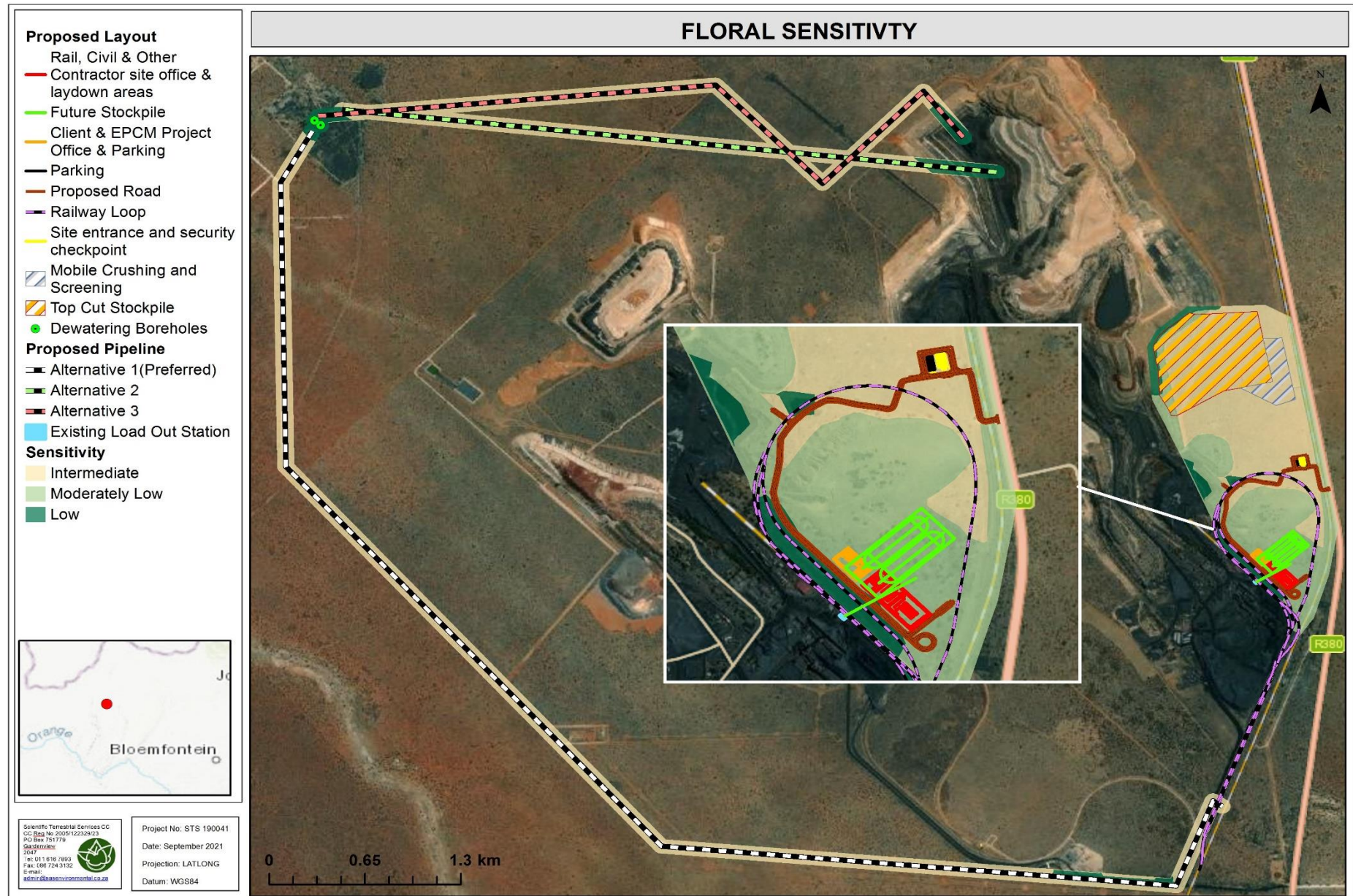


Figure 4: Sensitivity map for the study area.



5 IMPACT ASSESSMENT

The sections below provide the significance of perceived impacts on the floral ecology of the study area. An impact discussion and assessment of all potential construction, operational and decommissioning phase impacts are provided in Section 5.1. All mitigatory measures required to minimise the perceived impacts are presented in Section 5.3, with input on recommended floral and faunal monitoring presented in Section 7.4.

The impact assessment was based on the proposed layout as provided by the proponent (refer to Part A Section 1.1), which indicates the following:

The planned expansion activities assessed in this section of the report are as follows:

- Additional storage space is required for top-cut material. Prior to the material being sent to the sinter plant for primary crushing and screening will be required. Crushing and screening is proposed to be undertaken by a mobile crushing and screening plant. Due to the significantly smaller development footprint required for the crushing and screening plant, the impact assessment for the top-cut stockpile and crushing and screening plant was undertaken separately;
- Additional boreholes are required for water abstraction. MMT proposes to drill two boreholes at the currently unutilised Middelplaats mine. Three water pipeline alternatives are proposed. All three pipeline alternatives fall within the Kathu Bushveld, however Pipeline Alternative 1 is located within the existing road reserve. The impact assessment arising from the construction of Pipeline Alternatives 2 and 3 are anticipated to be similar, and these alternatives have been assessed together. The impact arising from Pipeline Alternative 1 is expected to be lower as this alternative is associated with an area of increased disturbance. This alternative was subsequently assessed separately; and
- Transnet Freight Rail (TFR) plans to increase the capacity of the Manganese rail line, by increasing the loading rate of trains. In order to meet the TFR expansion requirements the loading rate of trains at the MMT needs to be increased. The plan to achieve this will be through the establishment of a new railway loop, new loadout station, product stockpile areas, stacker and reclaimers.

5.1 Activities and Aspect Register

The table below indicates the perceived risks to floral species associated with the activities pertaining to the proposed mine expansion.



Table 6: Activities and aspects likely to impact on the floral resources of the study area. Blocks with a more red colour were regarded as having a higher impact significance and were rated higher in the impact assessment.

ACTIVITIES AND ASPECTS REGISTER	
Planning Phase	
-	Potential failure to obtain the necessary permits for removal of protected floral species..
-	Impact: Potential fines imposed on the mine by the relevant authorities
-	Potential failure to implement a rescue and relocation of protected forb species.
-	Impact: Permanent loss of protected floral species from the study area
-	Potential failure to have a Rehabilitation Plan developed and ready for implementation before the commencement of mining activities.
-	Impact: Without a developed rehabilitation plan it could lead to the exposure of areas of bare soil, which aren't immediately rehabilitated, and the subsequent establishment of AIP species and loss of viable soils for optimal plant growth.
-	Potential failure to implement an Alien and Invasive Plant (AIP) Management/Control Plan before construction activities commence.
-	Impact: Continued displacement of indigenous species by AIPs, subsequently leading to a loss in floral diversity, as well as displacement/ mortality of protected floral species.
-	Potential failure to implement an Erosion Control Plan for sloped areas leading to sedimentation of lower lying habitat and degradation of soil structure.
	Impact: Loss of favourable floral habitat and consequently declines in floral diversity.
-	Potential inadequate design of infrastructure leading to pollution of soils as a result of, e.g., seepage/leaks from infrastructure failure.
-	Impact: Contaminated soils lead to a loss of viable growing conditions for plants and results in a decrease of floral habitat, diversity, SCC and medicinal species – rehabilitation effort will also be increased as a result.
Construction and Operational Phase	
-	Site clearing and the removal of vegetation.
-	Impact: Loss of floral habitat and loss of floral SCC.
-	Proliferation of AIP species that colonise areas of increased disturbances and that outcompete native species, including the further transformation of adjacent or nearby natural areas.
-	Impact: Loss of favourable floral habitat outside of the direct development footprint, including a decrease in floral diversity, potential loss of floral SCC.
-	Potential failure to correctly stockpile topsoil removed during construction activities leading to:
	<ul style="list-style-type: none"> • Potential contamination of topsoil stockpiles with AIP propagules; • Compaction of stockpiled topsoil leading to loss of viable soils for rehabilitation; and • Inefficient vegetating of stockpiled topsoil resulting in loss and degradation of soils.
-	Impact: Loss of viable soils for rehabilitation, thus hampering the potential for floral species to successfully establish during rehabilitation activities. Ultimately a loss of floral diversity will result.
-	Failure to concurrently rehabilitate bare areas or disturbed sites as soon as they become available, potentially resulting proliferation of AIPs.
-	Impact: Long-term loss of favourable habitat for the establishment of floral species. Loss of floral diversity.
-	Potentially poorly managed edge effects:
	<ul style="list-style-type: none"> • Ineffective rehabilitation of compacted areas, bare soils, or eroded areas leading to a continual proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the floral habitat; and • Potential erosion stemming from soil left bare leading to sedimentation of downslope floral habitat.
-	Impact: Loss of floral habitat, diversity and SCC within the direct expansion development footprint of the mine. Loss of surrounding floral diversity and floral SCC through the displacement of indigenous flora by AIP species - especially in response to disturbance in natural areas.
-	Failure to implement ongoing monitoring of rescued and relocated floral species leading to individual mortality.
-	Impact: Permanent loss of protected floral species from the area.
-	Potential failure to implement a Biodiversity Action Plan (BAP), including the auditing of the BAP. Potential failure to initiate concurrent rehabilitation and implement an alien floral control plan during the operational phase,
-	Impact: Potentially leading to a permanent transformation of floral habitat and long-term degradation of important floral habitat within the surrounding region, i.e. floral communities associated with Kathu Bushveld. This will lead to a residual loss of biodiversity.



ACTIVITIES AND ASPECTS REGISTER	
-	Habitat fragmentation resulting from the expansion activities and poorly rehabilitated areas.
-	Impact: Long-term changes in floral structure, altered genetic fitness and potential loss of SCC.
-	Overexploitation through the removal and/or collection of important or sensitive medicinal and floral SCC beyond the direct footprint area.
-	Impact: Local loss of floral SCC abundance and diversity.
-	Risk of contamination from all operational facilities may pollute the receiving environment.
-	Impact: Leading to altered floral habitat.
-	Seepage from the top cut stockpile affecting soils and the groundwater regime.
-	Impact: Altered floral habitat.
-	Erosion as a result of mining development, stormwater runoff and on-going disturbance of soils due to operational activities.
-	Impact: Leading to a loss of floral habitat.
-	Dumping of excavated and construction material outside of designated areas, promoting the establishment of AIPs.
-	Impact: Loss of floral habitat, diversity and SCC.
-	Dust generated during construction and operational activities accumulating on the surrounding floral individuals, altering the photosynthetic ability of plants ³ and potentially further decreasing optimal growing/re-establishing conditions.
-	Impact: Declines in plant functioning leading to loss of floral species and habitat for optimal growth.
Decommissioning & Closure Phase	
-	Potential ineffective rehabilitation of exposed and impacted areas potentially leading to a shift in vegetation type.
-	Impact: Permanent loss of floral habitat, diversity and SCC, and a higher likelihood of edge effect impacts on adjacent and nearby natural vegetation of increased sensitivity.
-	Potential poor management and failure to monitor rehabilitation efforts, leading to:
•	Landscapes left fragmented, resulting in reduced dispersal capabilities of floral species and a decrease in floral diversity;
•	Compacted soils limiting the re-establishment of natural vegetation;
•	Increased risk of erosion in areas left disturbed.
-	Impact: Long-term (or permanent) loss of floral habitat, diversity and SCC.
-	Potentially poorly implemented and monitored AIP Management programme leading to the reintroduction and proliferation of AIP species.
-	Impact: Permanent loss of surrounding natural floral habitat, diversity and SCC.
-	On-going risk of contamination from mining facilities beyond closure.
-	Impact: Permanent impact on floral habitat.
-	On-going seepage and runoff may affect the groundwater regime beyond closure.
-	Impact: Loss of niche floral habitat and associated species.
-	Rehabilitation of currently degraded habitat and AIP clearance of already proliferated areas.
-	Impact (positive): Some ecological functioning will be restored that has been lost due to AIP proliferation and habitat transformation.

³ Sett, R. (2017). Responses in plants exposed to dust pollution. Horticulture International Journal, 1(2), 00010.).



5.3 Floral Impact Assessment Results

The following table indicates the perceived risks to the floral ecology associated with all phases of the proposed development. The table also provides the findings of the impact assessment undertaken with reference to the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post-mitigation impact scores will increase.

The pre-construction phase, especially from a floral resource management perspective, is essential in ensuring that activities associated with all phases of the project have the lowest possible impact on the receiving environment. In this regard, scoring of the pre-planning phase is considered important, since although it is unlikely to result in an immediate impact, failure to effectively plan, and implement an AIP control plan, a rehabilitation plan, obtain the necessary floral permits as well as design and implement a rescue and relocation plan prior to the onset of ground clearing activities, the impact is likely to be higher during the construction and operational phase., as well as the decommissioning and closure phase.

Table 7: Impact on the floral habitat, diversity and SCC arising from the proposed development activities.

	UNMANAGED							MANAGED					
Expansion Activity	Intensity	Duration	Extent	Consequence	Probability	Significance		Intensity	Duration	Extent	Consequence	Probability	Significance
Pre-Construction (Planning) Phase													
Impact of floral Habitat and Diversity													
Top-cut stockpile	M	H	M	M	VH	Medium		L	M	L	L	VH	Low
Crushing and Screening Plant	L	M	L	L	H	Low		VL	M	VL	VL	M	Very Low
Borehole Drilling	VL	L	VL	VL	M	Very Low		VL	VL	VL	VL	L	Insignificant
Dewatering Pipeline Alternative 1	L	L	L	L	H	Low		VL	L	VL	VL	M	Very Low
Dewatering Pipelines Alternative 2 and 3	M	L	L	M	H	Medium		L	L	VL	L	M	Very Low
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low		L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	M	H	M	M	VH	Medium		L	M	L	L	VH	Low
Impact on Floral SCC													
Top-cut stockpile	H	H	M	H	VH	High		M	M	L	M	VH	Medium
Crushing and Screening Plant	L	M	L	L	H	Low		VL	M	VL	VL	M	Very Low
Borehole Drilling	VL	L	VL	VL	M	Very Low		VL	VL	VL	VL	L	Insignificant



Expansion Activity	UNMANAGED						MANAGED					
	Intensity	Duration	Extent	Consequence	Probability	Significance	Intensity	Duration	Extent	Consequence	Probability	Significance
Dewatering Pipeline Alternative 1	M	H	L	M	H	Medium	L	M	VL	L	H	Low
Dewatering Pipelines Alternative 2 and 3	M	H	L	M	H	Medium	L	M	VL	L	M	Low
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low	L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	H	H	M	H	VH	High	M	M	L	M	VH	Medium
Construction and Operational Phase												
Impact of floral Habitat and Diversity												
Top-cut stockpile	H	H	M	H	VH	High	M	H	L	M	VH	Medium
Crushing and Screening Plant	L	H	L	M	H	Medium	VL	H	VL	L	H	Low
Borehole Drilling	VL	L	VL	VL	M	Very Low	VL	VL	VL	VL	L	Insignificant
Dewatering Pipeline Alternative 1	M	M	L	M	VH	Medium	L	L	VL	L	H	Low
Dewatering Pipelines Alternative 2 and 3	H	M	L	M	VH	Medium	L	L	VL	L	H	Low
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low	L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	H	H	M	H	VH	High	M	H	L	M	VH	Medium
Construction and Operational Phase												
Impact on Floral SCC												
Top-cut stockpile	H	H	M	H	VH	High	H	H	L	H	VH	High
Crushing and Screening Plant	M	H	L	M	VH	Medium	L	H	VL	L	H	Low
Borehole Drilling	VL	L	VL	VL	M	Very Low	VL	VL	VL	VL	L	Insignificant
Dewatering Pipeline Alternative 1	M	H	L	M	VH	Medium	L	H	VL	L	VH	Low
Dewatering Pipelines Alternative 2 and 3	M	H	L	M	VH	Medium	L	H	VL	L	VH	Low
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low	L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	H	H	M	H	VH	High	H	H	L	H	VH	High
Decommissioning and Closure Phase												
Impact of floral Habitat and Diversity												
Top-cut stockpile	H	H	M	H	H	High	M	M	L	M	H	Medium
Crushing and Screening Plant	M	H	L	M	H	Medium	L	M	VL	L	M	Very Low
Borehole Drilling	VL	L	VL	VL	M	Very Low	VL	VL	VL	VL	L	Insignificant
Dewatering Pipeline Alternative 1	M	H	L	M	H	Medium	L	M	VL	L	H	Low
Dewatering Pipelines Alternative 2 and 3	M	H	L	M	H	Medium	L	M	VL	L	M	Low



Expansion Activity	UNMANAGED						MANAGED					
	Intensity	Duration	Extent	Consequence	Probability	Significance	Intensity	Duration	Extent	Consequence	Probability	Significance
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low	L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	H	H	M	H	H	High	M	M	L	M	H	Medium
Impact on Floral SCC												
Top-cut stockpile	M	H	M	M	H	Medium	L	M	L	L	M	Low
Crushing and Screening Plant	L	M	M	M	M	Low	VL	M	VL	L	L	Very Low
Borehole Drilling	VL	L	VL	VL	M	Very Low	VL	VL	VL	VL	L	Insignificant
Dewatering Pipeline Alternative 1	M	M	L	M	VH	Medium	L	L	VL	L	H	Low
Dewatering Pipelines Alternative 2 and 3	H	M	L	M	VH	Medium	L	L	VL	L	H	Low
New offices, future stockpile area and contractor laydown	L	L	M	L	L	Low	L	L	L	L	L	Very Low
Manganese Rail line and road and security checkpoint	M	H	M	M	H	Medium	L	M	L	L	M	Low

5.4 Impact Discussion

5.4.1 Impact on Floral Habitat and Diversity

Based on the impact assessment results it is evident that the most significant impacts will occur during the construction and operational phase where vegetation clearing will result in a loss of floral habitat, diversity and SCC. Significant impacts is still however likely during the planning and decommissioning and closure phase, and is largely attributed to the loss of floral habitat and diversity in the surrounding landscape due to ineffective AIP control, as well as the potential loss of floral SCC beyond the development footprint area. Although the planning phase will not result in an immediate impact on the floral ecology, lack/ poor planning will likely result in more significant impacts during the construction, operation and decommissioning and closure phases. Of utmost importance is the design and implementation of AIP control plan during the planning phase. Permits to remove/ destroy/ as well as rescue and relocation of floral SCC should also be obtained during the planning phase.

The habitat sensitivity associated with the study area range from intermediate to low as discussed in Section 4 of this report. All three water Pipeline Alternatives as well as the top-cut stockpile, crushing and screening plant, as well as the northern portion of the Mamatwan Manganese Railway loop falls within the Kathu Bushveld Habitat, considered to be of



intermediate floral sensitivity. The south eastern portion of the Manganese Railway falls within the Degraded Bushveld Habitat unit, classified to be of moderately low sensitivity whilst the south western portions falls within the transformed habitat unit, considered to be of low sensitivity.

The most significant impact is expected to arise from the development of the top-cut stockpile, due to the large development footprint within habitat of increased sensitivity. Pipeline Alternative 1 is situated within the existing road reserve, where edge effect impacts have been higher as oppose to Pipeline Alternatives 1 and 2. The impact on floral habitat and diversity is subsequently considered to be lower for Pipeline Alternative 1.

From a floral perspective the upgrade of the Manganese Railway will impact on the floral ecology of the area as a result of vegetation clearance.

Due to the significant impact arising from the development of the top-cut stockpile and the railway loop (and to a degree the remaining activities, though of lesser impact significance), the implementation of all mitigation measures stipulated in this report is of high importance. Implementation of mitigation will restrict the impact to the development footprint and limit edge effects on surrounding natural Kathu Bushveld habitat outside of the development footprint. Of particular importance is the control of AIP species, to limit the spread of such species to surrounding sensitive habitat.

5.4.2 Impacts on Floral SCC

During the field assessment a number of NFA and NCNCA protected floral species were observed throughout the study area, and include *Vachellia erioloba*, *V. haematoxylon*, *Boophone disticha*, *Harpagophytum procumbens*, and *Tridentea sp.* Removal/ destruction of any of these will require permits from DOFF and NCDENC. Due to the drought onsite conditions, identification of all protected herbaceous species/individuals was difficult, and a summer walk down of all final development footprint areas will have to be undertaken and all protected individuals marked. Failure to initiate a summer walkdown, and subsequent rescue and relocation will result in the permanent loss of these protected floral species. None of the species associated with the study area is considered threatened and are species with large distribution ranges throughout the Northern Cape, and the country as a whole. Loss of individuals from the study area although considered a high impact, is not considered detrimental for the conservation of these species within the province. Loss of individuals should still be minimised by implementing a rescue and relocation plan for herbaceous



species, as well as by limiting the development footprint to what is essential and actively managing edge effects on the surrounding natural area.

5.4.3 Probable Latent Impacts

Even with extensive mitigation, significant latent impacts on the receiving floral ecological environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Continued loss of floral habitat of increased sensitivity, i.e. Kathu Bushveld;
- Continued loss of and altered floral species diversity;
- Alien and invasive plant proliferation, particularly in sensitive habitat where bare soils are left exposed;
- Permanent loss of floral SCC and suitable habitat; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and loss of floral habitat, species diversity and floral SCC will most likely be long term.

5.4.4 Cumulative Impacts

The proposed expansion activities will result in further clearance of indigenous vegetation. The immediate area is associated with the existing Mamata and Tshipi mines, with the Black Rock, and United Manganese of Kalahari Mines also situated in surrounding region. Mining activities associated with these mines has led to the degradation of the surrounding natural habitat. As such the area that will be cleared is no longer considered pristine. The additional impact attributed to the expansion activities is not considered to contribute significantly to the conservation and ecology of the larger area. The expansion activities will however lead to the permanent loss of floral SCC, and as such all mitigation measures as listed below should be implemented to limit the number of individuals that will be affected.

5.5 Integrated Impact Mitigation

The table below highlights the key, general integrated mitigation measures that are applicable to the proposed mining development in order to suitably manage and mitigate the ecological impacts that are associated with all phases of the proposed development activities.

Provided that all management and mitigation measures are implemented, as stipulated in this report, the overall risk to floral diversity, habitat and SCC can be mitigated and minimised.

Table 8: A summary of the mitigatory requirements for floral resources.

Project phase	<i>Pre-construction Phase</i>
Impact Summary	<i>Loss of floral habitat, species and floral SCC</i>
	<i>Proposed mitigation and management measures:</i>



Management Measures	<p>Floral Habitat and Diversity</p> <ul style="list-style-type: none"> - Minimise loss of indigenous vegetation where possible through effective planning and limiting the development footprint to what is essential. The designs must further adhere to all legislation and all possible precautions taken to prevent potential spills and /or leaks. - It is recommended that prior to the commencement of construction activities the entire construction servitude be fenced off, and clearly demarcated to limit footprint creep and edge effects; <p>Floral SCC</p> <ul style="list-style-type: none"> - It is recommended that prior to any construction/ earth moving activities are to take place, a detailed walkdown of all-natural areas falling within the final expansion footprint area be undertaken and all protected floral species be marked. - The walkdown should be undertaken during the summer season (February/March) when most herbaceous floral species will be in flower, and accurate identification will be easier. - Once all floral SCC and NCNCA protected floral species within the development footprint has been identified, a rescue and relocation plan should be designed specifically to each species. Rescue and relocation activities need to take place prior to commencement of any expansion activities. Rescue and relocation need to be overseen by a suitably qualified contractor/ mine employee. The success of relocation actions need to be monitored quarterly for a minimum period of three years post-relocation; and - The necessary permits need to be obtained from DOFF and NCDENC prior to the implementation of rescue and relocation activities. <p>AIP Control and Ongoing Rehabilitation</p> <ul style="list-style-type: none"> - Prior to the commencement of construction activities, an AIP Management/Control Plan should be compiled for implementation: <ul style="list-style-type: none"> • Removal of alien invasive species should preferably commence during the pre-construction phase and continue throughout the construction, operational, decommissioning and post-closure phases. AIPs should be cleared within areas where they have become proliferate within the existing mining and infrastructure areas (Degraded Bushveld and Transformed Habitat) as well as where new infrastructure is planned before any construction activities commence, thereby ensuring that no AIP propagules are spread, or soils contaminated with AIP seeds, during construction phases; • An AIP Management/Control Plan should be implemented by a qualified professional. No chemical control of AIPs to occur without a certified professional; • Of particular importance is the control of <i>Prosopis glandules</i>, which comprise of a deep-rooted taproot as well as an extensive lateral root system. This species subsequently not only compete with the indigenous <i>V. erioloba</i> for deep groundwater but also take-up sparse precipitation within the soil profile. This species also has a high transpiration rate, which further result in a rapid decline of the water table (Schattschneider and February, 2013). The proliferation of these species have the potential to result in significant long-term negative impacts on the surrounding landscape, particularly the NFA protected species <i>V. erioloba</i> and <i>V. haematoxylon</i>, which play a vital role in the ecosystem by providing habitat for a number of floral and faunal species (Seymour & Milton, 2003); and - Prior to the commencement of construction activities on site, a rehabilitation plan should be developed for implementation throughout the development phases.
Project phase	<i>Construction and Operational Phase</i>
Impact Summary	<i>Loss of floral habitat, species and floral SCC</i>
Management Measures	<p>Proposed mitigation and management measures:</p> <p>Development footprint</p> <ul style="list-style-type: none"> - The footprint areas of all surface infrastructure must be minimised to what is absolutely essential and within the designated and approved boundary; - No additional habitat is to be disturbed during the operational phase of the development. All material placed on the top-cut stockpile should be restricted to the footprint area that is authorised. Weekly monitoring and recording of the footprint area must be done; - Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimum. Any temporary roads should be rehabilitated as soon as they are no longer in use to prevent effects of habitat fragmentation;



	<ul style="list-style-type: none"> - No dumping of waste on site should take place. As such it is advised that waste disposal containers and bins be provided during the construction phase for all construction rubble and general waste; - Cut vegetation from site clearing to be removed immediately and not allowed to accumulate within surrounding natural habitat; - If any spills occur, they should be immediately cleaned up to avoid soil contamination that can hinder floral rehabilitation later down the line. Spill kits should be kept on site within workshops. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage should be practised preventing the ingress of hydrocarbons into the topsoil, - Natural habitat outside of the direct mining footprint areas must be avoided, and no construction vehicles, personnel, or any other construction-related activities are to encroach upon these areas; and - The footprint of daily operational activities must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding floral habitat. <p>Alien Vegetation</p> <ul style="list-style-type: none"> - Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect adjacent Kathu Bushveld Habitat, need to be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made of <i>Prosopis glandules</i> and all Category 1b AIP species, in line with the NEMBA Alien and Invasive Species Regulations (2016), as identified within the study area; - An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment; and - Ongoing alien and invasive plant monitoring and clearing/control should take place throughout all phases of the development, and the project perimeters should be regularly checked for AIP proliferation and to prevent spread into surrounding natural areas; - AIP management for construction-phase activities should be focused on limiting their spread, e.g. roadsides (gravel and tarred roads) should be monitored, as they serve as common corridors along which AIP species are introduced and dispersed, and disturbed areas should regularly be monitored for AIP recruitment until successfully rehabilitated; and - Alien vegetation that is removed must not be allowed to lay on unprotected ground as seeds might disperse upon it. All cleared plant material to be disposed of at a licensed waste facility which complies with legal standards. <p>Floral SCC</p> <ul style="list-style-type: none"> - During the surveying and site-pegging phase of surface infrastructure, all potential floral SCC as well as protected floral species that will be affected by surface infrastructure must be marked and, where possible, relocated to suitable habitat surrounding the disturbance footprint. The removal and/or rescue and relocation should be overseen by a qualified specialist, in association with a suitably qualified horticulturist. The relevant permits must be applied for from the various authorities prior to the commencement of the construction phase; - No collection of floral SCC or medicinal floral species within the site boundary must be allowed by construction personnel; and - Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC and protected floral species outside of the proposed expansion footprint area. <p>Dust</p> <ul style="list-style-type: none"> - Dust pollution has been associated with poor photosynthetic functionality in plants⁴. There is evidence of dust pollution leading to a reduction in chlorophyll, including chlorophyll degradation and reduced photosynthetic activity^{5,6}, resulting from dust deposition on leaf surfaces. Dust deposition also result in stomata clogging⁷, which
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⁴ Sett, R. (2017). Responses in plants exposed to dust pollution. Horticulture International Journal, 1(2), 00010.).

⁵ Gunamani T, Gurusamy R, Swamynathan K. Effect of dust pollution on the dermal appendages and anatomy of leaves in some herbaceous plants. J Swamy Boli Club. 1991;8(3-4):79-85.

⁶ Naik DP, Ushamani, Somasekhar RK. Reduction in protein and chlorophyll contents in some plant species due to some stone quarrying activity. Environ Polln Cont J. 2005;8:42-44.

⁷ Vijaywargiya A, Pandey GP. Effect of cement dust on soybean, Glycine max (L) merr. And Maize, Zea mays Linn. Inflorescence study. Geobios. 2003;30:209-212.



	<p>causes a decreased rate of carbon dioxide exchange, carbon assimilation, transpiration, and therefore decreased net photosynthesis; and</p> <ul style="list-style-type: none"> - An effective dust management plan must be designed and implemented in order to mitigate the impact of dust on flora throughout the construction and operational phase. <p>Fire</p> <ul style="list-style-type: none"> - No illicit fires must be allowed during the construction and operational phases of the proposed expansion activities; and - Fire breaks should be maintained during the operational phase. <p>Stormwater</p> <ul style="list-style-type: none"> - Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion of topsoil and the loss of floral habitat through the discharge of dirty water into the receiving environment. In this regard, special mention is made of: - Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; and - Runoff from paved surfaces should be slowed down by the strategic placement of bioswales. <p>Rehabilitation</p> <ul style="list-style-type: none"> - Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan should consider all development phases of the project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during decommissioning and closure; - The construction process should be phased to limit the extent of exposed areas at any one time and ensure that the time between initial disturbance and completion of construction is as short as possible with rehabilitation occurring concurrently where feasible; - Any natural areas beyond the expansion footprint, that have been affected by the construction and operational activities, must be rehabilitated using indigenous species; - As part of a Biodiversity Action Plan (BAP), floral monitoring should be done annually during operational activity. Please also refer to the monitoring guidelines below; - Rehabilitation must be implemented concurrently, and disturbed areas must be rehabilitated as soon as such areas become available. This will not only reduce the total disturbance footprint but will also reduce the overall rehabilitation effort and cost; and - All soils compacted as a result of construction activities falling outside of the project area should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.
Project phase	<i>Decommissioning and Closure Phase</i>
Impact Summary	<i>Loss of floral habitat, species and SCC</i>
	<p>Rehabilitation</p> <ul style="list-style-type: none"> - All infrastructure and mining operation footprints should be rehabilitated in accordance with a rehabilitation plan compiled by a suitable specialist; - All rehabilitated areas should be rehabilitated to a point where natural processes will allow the ecological functioning and biodiversity of the area to be re-instated as per the post-closure objective; and - Rehabilitation efforts must be implemented for a period of at least five years after decommissioning and closure. <p>Alien Vegetation</p> <ul style="list-style-type: none"> - Edge effects of decommissioning and closure activities, such as erosion and alien plant species proliferation, which may affect adjacent sensitive habitat, need to be strictly managed adjacent to the expansion footprint; - Ongoing alien and invasive vegetation monitoring and eradication should take place throughout the closure/ decommissioning phase of the development, and the Mamatwan Operations and immediate surrounding area (50 m from the perimeters) should be regularly checked during the decommissioning phase for alien vegetation proliferation to prevent spread into surrounding natural area; and - An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas. The alien floral control plan must be implemented for a period of at least 5 years after decommissioning and closure.



5.6 Floral Monitoring

It is recommended that a floral monitoring plan be designed and implemented throughout all phases of the proposed expansion activities, should it be approved. The following points aim to guide the design of the monitoring plan. The monitoring plan should be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must ideally be established in areas surrounding the expansion activities, particularly to the north and east of the top cut stockpile. These plots should be designed in such a way to accurately monitor the following parameters:
 - Recruitment of indigenous species and of alien and invasive species, particularly the establishment of *Prosopis glandules*;
 - Alien vs Indigenous plant ratio, especially *Vachellia erioloba* vs. *P. glandules*;
 - Erosion levels and the efficacy of erosion control measures; and
 - Monitoring to be undertaken annually for the first three years of the operational phase. Should no significant recruitment of additional AIPs be observed during this time, monitoring can be undertaken every two years for the remainder of the operational phase, as well as three years post closure.
- Monitoring of footprint area as well as a 50 m buffer surrounding the footprint area should persist throughout the operational phase to ensure these areas are not adversely affected by the mining operations;
- Monitoring of concurrent rehabilitation must also take place throughout all phases of the proposed mining development and for a period of five years after decommissioning and closure of each rehabilitated or infrastructure area;
- The rehabilitation plan should be continuously updated in accordance with the monitoring results in order to ensure that optimal rehabilitation measures are employed;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining expansion activities and action must be taken to mitigate impacts as soon as negative effects from these activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.



6 CONCLUSION

STS was appointed to conduct a Biodiversity Assessment as part of the environmental impact assessment and authorisation process for the proposed expansion activities at the Mamatwan Mine, near Hotazel, Northern Cape Province.

The proposed expansion activities associated with the study area include the following:

- Development of a top cut stockpile and crushing and screening plant;
- Railway loop; and
- Installation of a pipeline: Three alternatives are proposed, with alternative 1 considered as the preferred alternative.

During the field assessment three habitat units were identified, i.e. Kathu Bushveld, Degraded Bushveld and Transformed Habitat. The Kathu Bushveld comprised the majority of the study area, and degraded as a result of edge effects related to mining activities which has resulted in bush encroachment and AIP establishment in areas, this habitat unit comprised a number of protected floral species, and is of intermediate ecological importance and sensitivity.

The Degraded Bushveld has been severely altered from the reference Kathu Bushveld due to historic ground clearing/ disturbance activities, comprising predominantly of a grass layer, with a number of woody individuals scattered throughout the area, and is of moderately low ecological importance and sensitivity. The transformed habitat was largely void of vegetation or were associated with AIP species, and is considered to be of low ecological importance and sensitivity.

A number of protected floral species was observed at the time of the assessment, and include the NFA protected trees *Vachellia erioloba* and *V. haematoxylon*. Also observed was a number of NCNCA protected species, namely *Boophone disticha*, *Harpagophytum procumbens*, and *Tridentea* sp. It is recommended that a summer walkdown be undertaken and all protected floral species within the final development footprint be marked by means of GPS. Permits will have to be obtained from DEFF and NCDENC for all protected species prior to commencement of expansion activities. All herbaceous protected floral individuals should be rescued and relocated by a suitably qualified contractor.

Following the floral ecological assessment within the study area, the impacts associated with the proposed development activities were determined. The impacts arising from the proposed development will range from very low to high for floral habitat, diversity and SCC for the various expansion related activities. The most significant impacts is expected to arise from the development of the topcut stockpile and manganese Railway Line due to the extent of vegetation clearance and subsequent loss of protected floral species that will occur from



development of these infrastructure. With mitigation measures fully implemented, it is the opinion of the specialist that all impacts can be reduced.

The objective of this study was to provide sufficient information on the floral significance of the area, together with other studies on the physical and socio-cultural environment for the EAP and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The need for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure sustainable economic development of the country.

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.



7 REFERENCES

- Bromilow, C. 2001. Problem Plants of South Africa Revised Edition, First Impression. Briza Publications, Pretoria, RSA.
- Germishuizen, G., and Clarke, B. 2003. Illustrated guide to the Wildflowers of northern South Africa. Briza Publications, Pretoria.
- Henderson, L. 2001. Alien Weeds and Invasive plants – A Complete Guide to Declared Weeds and Invaders in South Africa. Plant Protection Research Institute, Agricultural Research Council Handbook No 12. Pretoria.
- Invasive Species South Africa (ISSA). Online available: [www.invasives.org.za].
- IUCN (2017). <http://www.iucnredlist.org/>.
- Low, A.B. and Rebelo, A.G. (eds). 1998. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria
- Pooley, E. (1998). A field guide to wildflowers: KwaZulu-Natal and the eastern region. Natal Flora Publ. Trust.
- Raimondo, D., von Staden, L., Foden, W., Victor, J.E, Helme, N.A., Turner, R.C, Kamundi, D.A. & Manyama, P.A. (eds). 2009. Red List of South African Plants Strelitzia 25. South African National Biodiversity Institute, Pretoria. Version 2014.1
- Schachtschneider, K. and February, E., 2013. Impact of *Prosopis* invasion on a keystone tree species in the Kalahari Desert. Journal of Plant Ecology Vol 214, pp 597-605
- Schmidt, E., Lotter, M., & McClelland, W. (2002). Trees and shrubs of Mpumalanga and Kruger national park. Jacana Media.
- Seymour, C. and Milton, S., assisted by Alias, D., and Hermann, E., 2003. A collation and overview of research information on *Acacia erioloba* (Camelthorn) and identification of relevant research gaps to inform protection of the species. Department of Water Affairs and Forestry (DWAF) 2003/089
- Smit, N. 2008. Field Guide to the Acacias of South Africa. Briza Publications, Pretoria
- The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: <http://bgis.sanbi.org> as retrieved in 2019
- Threatened Species Programme. 2017. Red Data List of South African Plant Species. Available online: <http://www.redlist.org>.
- Van der Walt, R. 2009. Wildflowers of the Limpopo Valley. Retha van der Walt, Musina, South Africa
- Van Oudtshoorn, F. (1999). Guide to Grasses of Southern Africa. 2nd Ed. Briza Publications, Pretoria.
- Van Wyk, B. and Malan, S. (1998). Field Guide to the Wild Flowers of the Highveld. Struik Publishers, Cape Town.
- Van Wyk, B., & Van Wyk, P. (1997). Field guide to trees of southern Africa. Struik.
- Van Wyk, B., van Oudtshoorn, B. & Gericke, N. 2009. Medicinal Plants of South Africa. Briza Publications, Pretoria.



APPENDIX A: Floral Method of Assessment

Floral Species of Conservation Concern Assessment

Prior to the field visit, a record of all potential floral SCC and their habitat requirements was acquired making use of relevant national and provincial list published in:

- the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009),
- Government Notice 256 Threatened or Protected Species (TOPS) as published in the Government Gazette 38600 of 2015 as it relates to the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004); and
- Government Notice 908 List of Protected Tree Species as published in the Government Gazette 38215 as it relates to the National Forest Act, 1998, (Act 84 of 1998, amended in September 2011).

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

$[\text{Distribution} + \text{Habitat availability} + \text{Habitat disturbance}] / 15 \times 100 = \text{POC}\%$

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic 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):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **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;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic 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 floral 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 floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table A1: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1.0 < 1.5	Low	Optimise development potential.
$\geq 1.5 < 2.5$	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
$\geq 2.5 < 3.5$	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
$\geq 3.5 < 4.5$	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
$\geq 4.5 \leq 5.0$	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



APPENDIX B: Floral SCC

The species listed below and protected within the various legislature have an increased probability of occurring within the study area. Species identified at the time of assessment are emboldened.

Table B1: NFA (1998) plant list for the tree species expected to occur within the study area.

Family	Scientific Name	Habitat	Threat Status	POC (%)
Fabaceae	<i>Vachellia erioloba</i>	Savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops	LC	100
Fabaceae	<i>Vachellia haematoxylon</i>	Bushveld, usually on deep Kalahari sand between dunes and dry watercourses.	LC	100
Capparaceae	<i>Boscia albitrunca</i>	This species is found in the drier parts of southern Africa, in areas of low rainfall.	LC	60

LC = Least Concern

Table B2: NCNCA (2009) plant list for the floral species likely to occur within the study area.

Family	Scientific Name	Habitat	Schedule	Threat Status	POC (%)
Apocynaceae	<i>Hoodia gordonii</i>	Occurs in a wide variety of arid habitats from coastal to mountainous, also on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds.	Schedule 1	DDD	60
Fabaceae	<i>Lessertia frutescens</i> subsp. <i>frutescens</i>	Occurs naturally throughout the dry parts of southern Africa.	Schedule 1	LC	60
Pedaliaceae	<i>Harpagophytum procumbens</i>	Well drained sandy habitats in open savanna and woodlands.	Schedule 1	NE	100
Amaryllidaceae	<i>Boophone disticha</i>	Dry grassland and rocky areas	Schedule 2	LC	100
Amaryllidaceae	<i>Nerine laticoma</i>	<i>Nerine laticoma</i> occurs in a broad band stretching from the dry inland parts of Namibia eastwards and southwards through southern Botswana, Limpopo, Gauteng, the North-West, Northern Cape, Free State and Lesotho. It usually occurs in large colonies on deep, red, sandy soils.	Schedule 2	LC	60
Apocynaceae	<i>Orbea lutea</i> subsp. <i>lutea</i>	The plants grow in scrub, savanna (Acacia and mopane veld) and grassland at altitudes of 500-1500 m in full sun or semi-shade	Schedule 2	LC	47
Apocynaceae	<i>Tridentea</i> sp.		Schedule 2	LC	100
Asphodelaceae	<i>Aloe grandidentata</i>	Nama karoo shrubland, occurs on ironstone ridges, but in the eastern part of the range it is also found on calcrete.	Schedule 2	LC	40
Capparaceae	<i>Boscia albitrunca</i>	This species is found in the drier parts of southern Africa, in areas of low rainfall.	Schedule 2	LC	60
Iridaceae	<i>Babiana hypogaea</i> (All species of Iridaceae)	Red sand plains. Usually in Kalahari Sand or stony laterite in open woodland or grassland	Schedule 2	LC	80

DDD = Data deficient – Insufficient Information; NE = Near Endemic; LC = Least Concern



Table B3: TOPS plant list for the floral species expected to occur within the Northern Cape.

Family	Scientific Name	Habitat	Growth Form	TOPS Threat Status	POC (%)
Aizoaceae	<i>Cheiridopsis peculiaris</i>	Gravels and shale derived from metamorphic rocks of the Namaqualand Complex	Succulent	CR	20
Aizoaceae	<i>Conophytum herreanthus</i> subsp. <i>Herreanthus</i>	Quartz patches	Succulent	CR	0
Asphodelaceae	<i>Aloidendron pillansii</i>	Succulent Karoo shrubland on dry, rocky dolomite and gneiss hillsides.	Succulent, Tree	EN	0
Amaryllidaceae	<i>Haemanthus graniticus</i>	Namaqualand Klipkoppe Shrubland or Namaqualand Granite Renosterveld.	Geophyte	EN	20
Aizoaceae	<i>Lithops dorotheae</i>	Fine-grained, sheared, feldspathic quartzite	Succulent	EN	0
Asphodelaceae	<i>Aloidendron dichotomum</i>	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	33
Amaryllidaceae	<i>Brunsvigia herrei</i>	Succulent Karoo Shrubland, granitic soils on flats and sometimes in deposits of fairly large stones.	Geophyte	VU	0
Aizoaceae	<i>Conophytum bachelorum</i>	Rocky outcrops	Succulent	VU	0
Aizoaceae	<i>Conophytum ratum</i>	Spongy quartz soil.	Succulent	VU	0
Amaryllidaceae	<i>Gethyllis grandiflora</i>	Sandy and or stony soils in arid karroid shrubland.	Geophyte	VU	20
Amaryllidaceae	<i>Gethyllis namaquensis</i>	Coastal dunes and gravelly mountain slopes in succulent karoo shrubland.	Geophyte	VU	0
Amaryllidaceae	<i>Brunsvigia josephinae</i>	Heavy clay soils.	Geophyte	VU	0
Asphodelaceae	<i>Aloe krapohlana</i>	Occurs in the extremely arid northern regions of the Succulent Karoo, on clay, stony (mostly quartzitic) and sandy soils on flats and slopes.	Herb, Succulent	P	0
Amaryllidaceae	<i>Cyrtanthus herrei</i>	Deeply shaded rock ledges on south-facing rocky slopes.	Bulb	P	0
Aizoaceae	<i>Sceletium tortuosum</i>	Quartz patches and is usually found growing under shrubs in partial shade.	Succulent	P	20
Pedaliaceae	<i>Harpagophytum procumbens</i>	Well drained sandy habitats in open savanna and woodlands.	Herb	P	100

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



APPENDIX C: Floral Species List

Table C1: Dominant plant species encountered in the study areas during the field assessment. Alien species are indicated with an asterisk (*).

Species *Alien **Succulent	Habitat Unit		
	Kathu Bushveld	Degraded Bushveld	Transformed
TREES AND SHRUBS			
* <i>Nicotiana glauca</i>		X	X
* <i>Prosopis glandulosa</i>	X	X	X
<i>Asparagus suaveolens</i>	X		
<i>Blepharis sp.</i>	X		
<i>Dichrostachys cinerea</i>	X		
<i>Elephantorrhiza elephantina</i>	X		
<i>Grewia flava</i>	X	X	
<i>Hirpicium echinus</i>	X		
<i>Laggera decurrens</i>	X		
<i>Lasiosiphon polycephalus</i>	X		
<i>Searsia lancea</i>		X	
<i>Senegalia mellifera</i>	X		
<i>Tarchonanthus camphoratus</i>	X		
<i>Vachellia erioloba</i>	X		
<i>Vachellia haematoxylon</i>	X		
<i>Vachellia hebeclada</i> subsp. <i>hebeclada</i>	X		
<i>Ziziphus mucronata</i>	X		
HERBS			
* <i>Argemone ochroleuca</i>		X	X
<i>Acrotome sp.</i>	X		
<i>Dicoma sp.</i>	X		
<i>Harpagophytum procumbens</i>	X		
<i>Helichrysum argyrospaeum</i>	X	X	
<i>Hirpicium sp.</i>	X		
<i>Nidorella hottentotica</i>	X		
<i>Salvia runcinata</i>	X		
<i>Sansevieria aethiopica</i>	X		
<i>Senecio consanguineus</i>	X	X	
<i>Tridentea sp.</i> likely <i>T. gemmiflora</i> (<i>Stapelia gemmiflora</i>)	X		
CREEPERS AND CLIMBERS			
<i>Acanthosicyos naudinianus</i>		X	
<i>Coccinia rehmanii</i>	X		
<i>Senna italica</i> subsp. <i>arachoides</i>	X		
BULBS			
<i>Boophone disticha</i>			
GRASSES/			
* <i>Pennisetum setaceum</i>			
<i>Aristida congesta</i> subsp. <i>congesta</i>	X		
<i>Aristida meridionalis</i>	X	X	X
<i>Centropodia glauca</i>	X		
<i>Chrysopogon serrulatus</i>		X	
<i>Enneapogon cenchroides</i>	X		
<i>Eragrostis curvula</i>	X		
<i>Eragrostis lehmanniana</i>	X		
<i>Eragrostis truncata</i>	X		
<i>Stipagrostis uniplumis</i>	X		
PARASITES			
<i>Tapinanthus oleifolius</i>	X		

