APPENDIX J: BIODIVERSITY IMPACT ASSESSMENT REPORT

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

Prepared for

SYNERGISTICS - part of the SLR group

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SECTION B – FLORAL ASSESSMENT

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ACRONYMS

BGIS	Biodiversity Geographic Information System
CARA	Conservation of Agricultural Resources Act
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GWC	Griqualand West Centre of Endemism
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NWA	National Water Act
POC	Probability of Occurrence
RDL	Red Data Listed
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SCC	Species of Conservational Concern
SCC	The term SCC in the context of this report refers to all RD (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.
SCCSIS	Species of Conservational Concern Sensitivity Index Score

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal and wetland assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the COZA Iron Ore Project on the farm Jenkins 562 near the town Postmasburg within the Northern Cape Province.

The study area is situated approximately 20 km south of the town of Kathu, 11 km south of the Sishen mine and the south western boundary of the study area is situated adjacent to the R325 roadway (refer to

Section A: Figure 1 and 2).

2 GENERAL SITE SURVEY

A site visit was undertaken during June 2015 to determine the ecological status of the study area. A reconnaissance “walkabout” was undertaken to determine the habitat types found throughout the study area. Sites were investigated to identify the occurrence of dominant floral species and habitat diversities, where special emphasis was placed on potential areas that August support Species of Conservational Concern (SCC).

3 FLORAL METHOD OF ASSESSMENT

3.1 Field Surveys

The overall vegetation survey was conducted by first identifying different habitat units and then analysing the floral species composition. Vegetation analyses were conducted within the study area that is perceived to best represent the various plant communities. Species were recorded and a species list was compiled for each habitat unit. These species lists were compared with the vegetation expected to be found within the Kathu Bushveld and Kuruman Thornveld vegetation types, which serves to provide an accurate indication of the ecological integrity and conservation value of each habitat unit (Evans & Love, 1957; Owensby, 1973).

3.2 Vegetation Index Score (VIS)

The VIS was designed to determine the ecological state of each habitat unit defined within an assessment area. This enables an accurate and consistent description of the Present Ecological State (PES) concerning the study area in question. The information gathered

during the assessment also significantly contributes to sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined habitat unit is assessed using separate data sheets and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

VIS = [(EVC) + (SI x PVC) + (RIS)]

Where:

1. **EVC** is extent of vegetation cover;
2. **SI** is the structural intactness;
3. **PVC** is the percentage cover of indigenous species and
4. **RIS** is the recruitment of indigenous species.

Each of these contributing factors is individually calculated as discussed below. All scores and tables indicated are used in the final score calculation for each contributing factor.

1. EVC= [(EVC1+EVC2) /2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance scores	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 2 score	5	4	3	2	1	0

2. SI= (SI1+SI2+SI3+SI4) /4)

	Trees (S1)		**Shrubs (S2)**		**Forbs (S3)**		**Grasses (S4)**	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								
Clumped								
Scattered								
Sparse								

*Present State (P/S) = currently applicable for each habitat unit
**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for the present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. ***PVC= [(EVC) - (exotic x 0.7) + (bare ground x 0.3)]***

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5

4. ***RIS***

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS						
RIS Score	0	1	2	3	4	5

The final VIS scores for each habitat unit are then categorised as follows:

VIS	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat, extensive
<5	**F**	Modified completely

3.3 Species of Conservational Concern (SCC) Assessment

Prior to the field visit a record of Red Data Listed (RDL) or SCC floral species and their habitat requirements was acquired from the South African National Biodiversity Institute (SANBI) for the Quarter Degree Square (QDS's) 2722DD and 2723CC and important and protected species as listed in the National Environmental Management Biodiversity Act (NEMBA), 2004 (Act 10 of 2004) Threatened or Protected Species (TOPS) document and the List of Protected Tree Species (2012) under the National Forest Act, 1998 (Act No. 945 of 1998). Throughout the floral assessment, special attention was paid to the identification of any RDL floral species, as listed by the QDS (SANBI), the NEMBA TOPS list or the protected tree species list. Identification of suitable habitat that could potentially sustain these species was also assessed.

The Probability of Occurrence (POC) for each floral species of concern was determined using the following calculation wherein the habitat requirements and disturbance was considered. The accuracy of the calculation was based on the available knowledge about the species in question, with many of the species lacking in depth habitat research. Therefore, it is important that the literature available is also considered during the calculation. Each factor contributes an equal value to the calculation.

Literature availability						
Criteria	**No literature available**					**Literature available**
Score						
	0	1	2	3	4	5
Habitat availability						
Criteria	**No habitat available**					**Habitat available**
Score						
	0	1	2	3	4	5
Habitat disturbance						
Criteria	**Pristine**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Score						
	5	4	3	2	1	0

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

4 METHOD OF IMPACT ASSESSMENT

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

5 SENSITIVITY MAPPING

All sensitive features and or habitats (including the localities of RDL/protected floral species, wetlands, rivers and ridges) were mapped utilising a Geographical Positioning System (GPS) and a sensitivity map was compiled. This sensitivity map will aim to guide the design of the study area in order to have the least ecological impact on the receiving environment.

6 RESULTS OF FLORAL INVESTIGATION

6.1 Floral Habitat Descriptions

Upon completion of the site assessment, four floral habitat types were determined to occur within the study area. These habitat units include:

- *Vachellia erioloba* (formally known as *Acacia erioloba)* Bushveld Habitat Unit;
- Kathu Bushveld Habitat Unit;
- Rocky Ridge Habitat Unit; and
- Wetland Habitat Unit (Wetland Pans and Ephemeral Drainage Lines). The wetland habitat unit is discussed in detail in Section D.

The floral habitat units applicable to the study area are indicated in Figure 1 and will be discussed in further detail in the paragraphs to follow.

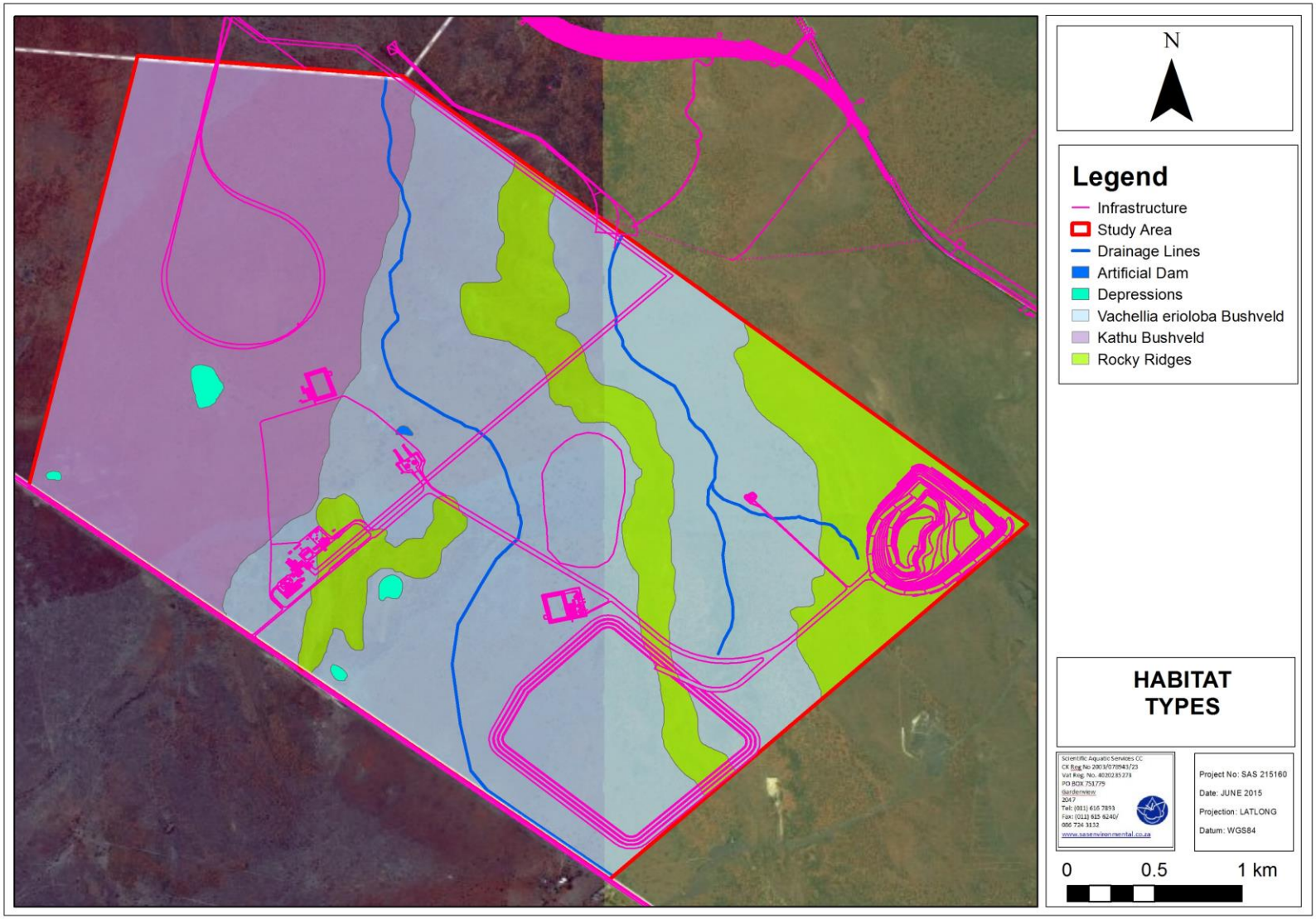

Figure 1: Floral habitat units associated with the study area.

6.1.1 *Vachellia erioloba* Bushveld Habitat Unit

The *Vachellia erioloba* woodland habitat unit is located within the eastern portions of the study area. This habitat unit is characterised by the dominance of the protected tree species *Vachellia erioloba* which is listed as declining in the region. Additional dominant floral species encountered include *Grewia flava*, *Tarconanthus camphoratus*, *Elephantorrhiza elephantina, Senegalia mellifera, Ziziphus mucronata, Prosopis glandulosa, Senna italica, Tribulus terrestris, Schmidtia pappophoroides, Aristida meridionalis, Aristida congesta* subsp*. congesta* and *Eragrostis lehmanniana*. A complete list of dominant floral species encountered within the *Vachellia erioloba* woodland habitat unit is presented in Appendix A.

Four floral SCC, namely *Vachellia erioloba*, *Vachellia haematoxylon, Boophane disticha* and *Babiana framesii,* which are protected under various national and provincial acts, were encountered within this habitat unit, These species will be discussed in greater detail in Section 6.3 below.

The vegetation associated with the habitat unit has been disturbed as a result of historic livestock grazing (cattle and goats), other agricultural activities such crop cultivation and general anthropogenic activities. Overall, the ecological integrity and function of this habitat unit was moderately intact when compared to surrounding, more natural sections of this vegetation type, which are well represented in the region. Thus, any activities encroaching upon this habitat unit are likely to have a moderate to low impact significance, provided that mitigation measures as set out in this report are adhered to.

Figure 2: *Vachellia erioloba* woodland encountered within the study area.

6.1.2 Kathu Bushveld Habitat Unit

The Kathu bushveld habitat unit is located within the western portions of the study area, where vegetation seems to have been cleared historically for agricultural purposes. The habitat unit is characterised by a scattered shrub layer subtended by a sparse grassy layer with very few large trees. Species dominating the habitat unit include *Grewia flava*, *Tarconanthus camphoratus*, *Elephantorrhiza elephantina, Senegalia mellifera, Ziziphus mucronata, Searsia ciliata, Chrysochoma ciliata, Schmidtia pappophoroides, Digitaria eriantha, Tragus berteronianus, Aristida meridionalis, Aristida congesta* subsp*. congesta, Heteropogon contortus* and *Eragrostis lehmanniana*. A complete list of dominant floral species encountered within the Kathu bushveld habitat unit is presented in Appendix A. The protected species, *Babiana framesii*, was encountered within the habitat unit as well as a few individuals of the protected SCC *Vachellia erioloba*.

Vegetation within the habitat unit is perceived to be in a transformed state due to clearing of vegetation for cattle and goat farming, resulting in the severe invasion of *Tarconanthus camphoratus*. Several old homesteads and cultivated fields were also encountered. Overall, the ecological integrity and function of this habitat unit was moderate to low when compared to surrounding, more natural sections of this vegetation type, which are well represented in the region. Thus, any activities encroaching upon this habitat unit are likely to have a low impact significance, provided that mitigation measures as set out in this report are adhered to.

Figure 3: Kathu bushveld habitat unit encountered within the study area.

6.1.3 Rocky Ridge Habitat

Several rocky ridges are present in the eastern sections of the study area. All rocky ridge areas have undergone minor (gravel roads and overgrazing) to major (historic mining and prospecting activities) disturbance, however, the majority of the habitat is considered to be in a natural state. The high ecological functionality and intact habitat integrity of the rocky ridge areas combine to increase the ecological sensitivity and conservation value of this habitat unit. This area should be excluded from the proposed mining activities if at all possible.

It has been determined that the lower slopes of the rocky ridge habitat unit provide habitat for a large number of *Boscia albitrunca*, which is a protected species in terms of the National Forests Act (Act 84 of 1998, as amended in 2011). *Searsia tridactyla*, a species endemic to the region was also identified in the rocky ridge habitat unit. *Aloe grandidentata, A. hereroensis* and *Anacampseros filamentosa,* which are protected under the Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA), were also encountered within this habitat unit. Furthermore, the rocky ridge areas may provide important habitat and migratory connectivity for faunal species that move through the area. The rocky ridge habitat unit is therefore deemed to be of high ecological sensitivity. A complete list of the dominant floral species present in the rocky ridge habitat unit is available in Appendix A.

Figure 4: Representative photographs of the rocky ridge habitat unit

6.1.4 Wetland Habitat Unit

6.1.4.1 Wetland Depressions

Four wetland pans/depressions are located within the study area. These depressions are dominated by the facultative wetland species *Eragrostis bicolor* which was restricted to the temporary zone of the wetland, with a distinctive increase of *Pentzia calcarea* and *Lycium cinereum* within adjacent terrestrial areas. Two of the depressions have been affected by excavation and general topographic alteration, while two were in a more natural state. Furthermore, an artificial dam was also encountered near the abandoned homestead,

however no facultative wetland species were encountered within the dam. Wetland depressions are considered to be of increased sensitivity and ecological importance as they provide the habitat necessary to sustain wetland dependent floral species in a relatively dry region. A complete list of the dominant floral species present in the wetland depression habitat unit is available in Appendix A.

Figure 5: Wetland depression identified within the study area.

6.1.4.2 Ephemeral Drainage Lines

When considering the terrain units within the landscape, two drainage lines are evident within the study area that would convey water during and immediately after rainfall events. However, the drainage lines do not retain water long enough for the formation of hydromorphic soils that would support facultative floral species. As a result, these systems cannot be defined as wetlands (DWA, 2005) and the National Water Act in terms of Section 21 and GN no. 1199 of 2009 as it relates to the National Water Act will not apply. Although no hydromorphic soil was encountered within the features, the abundance of woody vegetation (*Tarchonanthus camphoratus, Diospyros lycioides, Grewia flava* and *Ziziphus mucronata*) along each drainage line did increase. This is considered a result of soil being transported by water forming areas with increased soil depth that are able to support larger tree species. However, the drainage lines are not considered to be sensitive from a floral ecological perspective as the floral species composition was similar to the surrounding terrestrial habitat and thus not unique.

6.2 Vegetation Index Score (VIS)

The information gathered during the assessment of the study area was used to determine the Vegetation Index Score (VIS) - see Appendix B for calculations. The tables below list the scoring system as well as the results.

Table 1: Scoring for the Vegetation Index Score.

Vegetation Index Score	Assessment Class	Description
22 to 25	A	Unmodified, natural
18 to 22	B	Largely natural with few modifications.
14 to 18	C	Moderately modified
10 to 14	D	Largely modified
5 to 10	E	The loss of natural habitat extensive
<5	F	Modified completely

Table 2: Vegetation Index Score.

Habitat unit	Score	Class	Motivation
Vachellia erioloba Bushveld Habitat Unit	14	**C: Moderately modified**	The *Vachellia erioloba* Bushveld Habitat Unit is characterised by the dominance of the protected tree species *Vachellia erioloba* and *Vachellia haematoxylon*. The vegetation associated with the habitat unit has been disturbed as a result of livestock grazing.
Kathu Bushveld Habitat Unit	11.5	**D: Largely modified**	Vegetation within this habitat is perceived to be relatively intact with the exception of areas disturbed as a result of gravel roads and overgrazing. Species that dominate this habitat unit such as *Tarchonanthus camphoratus* and *Senegalia mellifera,* are considered to occur as bush encroachers due to overgrazing and disturbed veld, creating space for these shrubs to increase in abundance.
Rocky Ridge Habitat Unit	18	**B/C – Largely natural/Moderately modified**	Isolated areas of disturbance, presence of floral SCC, low levels of alien floral invasion and representative of the vegetation type. This places the habitat unit between Class B and C VIS.
Wetland Habitat Unit	15	**C – Moderately modified**	Some evidence of earthworks, overgrazing and terrestrial plant species invasion was noted, although overall functioning is still largely intact, placing the wetlands within a Class C VIS.

6.3 SCC and Protected Species Assessment

An assessment considering the presence of any other floral species of concern, as well as suitable habitat to support any such species, was undertaken. A list was acquired from NEMBA Government Gazette Notice 389 of 2013 (Lists of species that are threatened or protected, activities that are Prohibited and exemption from restriction) and the National Forest Act, 1998 (Government Gazette No 716 of 2012 – Notice of list of protected tree species). The following species were listed for the area. During the site assessment, the species listed were specifically searched for.

Table 3: Species of Conservational Concern (SCC) under NEMBA.

FAMILY	SPECIES	COMMON NAME	THREAT STATUS	HABITAT DESCRIPTION
Amaryllidaceae	*Boophane disticha*	Poison bulb	Declining	Dry grassland and rocky areas.
Iridaceae	*Babiana praemorsa*	Stompstertbobbejaantjie, perskussing	Rare	*Babiana praemorsa* is found in the Northern Cape: Calvinia District, from the Hantamsberg and westward to near Nieuwoudtville on the Bokkeveld plateau in dolorite outcrops, often in rock crevices.
Pedaliaceae	*Harpagophytum procumbens*	Devil's Claw	Least Concern	Well drained sandy habitats in open savanna and woodlands.
Oxalidaceae	*Oxalis hirsuta*	N/A	DDD	Terrestrial habitat, mainly in Fynbos habitat
Fabaceae	*Amphithalea minima*	N/A	CR	Fynbos on rocky outcrops
Aizoaceae	*Drosanthemum inornatum*	N/A	LC	
Euphorbiaceae	*Euphorbia rhombifolia*	N/A	LC	Terrestrial
Asteraceae	*Euryops mirus*	Golden Euryops	EN	Transition soil between sandstone and tillite clays, on flat ground. This species also occurs on dolerite soils
Asteraceae	*Euryops rosulatus*	N/A	CR	Transition soil between sandstone and tillite clays, on flat ground.
Asteraceae	*Euryops virgatus*	Harpuisbos	CR	Rocky, sandy flats on Dwyka tillite clay
Iridaceae	*Geissorhiza subrigida*	N/A	CR	Dry montane fynbos in rocky soils derived from sandstone
Aizoaceae	*Lithops dorotheae*	Living stones	EN	Fine-grained, sheared, feldspathic quartzite
Hyacinthaceae	*Drimia sanguinea*	Transvaal slangkop	NT	Open veld and scrubby woodland in a variety of soil types.

Table 4: PRECIS plant list for the QDS 2722DD (SANBI, www.posa.sanbi.org).

Family	Species	Threat status	Growth forms	Habitat
FABACEAE	*Acacia erioloba E.Mey.*	Declining	Shrub, tree	

Table 5: Protected tree species listed under the National Forest Act.

FAMILY	SPECIES	COMMON NAME	THREAT STATUS	HABITAT DESCRIPTION
Fabaceae	*Vachellia erioloba*	Camel thorn	Protected (declining)	The beautiful, slow-growing camel thorn grows well in poor soils and in harsh environmental

				conditions.
Fabaceae	*Vachellia haematoxylon*	Grey camel thorn	Protected (least threatened)	Found in arid regions in deep red Kalahari sands or along dry river beds.
Capparaceae	*Boscia albitrunca*	Shepherd's Tree	Protected	This species is found in the drier parts of southern Africa, in areas of low rainfall.

The POC of each of the species listed above was calculated (table below) with reference to habitat suitability found during the assessment.

Table 6: The POC for the floral species of concern.

SPECIES	HABITAT DESCRIPTION	POC (%)	MOTIVATION
Boophane disticha	Dry grassland and rocky areas.	100%	Recorded during assessment
Babiana praemorsa	*Babiana praemorsa* is found in the Northern Cape: Calvinia District, from the Hantamsberg and westward to near Nieuwoudtville on the Bokkeveld plateau in dolorite outcrops, often in rock crevices.	0%	Although *Babiana praemorsa* is found in the Northern Cape, it is mainly found within the south western parts of the Northern Cape. It occurs in plateau of dolomite outcrops, which were not found within the study area.
Harpagophytum procumbens	Well drained sandy habitats in open savanna and woodlands.	85%	*Harpagophytum procumbens* is known to occur within this area. Suitable habitat is available for this species, but none were recorded.
Oxalis hirsuta	Terrestrial habitat, mainly in Fynbos habitat	75%	Although this species is known to occur mostly in Fynbos habitat, this species has been recorded in the Postmasburg area. Thus, the habitat and historic data is available and tends to show that this species is likely to occur within the surroundings of the study area, but due to the level of disturbance and grazing and the time of the assessment (late autumn), this species was not noted during the site assessment.
Amphithalea minima	Fynbos on rocky outcrops	0%	According to literature, this species occurs within habitat dominated by Fynbos on rocky outcrops. No suitable habitat was located within the study area for this species.
Drosanthemum inornatum	Terrestrial	20%	Although sufficient terrestrial habitat was available within the study area, this species was not noted during the site assessment.
Euphorbia rhombifolia	Terrestrial	25%	Suitable habitat present, although not clear if study area falls within distribution range of this species. It must be noted that the status of *Euphorbia rhombifolia* is rated as least concern.
Euryops mirus	Transitional soil between sandstone and tillite clays, on flat ground. This species also occurs on dolerite soils	0%	This species is known to occur on the border of the Northern Cape and the Western Cape. Outside of distribution

SPECIES	HABITAT DESCRIPTION	POC (%)	MOTIVATION
			range.
Euryops rosulatus	Transition soil between sandstone and tillite clays, on flat ground.	0%	This species is known to occur on the border of the Northern Cape and the Western Cape. Outside of distribution range.
Euryops virgatus	Rocky, sandy flats on Dwyka tillite clay	0%	This species is known to occur on the border of the Northern Cape and the Western Cape. Outside of distribution range.
Geissorhiza subrigida	Dry montane fynbos in rocky soils derived from sandstone	0%	Outside of distribution range
Lithops dorotheae	Fine-grained, sheared, feldspathic quartzite	15%	*Lithops* species is known to occur within rocky and sandy areas. No quartzite substrate found. *Lithops* species were not encountered during the site assessment.
Drimia sanguinea	Open veld and scrubby woodland in a variety of soil types.	50%	*Drimia* species can grow in a variety of soil types. Their distribution indicated that they have been recorded in the north eastern parts of the Northern Cape. Suitable habitat present in the Kathu Bushveld and *Vachellia erioloba* habitat units
Vachellia erioloba	The beautiful, slow-growing camel thorn grows well in poor soils and in harsh environmental conditions.	100%	Recorded on site
Vachellia haematoxylon	Found in arid regions in deep red Kalahari sands or along dry river beds.	100%	Recorded on site
Boscia albitrunca	This species is found in the drier parts of southern Africa, in areas of low rainfall.	100%	Recorded on site

The three protected tree species *Boscia albitrunca, Vachellia erioloba* and *V. haematoxylon* which are also listed as protected species (Government Gazette No 716, 2012), were encountered within the *Vachellia erioloba* and Kathu Bushveld and also the Rocky Ridge habitat units. Furthermore, *Aloe grandidentata, A. hereroensis, Babiana framesii* and *Anacampseros filamentosa,* which are protected under the Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA), were also encountered in the Kathu Bushveld and Rocky Ridge habitat units. It is recommended that a detailed walkdown of the final infrastructure footprint areas is performed by a suitable qualified specialist and all floral SCC marked.

Should protected species to be cut, disturbed, damaged or destroyed, applications for such activities must be made to the Northern Cape Department of Agriculture, Forestry and Fisheries (DAFF).

7 EXOTIC AND INVADER SPECIES

Alien invaders are plants that are of exotic origin and are invading previously pristine areas of ecological niches (Bromilow, 2001). Not all weeds are exotic 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. Therefore, 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 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.

Alien vegetation was encountered scattered throughout the study area. However, the density of alien species was found to increase in areas in the vicinity of the artificial dam. Alien and weed species encountered within the study area are to be removed in order to comply with existing legislation (NEMBA Alien and Invasive Species Regulations (2014)).

It is important that abundances of these species be monitored in order to identify the significance of encroachment and if necessary the implementation of appropriate management measures to avoid loss of natural species diversity.

Table 7: Dominant exotic vegetation species identified during the general site assessment.

Scientific name	Common name	Category
TREES		
Prosopis glandulosa	Honey Mesquite	3
Schinus molle	Brazilian pepper tree	3
SHRUB AND FORBS		
Opuntia sp.	Prickly pear	1b
Chenopodium album	Bloubossie	N/A

Scientific name	Common name	Category
Salsola kali	Russian tumbleweed	1b
Solanum sp.	Bitter apple	1b
Tagetes minuta	Tall khaki weed	N/A
Hibiscus canabinus	Wild stockrose	N/A
Datura ferox	Large thorn apple	1b
Alternanthera pungens	Khakiweed	N/A
Tribulus terrestris	Devils thorn	N/A
Schkuhria pinnata	Kleinkakiebos	N/A

Categories according to NEMBA (Alien and Invasive Species Regulations, 2014)
Category 1a - Invasive species that require compulsory control.
Category 1b - Invasive species that require control by means of an invasive species management programme.
Category 2 - Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
Category 3 - Ornamentally used plants that may no longer be planted.

8 MEDICINAL FLORAL SPECIES

The medicinal species *Senna italica*, *Vachellia erioloba*, *Elephantoriza elephantina* and *Ziziphus mucronata* were encountered within all habitat units. However, *Boophone disticha* was only encountered within the *Vachellia erioloba* woodland habitat unit. Three medicinal species, *Vachellia erioloba, Boophone disticha* and *Boscia albitrunca* are SCC and are listed as protected species within the region.

Table 8: Traditional medicinal plants identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2012).

Scientific name	Common name	Plant part used	Uses
Boophone disticha	Bushman poison bulb	Bulb scales	The outer scales of the bulb are used as an outer dressing after circumcision and are also applied to boils or septic wounds to alleviate pain and to draw out the pus. Weak decoction of the bulb scales are administered by mouth or as an enema for various complaints such as headaches, abdominal pain, weakness and eye conditions. In the Karoo near Touws River there is an old belief that sleeping on a mattress filled with bulb scales will relieve hysteria and insomnia. Very weak decoction is used as an effective sedative. Higher doses induce visual hallucinations which are sometime used for divination and even higher doses can be fatal.
Boscia albitrunca	Shepherd's tree	Bark, roots, leaves	The root is pounded to make porridge. It is commonly used as a substitute for coffee or chicory. The root is also used to make a beer and to treat haemorrhoids. The leaves are nutritious and are often browsed by cattle. An infusion of the leaves is used to treat eye infections in cattle.
Datura stramonium	Common thorn apple	Leaves and fresh green fruit	Used for the relief of asthma and to reduce pain. Weak infusions are used as hypnotics by the elderly and as aphrodisiacs by adults. The fresh warm leaves may be used as a poultice to relive the pain of rheumatism, gout, boils, abscesses

Scientific name	Common name	Plant part used	Uses
			and wounds. The fresh green fruit is sometimes applied locally for toothache, a sore throat and tonsillitis. The leaf is rolled up and smoked to relieve asthma and bronchitis.
Elephantoriza elephantina	Elandsbean	Underground rhizomes.	This is a traditional remedy for a wide range of ailments, including diarrhoea and dysentery, stomach disorders, haemorrhoids and perforated peptic ulcers, and as emetics. It is popular for the treatment of skin diseases and acne.
Senna italica	Wild senna	Roots	Used to treat influenza, indigestion, liver and gall bladder complaints, gastrointestinal disorders, dysmenorrhoea and uterine pain.
Tarconanthus camphoratus	Wild camphor bush	Leaves and twigs	Infusions and tinctures of the leaves and twigs are used for stomach trouble, abdominal pain, headache, toothache, asthma, bronchitis and inflammation. A hot poultice on the chest is said to give relief from headache, asthma, bronchitis, and inflammation. Smoke or fumes from the fresh and dried plant are inhaled for asthma, headache and rheumatism.
Vachellia erioloba	Camel thorn	Pods, roots	Ground pods are used to treat ear infections. Roots are used to treat headache, Tuberculosis and also tooth ache.
Ziziphus mucronata	Buffalo-thorn	Roots, bark and leaves	Warm bark infusions are used as expectorants in cough and chest problems, while root infusions are popular as a remedy for diarrhoea and dysentery. Decoctions of roots and leaves are applied externally to boils, sores and glandular swellings, not only to promote healing bur also for pain relief.

9 SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased ecological sensitivity in relation to the proposed project. The areas are depicted according to their sensitivity in terms of floral habitat integrity and their suitability to provide habitat to faunal and floral communities.

Wetland Depressions are considered to be of increased sensitivity and ecological importance as they provide the habitat necessary to sustain wetland dependent floral species in a relatively dry region. As such, impacts on sensitive systems associated with the study area are likely to be significant on a local and regional scale and must be avoided.

The Rocky Ridge habitat unit has general high ecological functionality and overall high levels of habitat integrity and is in a relatively undisturbed condition. The species composition of this habitat unit is also representative of the vegetation type in which it occurs. Furthermore, this habitat unit contains several floral SCC. Thus, this habitat unit is considered to be highly sensitive and

The ecological integrity and function of the *Vachellia erioloba* habitat unit was moderately intact when compared to surrounding, more natural sections of this vegetation type, which are well represented in the region. Thus, any activities encroaching upon this habitat unit are likely to have a moderate impact significance, provided that mitigation measures as set out in this report are adhered to.

Vegetation within the Kathu Bushveld habitat unit is perceived to be in a transformed state due to clearing of vegetation for cattle and goat farming, resulting in the severe invasion of *Tarconanthus camphoratus*. Overall, the ecological integrity and function of this habitat unit was moderate to low when compared to surrounding, more natural sections of this vegetation type, which are well represented in the region. Thus, any activities encroaching upon this habitat unit are likely to have a moderately low impact significance, provided that mitigation measures as set out in this report are adhered to.

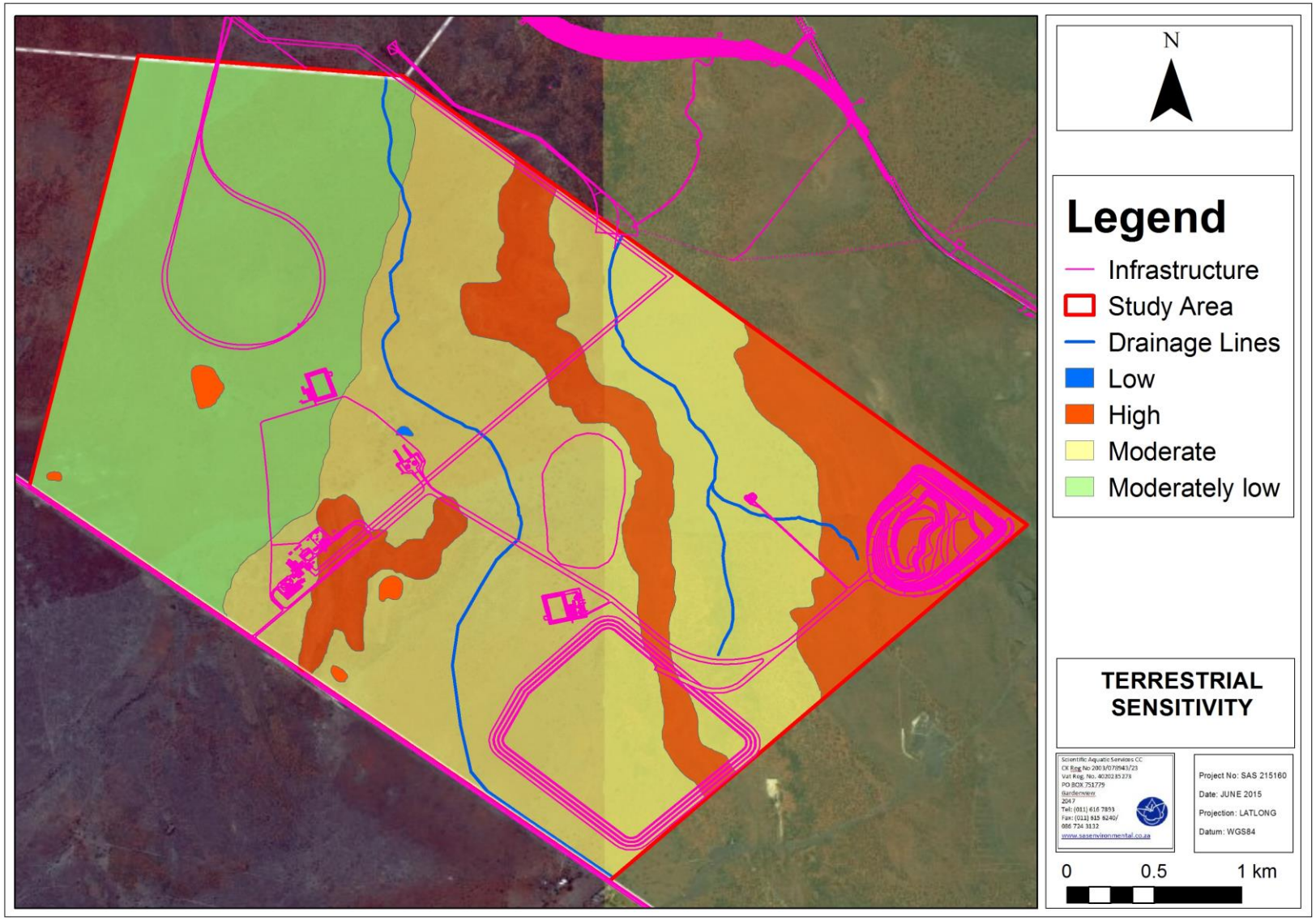

Figure 6: Terrestrial sensitivity map for the study area in relation to proposed mining infrastructure.

10 REFERENCES

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

Department of Water Affairs (DWA) 2005: Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.

Kleynhans, CJ. 1999. A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African River. Institute of Water Quality Studies, Department of Water Affairs & Forestry, Pretoria.

Kleynhans C.J., Thirion C. and Moolman J. 2005. A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2008. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane, DM; Kotze, DC; Ellery, WN; Walters, D; Koopman, V; Goodman, P; & Goge, C. 2008. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

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

National Environmental Management Act (NEMA) 107 of 1998.

National Environmental Management: Biodiversity Act (NEMBA) 10 of 2004.

National Water Act (NWA) 36 of 1998.

GN 1199 as published in the Government Gazette 32805 of 2009 as it relates to the NWA.

The Northern Cape Nature Conservation Act (NCNCA) 9 of 2009.

Ollis, D.J., Snaddon, C.D., Job, N.M., & Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems*. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Provincial Development and Resources Management Plan / Provincial Spatial Development Framework (PSDF) 2012. Department of Co-operative Governance, Human Settlements and Traditional Affairs.

Rutherford, M.C. 1997. Categorization of biomes. In: Cowling RM, Richardson DM, Pierce SM (eds.) Vegetation of Southern Africa. Cambridge University Press, Cambridge, pp. 91-98 ISBN 0-521-57142-1.

Rutherford, M.C. and Westfall, R. H. 1994. Biomes of Southern Africa: An objective categorization. National Botanical Institute, Pretoria, RSA.

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) *[online].* URL: http://bgis.sanbi.org as retrieved on 03/03/2015.

Van Wyk AE. & Smith, GF. 2001. Regions of Floristic Endemism in Southern Africa. UMDAUS Press, Hatfield, RSA

APPENDIX A
Floral Species lists

Table 9: Floral species identified within the various habitat units in the study area.

	Vachellia erioloba Busveld	Kathu Bushveld	Rocky Ridge	Wetland Pan	Ephemeral Drainage Features
Acacia erioloba	X	X			
Acacia hebeclada		X	X		
Acacia haematoxylon	X				
Acacia karroo	X	X			
Acacia mellifera	X	X	X		X
Acacia tortillis	X	X			
Aloe grandidentata			X		
Aloe hereroensis			X		
Aptosimum linear			X		
Aptosimum spinescens	X	X			
Anacampseros filamentosa			X	X	
Asparagus retrofractus	X	X	X	X	X
Barleria rigida			X		
Boscia albitrunca	X	X	X		
Chrysocoma obtusata	X	X	X	X	X
Diospyros lycioides	X	X		X	X
Ehretia rigida			X		
Eriocephalus ericoides	X	X			
Euclea undulata			X		
Grewia flava	X	X	X		
Gymnosporia buxifolia			X		X
Helichrysum cerastioides				X	
Helichrysum zeyheri			X		
Hertia pallens	X	X			X
Kalanchoe rotundifolia			X		
Lopholaena cneorifolia			X		
Lycium boscifolium	X	X	X	X	X
Lycium cinereum	X	X	X	X	X
Lycium hirsutum	X	X	X		X
Melolobium microphyllum	X	X			
Monechma incanum	X				
Pentzia calcarea	X	X	X	X	X
Prosopis glandulosa	X				X
Putterlickia saxatilis			X		
Rhigozum trichotomum			X		
Salsola aphylla	X				
Searsia ciliata	X	X			
Searsia lancea	X	X			
Searsia pyroides	X	X			
Searsia tridactyla			X		
Seriphium plumosa	X	X			
Tapinanthus oleifolius			X		
Tarconanthus camphoratus	X	X	X		X

	Vachellia erioloba Busveld	Kathu Bushveld	Rocky Ridge	Wetland Pan	Ephemeral Drainage Features
Ziziphus mucronata	X	X	X	X	X
Zygophyllum pubescens	X	X	X		
Bauhinia sp.	X	X			X
Dicoma sp.	X	X	X	X	X
Geigeria filifolia	X	X			X
Geigeria ornativa	X				
Gisekia africana	X	X			
Gomphocarpus fruticosus			X		
Hermannia comosa	X	X	X		
Hermannia tomentosa	X				
Hermbstaedtia fleckii	X	X	X		
Ipomoea bolusiana	X	X	X	X	X
Jamesbrittenia atropurpurea	X	X			
Justicea purpurea	X		X		
Kohautia cynanchica	X	X	X	X	X
Kyphocarpa angustifolia	X	X	X		
Limeum aethipoicum	X	X	X		
Selago densiflora				X	
Senna italica	X	X	X	X	X
Sesamum triphyllum	X	X			
Sutera sp.			X		
Tribulus terestris	X	X	X	X	X
Tribulus zeyheri	X	X	X		X
Waltheria indica	X		X		X
Ammacharis coranica	X	X			X
Boophane disticha	X		X		
Eriospermum corymbosum	X				X
Ledebouria sp.	X	X	X		X
Nerine laticoma	X				X
Ornithogalum sp.	X	X	X		
Aristida adscensionis	X		X		
Aristida congesta var barbicollis	X			X	X
Aristida congesta var congesta	X		X	X	X
Aristida diffusa	X	X	X		
Aristida meridionalis			X		
Brachiaria serrata			X		
Cenchrus ciliaris			X		
Chloris virgata				X	
Cymbopogon pospischilii	X	X	X		
Cyndon dactylon				X	
Enneapogon cenchroides	X				
Enneapogon desvauxii	X		X		

	Vachellia erioloba Busveld	Kathu Bushveld	Rocky Ridge	Wetland Pan	Ephemeral Drainage Features
Enneapogon scaber	X	X	X		X
Enneapogon scoparius			X		
Eragrostis bicolor				X	
Eragrostis chloromelas			X		
Eragrostis echinochoidea	X	X		X	X
Eragrostis lehmanniana	X	X	X	X	X
Eragrostis nindens	X	X	X		X
Eragrostis truncata	X	X		X	X
Fingeruthia africana		X	X		
Heterepogon contortus	X		X		
Hyparrhenia hirta			X		
Melinis repens	X	X	X		
Oropetium capense	X				
Panicum sp.				X	
Schmitia papporophoroides	X	X	X		
Setaria verticilata	X		X		X
Stipagrostis obtusa	X	X			
Stipagrostis uniplumis	X	X	X		X
Themeda triandra	X				X
Tragus racemosus				X	
Bulbostylis sp.					X
Ficinia sp.					X
Juncus sp.				X	X

APPENDIX B
VIS

Vegetation Index Score –*Vachellia erioloba* Bushveld Habitat Unit

EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					x	
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score			x			
EVC 2 score	5	4	3	2	1	0

SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous	x	x						x
Clumped								
Scattered			x	x		x		
Sparse					x		x	

*Present State (P/S) = currently applicable for each habitat unit
**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5

RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS						x
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 14

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Vegetation Index Score –Kathu Bushveld Habitat Unit

EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score				x		
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score				x		
EVC 2 score	5	4	3	2	1	0

SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous			x					
Clumped								
Scattered				x		x	x	x
Sparse	x	x			x			

*Present State (P/S) = currently applicable for each habitat unit
**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5

RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS				x		
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 11.5

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Vegetation Index Score – Rocky Ridge

EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						X
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score		X				
EVC 2 score	5	4	3	2	1	0

SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous							X	X
Clumped			X	X	X	X		
Scattered	X	X						
Sparse					x			

*Present State (P/S) = currently applicable for each habitat unit
**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		X				
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			X			
PVC score	0	1	2	3	4	5

RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS					X	
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 18

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Vegetation Index Score –Wetland Habitat Unit

EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					X	
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score			x			
EVC 2 score	5	4	3	2	1	0

SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								
Clumped								
Scattered	x	x	x	x		x		
Sparse					x		x	x

*Present State (P/S) = currently applicable for each habitat unit
**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5

RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS					X	
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 15

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

Prepared for

SLR CONSULTING (SYNERGISTICS)

January 2016

SECTION C – FAUNAL ASSESSMENT

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ACRONYMS

CR	Critically Endangered
DD	Data Deficient
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EN	Endangered
EW	Extinct in the Wild
GPS	Global Positioning System
IUCN	International Union for the Conservation of Nature
LC	Least Threatened
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NCNCA	Northern Cape Nature Conservation Act
NYBA	Not Yet Been Assessed
POC	Probability of Occurrence
RD	Red Data
SAS	Scientific Aquatic Services
SCC	Species of Conservational Concern
SCC	The term SCC in the context of this report refers to all RD (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.
SCCSIS	Species of Conservational Concern Sensitivity Index Score
TSS	Total Species Score
TT	Threatened Taxa
VU	Vulnerable

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal and wetland assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the COZA Iron Ore Project on the farm Jenkins 562 near the town Postmasburg within the Northern Cape Province.

The study area is situated approximately 20 km south of the town of Kathu, 11 km south of the Sishen mine and the south western boundary of the study area is situated adjacent to the R325 roadway (refer to Section A: Figure 1 and 2).

2 GENERAL SITE SURVEY

A site visit was undertaken during June 2015 to determine the ecological status of the study area. A reconnaissance “walkabout” was undertaken to determine the habitat types found throughout the study area. Sites were investigated to identify the occurrence of faunal species and habitat diversities, where special emphasis was placed on potential areas that may support Species of Conservational Concern (SCC).

3 FAUNAL METHOD OF ASSESSMENT

3.1 Field Surveys

Faunal habitat units were identified and all faunal species were recorded during the assessment. It is important to note that due to the nature and habits of fauna it is unlikely that all species were recorded during the site assessment. In addition, the levels of anthropogenic activity on the study area and the surrounding area will have a direct impact on faunal species and the rate of observation of these species. The faunal categories that will be covered are: mammals, avifaunal, reptiles; amphibians; invertebrates and araneae.

3.2 Mammals

Small mammals were actively searched for where burrows and nesting areas were evident or likely to occur. Medium and larger faunal species were recorded during the field assessment with the use of visual identification as well as where, spoor, call, or dung samples could be positively identified. Specific attention was paid to mammal SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA) in conjunction with the IUCN, 2015.

3.3 Avifauna

The Southern African Bird Atlas Project 2 database (http://sabap2.adu.org.za/) lists for the relevant quarter degree squares was compared with the recent field survey of avifaunal species identified in the study area. Field surveys were undertaken utilising a pair of Bushnell 10x50 binoculars and bird call identification techniques were utilised during the assessment in order to accurately identify avifaunal species. Specific attention was paid to avifaunal SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA) in conjunction with the IUCN, 2015.

3.4 Reptiles

Reptiles were physically identified during the field survey. Mountainous and rocky outcrop areas and fallen dead trees were inspected whilst all reptiles encountered were identified. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur in the study area. Specific attention was paid to reptile SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) in conjunction with the IUCN, 2015.

3.5 Amphibians

Identifying amphibian species is done by the use of direct visual identification along with call identification technique. Amphibian species flourish in and around wetland and riparian areas, however within the study area these habitats were limited and very dry. It is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which amphibian species are likely to occur within the study area as well as the surrounding area. Specific attention was paid to amphibian SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) in conjunction with the IUCN, 2015.

3.6 Invertebrates

A list of visually identified and observed general invertebrate species was compiled during the field survey. However, due to their cryptic nature and habits, varied stages of life cycles, seasonal and temporal fluctuations within the environment, it is unlikely that all invertebrate species will have been recorded during the site assessment period. Nevertheless, the data gathered during the general invertebrate assessment along with the habitat analysis provided an accurate indication of which invertebrate species are likely to occur on the study area at the time of survey. Specific attention was paid to

invertebrate SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) in conjunction with the IUCN, 2015.

3.7 Arachnids

Suitable undisturbed habitats, such as rocky bushveld areas where spiders and scorpions are likely to reside were searched. Rocks were overturned and inspected for signs of these species. Specific attention was paid to searching for Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as potential SCC scorpions within the study area. Specific attention was paid to arachnid SCC listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) in conjunction with the IUCN, 2015.

3.8 Species of Conservational Concern Sensitivity Index Score (SCCSIS)

The term SCC in the context of this report refers to all RD (Red Data) and IUCN (International Union for the Conservation of Nature) listed faunal species, as well as protected species of relevance to the project. The lists below are all specified in legislation except for IUCN, which is the oldest and largest global environmental organisation and helps the world find pragmatic solutions to our most pressing environment and development challenges. It should be noted that some species or families considered threatened on a national level August not be considered threatened on a provincial level due to various factors such as stable local population trends; for these species provincial status took precedence.

The following legislations and international listings were used during the SCC consideration:

I. **Provincial conservation:** protected species listed in the Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA),

II. **National conservation:** National Environmental Management Act (Act 107 of 1998) (NEMA) and National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA), and

III. **Global conservation:** protected species under International Union for the Conservation of Nature (IUCN). Organisms that fall into the *Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) Least Concern (LC), and Data deficient (DD)* categories of ecological status.

Given the restrictions of field assessments to identify all the faunal species that possibly occur on a particular property, the SCCSIS has been developed to provide an indication of the potential faunal SCC that could reside in the area, while simultaneously providing a quantitative measure of the study area's value in terms of conserving faunal diversity. The SCCSIS is based on the principles that when the knowledge of a species' historical distribution is combined with a field assessment that identifies the degree to which the property supports a species' habitat and food requirements, interpretations can be made about the probability of that particular species residing within the study area. Repeating this procedure for all the potential faunal SCC of the area and collating this information then provides a sensitivity measure of the property that has been investigated. The detailed methodology to determine the SCCSIS of the property is presented below:

The probability of Occurrence (POC): Known distribution range (D), habitat suitability of the site (H) and availability of food sources (F) on the site were determined for each of the species. Each of these variables is expressed a percentage (where 100% is a perfect score). The average of these scores provided a POC score for each species. The POC value was categorised as follows:

- **0-20% = Low;**
- **21-40% = Low to Medium;**
- **41-60% = Medium;**
- **61-80% = Medium to High and**
- **81-100% = High**

POC = (D+H+F)/3

Total Species Score (TSS): Species with POC of more than 60% (High-medium) were considered when applying the SCCSIS. A weighting factor was assigned to the different IUCN categories, providing species with a higher conservation status, a higher score. This weighting factor was then multiplied with the POC to calculate the TSS for each species. The weighting as assigned to the various categories is as follows:

- **Data Deficient = 0.2;**
- **Rare = 0.5;**
- **Near Threatened = 0.7;**

- **Vulnerable = 1.2;**
- **Endangered = 1.7 and**
- **Critically Endangered = 2.0.**

TSS = (IUCN weighting*POC) where POC > 60%

Average Total Species (Ave TSS) and Threatened Taxa Score (Ave TT): The average of all TSS potentially occurring on the site is calculated. The average of all the Threatened taxa (TT) (Near threatened, Vulnerable, Endangered and Critically Endangered) TSS scores is also calculated. The average of these two scores (Ave TSS and Ave TT) was then calculated in order to add more weight to threatened taxa with POC higher than 60%.

Ave = Ave TSS [TSS/No of Spp] + Ave TT [TT TSS/No of Spp]/2

SCCSIS: The average score obtained above and the sum of the percentage of species with a POC of 60% or higher of the total number of SCC listed for the area was then calculated. The average of these two scores, expressed as a percentage, gives the SCCSIS for the area investigated.

SCCSIS = Ave + [Spp with POC>60%/Total no Of Spp*100]/2

SCCSIS interpretation:

Table 1: SCCSIS value interpretation with regards to faunal SCC importance on the study area.

SCCSIS Score	SCCSIS mammal importance
0-20%	Low
21-40%	Low-Medium
41-60%	Medium
60-80%	High-Medium
81-100%	High

4 RESULTS OF FAUNAL INVESTIGATION

The study area historically was utilised for the grazing of goats and cattle, however this has ceased in the last few years, and as such the veld has recovered to a degree, evident through the increased observation rates of faunal species. Overall the study area has suitable habitat for faunal species, with a mixture of habitat types being found within the study area. The rocky ridges and rocky outcrops are more suited to reptile species, as well as arachnid species, however small mammals were also found to inhabit these rocky areas. The bushveld and shrubland areas had the highest diversity of avifaunal species, with these areas also being utilised by small to medium sized mammals.

4.1 Mammals

The assessment of the study area resulted in the observation of numerous signs of mammal species, most notably in the form of scat and spoor, however, direct observations of *Tragelaphus strepsiceros* (Kudu), *Suricata suricatta* (Meerkat), *Saccostomus campestris* (Pouched Mouse) and *Aethomys namaquensis* (Namaqua Rock Mouse) were made. All the species observed within the study areas are listed below in Table 2. No mammal SCC were observed within the study areas, nor are any expected to occur within the study area. The habitat conditions within the study area are still relatively intact and as such are able to support a number of large and small mammal species, notably so as a result of the ceasing of cattle grazing practices within the study area. Due to the overall aridity of the study area, as well as the lack of surface water, only mammal species which can move long distances to find water, or species that are water independent are likely to be found within the study area.

Table 2: Mammal species observed within the study area and the surrounding region.

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Cynictis penicillata	Yellow Mongoose	LC
Hystrix africaeaustralis	Porcupine	LC
Xerus inauris	South African Ground Squirrel	LC
Raphicerus campestris	Steenbok	LC
Lepus saxatilis	Scrub Hare	LC
Tragelaphus strepsiceros	Kudu	LC
Procavia capensis	Rock Dassie	LC
Orycteropus afer	Aardvark	LC
Saccostomus campestris	Pouched Mouse	LC

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Suricata suricatta	Meerkat	LC
Hystrix africaeaustralis	Porcupine	LC
Cynictis penicillata	Yellow Mongoose	LC
Rhabdomys pumilio	Striped Mouse	LC
Cryptomys hottentotus	Common Mole-rat	LC
Aethomys namaquensis	Namaqua Rock Mouse	LC

LC = Least Concern

4.2 Avifauna

Avifaunal surveys were conducted covering the entire study area, and all avifaunal species seen or heard during the time of the field assessment were recorded. Table 3 below lists all the avifaunal species identified during the assessment as well as their current IUCN status.

From Table 3 below it can be seen that all avifaunal species identified within the study area are common species known to reside within or utilise the arid bushveld, thornveld and open grassland habitat in the region and may be permanent or occasionally present within the area.

Of importance is that a pair of *Ardeotis kori* (Kori Bustard), listed as Near Threatened (NT) by the IUCN, which was observed on two occasions within the study area, notably in the Kathu bushveld habitat stretching across the western and northern half of the study area. The reason for this species decline is as of yet not fully understood, however power line collisions and habitat degradation are thought to be main contributors.

Table 3: Bird species recorded during the bird survey.

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Ploceus velatus	Southern Masked Weaver	LC
Anthoscopus minutus	Cape Penduline Tit	LC
Cercotrichas coryphaeus	Karoo Robin	LC
Cercotrichas paena	Kalahari Robin	LC
Cossypha caffra	Cape Robin	LC
Colius colius	White-backed Mousebird	LC
Numida meleagris	Helmeted Guineafowl	LC
Prinia flavicans	Black-chested Prinia	LC
Pterocles namaqua	Namaqua Sandgrouse	LC
Amadina erythrocephala	Red-headed Finch	LC
Cercomela schlegelii	Karoo Chat	LC
Plocepasser mahali	White-browed Sparrow-weaver	LC

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Pycnonotus nigricans	Red-eyed Bulbul	LC
Serinus flaviventris	Yellow Canary	LC
Passer melanurus	Cape Sparrow	LC
Streptopelia capicola	Cape Turtle-Dove	LC
Sporopipes squamifrons	Scaly-feathered Finch	LC
Spreo bicolor	Pied Starling	LC
Saxicola torquata	African Stonechat	LC
Myrmecocichla formicivora	Ant-eating Chat	LC
Anthus cinnamomeus	African Pipit	NYBA
Cisticola fulvicapillus	Neddicky	LC
Cisticola aridulus	Desert Cisticola	LC
Oenanthe monticola	Mountain Chat	LC
Elanus caeruleus	Black-shouldered Kite	LC
Vanellus coronatus	Crowned Lapwing	LC
Tockus nasutus	African Grey Hornbill	LC
Ardeotis kori	**Kori Bustard**	**NT**
Lophotis ruficrista	Red-crested Korhaan	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Hirundo fuligula	Rock Martin	LC
Parus cinerascens	Ashy Tit	LC
Calandrella cinerea	Red-capped Lark	LC
Mirafra africana	Rufous-naped Lark	LC
Mirafra africanoides	Fawn-coloured Lark	LC
Batis pririt	Pririt Batis	LC
Sigelus silens	Fiscal Flycatcher	LC
Parisoma subcaeruleum	Chestnut-vented Titbabbler	NYBA
Emberiza flaviventris	Golden-breasted Bunting	LC

According to Birdlife South Africa, the study area is not located within or near any Important Bird Areas (IBA), which have been identified within South Africa (www.birdlife.org.za).

4.3 Reptiles

Three reptile species were observed during the assessment of the study area. The rocky outcrops as well as the dense shrub areas provide suitable for reptile species, and it is possible that not all the reptile species within the study area will have been recorded as a result of the seasonality of the site assessment. Of the species recorded in the study area,

none are classified by the IUCN as of yet, however from present data and knowledge, it appears that they are widespread throughout Southern Africa.

Table 4: Reptile species recorded during the site survey.

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Naja nivea	Cape Cobra	NYBA
Trachylepis variegata	Variegated Skink	NYBA
Naja nivea	Puff Adder	NYBA

NYBA = Not Yet Been Assessed

4.4 Amphibians

No amphibians were observed within the study area. This can primarily be attributed to the arid ecology of the study area and the lack of surface water during the time of assessment. Although evidence suggests the occurrence of ephemeral pans within the study area, these were notably dry and from observations appear to have been dry for an extended period of time. As such, it is unlikely that these pans will contain suitable amounts of water for a sufficient period to ensure amphibian habitation and breeding.

4.5 Invertebrates

Invertebrate diversity throughout the study area was low, and can be attributed to the cold weather experienced during the site assessment combined with the seasonal nature of invertebrates. All the species observed are considered common and fairly widespread in Southern Africa, whilst many of them have yet to be listed by the IUCN.

Table 5: Invertebrate species identified through sighting or other evidence within the sites indicating IUCN status as well as whether the species is listed as protected.

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME	2015 IUCN STATUS
Orthoptera	Acrididae	*Conistica saucia*	Rock Grasshopper	NYBA
		Sphingonotus scabriculus	Blue-wing	NYBA
		Acanthacris ruficornis	Garden Locust	NYBA
		Gastrimargus sp.	N/A	NYBA
		Rhachitopis sp	N/A	NYBA
Coleoptera	Carabidae	*Anthia thoracica*	Tyrant Ground Beetle	NYBA
	Carabidae	*Graphipterus limbatus*	Velvet Ground Beetle	NYBA
	Tenebrionidae	*Trigonopus* sp	N/A	NYBA
Hymenoptera	Eumenidae	*Anterhynchium fallax*	N/A	NYBA

	Formicidae	*Camponotus fulvopilosus*	Bal-byter	NYBA
		Crematogaster peringueyi	Cocktail Ant	NYBA
Lepidoptera	Pieridae	*Belenois aurota*	Brown-veined White	NYBA
		Junonia orithya	Eyed Pansy	NYBA
	Nymphalidae	*Danaus chrysippus*	African Monarch	NYBA
		Colotis euippe	Smokey Orange Tip	NYBA
	Papilionidae	*Eurema brigitta*	Broad-bordered Grass Yelow	NYBA
	Hesperiidae	*Spalia* sp	Sandman	NYBA
	Crambidae	*Loxostege frustalis*	Karoo Moth	NYBA
Isoptera	Hodotermitidae	*Hodotermes mossambicus*	Northern Harvester Termite	NYBA
Odonata	Libellulidae	*Pantala flavescens*	Wandering Glider	LC

*LC = Least Concern, NYBA = Not Yet Been Assessed

Many invertebrate species that are found within arid regions of South Africa generally tend to be dictated by season and food resources. As such the arid nature of the study area and the low levels of food resources as a result of grazing pressure will preclude the occurrence of invertebrate species in large numbers from the study areas. Furthermore, no invertebrate SCC are expected to occur within the study area.

Figure 1: *Junonia orithya* (Eyed Pansy) observed within the study area.

4.6 Arachnids

The general aridity of the environment combined with the lower prey (invertebrate) abundance and diversity, is likely to decrease the likelihood of arachnid detection within

the study area, as well as limit the overall abundance of species within the study area. No signs of baboon or trap door spiders were observed within the study area, and according to literature and known distribution ranges, no arachnid SCC are expected to occur within the study area.

The only evidence of arachnid habitation was that of a scorpion carapace and the locating of a very young scorpion within the rocky ridge areas. The rocky ridges will likely provide suitable habitat for arachnid species during suitable seasonal times.

Table 6: Scorpion observed within the study area

SPECIES SCIENTIFIC NAME	COMMON NAME	IUCN 2015
Opistophthalmus carinatus	Burrowing Scorpion	NYBA

4.7 Species of Conservational Concern Assessment

In terms of SCC, the only species observed within the study area that needs to be noted here is that of *Ardeotis kori* (Kori Bustard). This avifaunal SCC was the only SCC observed, with no other SCC expected to occur within the study area. *Ardeotis kori* (Kori Bustard) population numbers are currently declining, likely as a result of habitat degradation amongst other impacts. This species is generally observed within open sparse shrublands, as can be found within the western and northern section of the study area. As such, it is recommended that as far as possible mining infrastructure and activities does not take place within these areas, in order to maintain suitable habitat for *Ardeotis kori*. The preservation of habitat for *Ardeotis kori* will in turn have a positive knock on effect for other species, as they will also be able to utilise the habitat in the undisturbed areas, resulting in a greater protection and conservation effort of species.

5 REFERENCES

Alexander, G and Marais, J. 2008. Second Edition. **A guide to the reptiles of Southern Africa**. Struik Publishers, Cape Town.

Barnes, K.N. (Ed). 2000. **The Eskom Red Data Book of Avifauna of South Africa, Lesotho and Swaziland.** Avifauna life South Africa, Johannesburg, RSA.

BirdLife International. 2014. ***www.birdlife.org.*** In conjunction with the International Union for Conservation of Nature (IUCN).

Branch, B. 1998. Third Edition. **Field Guide to Snakes and other Reptiles in Southern Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Cook, C.L. 1996. **Aspects of the Ecology and Breeding Biology of the Giant Bullfrog *Pyxicephalus adspersus*.** MSc. Thesis, University of Pretoria

Dippenaar-Schoeman. A. **Field Guide to the Spiders of South Africa.** Lapa Publishers(PTY) Ltd, Pretoria, RSA

Du Preez, L and Carruthers, V. 2009. **A complete guide to the frogs of southern Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Endangered Wildlife Trust, 2004. (Conservation Breeding Specialist Group). 2004. **Red Data Book of the Mammals of South Africa: A conservation Assessment.**

Henning, G.A and Henning, S.F. 1989. **South African Red Data Book of Butterflies.** South African National Scientific Programmes Report No. 158

Hockey PAR, Dean WRJ and Ryan PG. 2005. *Roberts - Birds of southern Africa,* VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

IUCN. 2014. International Union for Conservation of Nature **http://www.iucnredlist.org/.**

Leeming, J. 2003. **Scorpions of Southern Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Leroy, A. and Leroy, J. Second Edition. 2003. **Spiders of Southern Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Limpopo SOER. 2004. **Limpopo Department of Finance and Economic Development**, Limpopo Province, State of the Environment Report (Phase 1).

Marais, J. 2004. **A complete guide to the Snakes of Southern Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J., & Kloepfer, D. (Eds). 2004. **Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland.** SI/MAB Series #9. Smithsonian Institute, Washington, DC, USA.

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

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

Northern Cape Nature Conservation Act (NCNCA) 9 of 2009.

Picker. M., Griffiths. C. and Weaving. A. 2004. New Edition. **Field Guide to Insects of South Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

Prendini, L. 2006. **New South African Flat Rock Scorpions** (Liochelidae: Hadogenes). American Museum Novitates 3502, 32pp.

SABAP2, 2013. **The South Africa Bird Atlas Project 2 database.** http://sabap2.adu.org.za/gap_analysis_spp_qdgc.php?qdgc=2430CA

Sinclair, I., Hockey, P. and Tarboton, W. 2002. Third Edition. **Sasol Birds of Southern Africa**. Struik Publishers, Cape Town, RSA.

Smithers, R. H. N. 2000. Third Edition. Edited by Peter Apps. **The Mammals of the Southern African. A Field Guide.** Struik Publishers, Cape Town, RSA.

Stuart,C., Stuart, T. 2000. Third Edition. **Track and Signs of Southern and East African Wildlife.** Struik Publishers (PTY) Ltd, Cape Town , RSA

Walker, C. 2009. Twelfth impression. **Signs of the Wild**. Struik Publishers (Pty) Ltd, Cape Town, RSA

Woodhall, S. 2005. **Field Guide to Butterflies of South Africa.** Struik Publishers (Pty) Ltd, Cape Town, RSA

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

Prepared for

SLR CONSULTING (SYNERGISTICS)

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SECTION D – WETLAND ASSESSMENT

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ACRONYMS

DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
FEPA	Freshwater Ecosystem Priority Area
GPS	Geographical Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
SAS	Scientific Aquatic Services

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal and wetland assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the COZA Iron Ore Project on the farm Jenkins 562 near the town Postmasburg within the Northern Cape Province.

The study area is situated approximately 20 km south of the town of Kathu, 11 km south of the Sishen mine and the south western boundary of the study area is situated adjacent to the R325 roadway (refer to Section A: Figure 1 and 2).

2 GENERAL SITE SURVEY

A site visit was undertaken during June 2015 to determine the ecological status of the study area. A reconnaissance "walkabout" was undertaken to identify wetland features found throughout the study area.

3 WETLAND METHOD OF ASSESSMENT

3.1 Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland features encountered within the study area were assessed using the *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems*, hereafter referred to as the "classification system" (Ollis *et al*., 2013). A summary on Levels 1 to 4 of the classification system are presented in tables that follow.

Table 1: The proposed classification structure for Inland Systems, up to Level 3.

<table>
<tr><th colspan="3">WETLAND / AQUATIC ECOSYSTEM CONTEXT</th></tr>
<tr><th>LEVEL 1:
SYSTEM</th><th>LEVEL 2:
REGIONAL SETTING</th><th>LEVEL 3:
LANDSCAPE UNIT</th></tr>
<tr><td rowspan="4">Inland Systems</td><td rowspan="4">DWA Level 1 Ecoregions
OR
NFEPA WetVeg Groups
OR
Other special framework</td><td>Valley Floor</td></tr>
<tr><td>Slope</td></tr>
<tr><td>Plain</td></tr>
<tr><td>Bench
(Hilltop / Saddle / Shelf)</td></tr>
</table>

Table 2: Hydrogeomorphic (HGM) Units of the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(Not applicable)	(Not applicable)
Unchannelled valley-bottom wetland	(Not applicable)	(Not applicable)
Floodplain wetland	Floodplain depression	(Not applicable)
	Floodplain flat	(Not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(Not applicable)
	Without channelled outflow	(Not applicable)
Wetland flat	(Not applicable)	(Not applicable)

Level 1: Inland systems

For the classification system, Inland Systems are defined as an aquatic ecosystem that have no existing connection to the ocean[1] (i.e. Characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had an historical connection to the ocean, which in some cases may have been relatively recent.

[1] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that will be included in Level 2 of the classification system is that of the Department of Water Affairs' (DWA's) Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al*., 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland (figure below). DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) will be derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a spatial framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

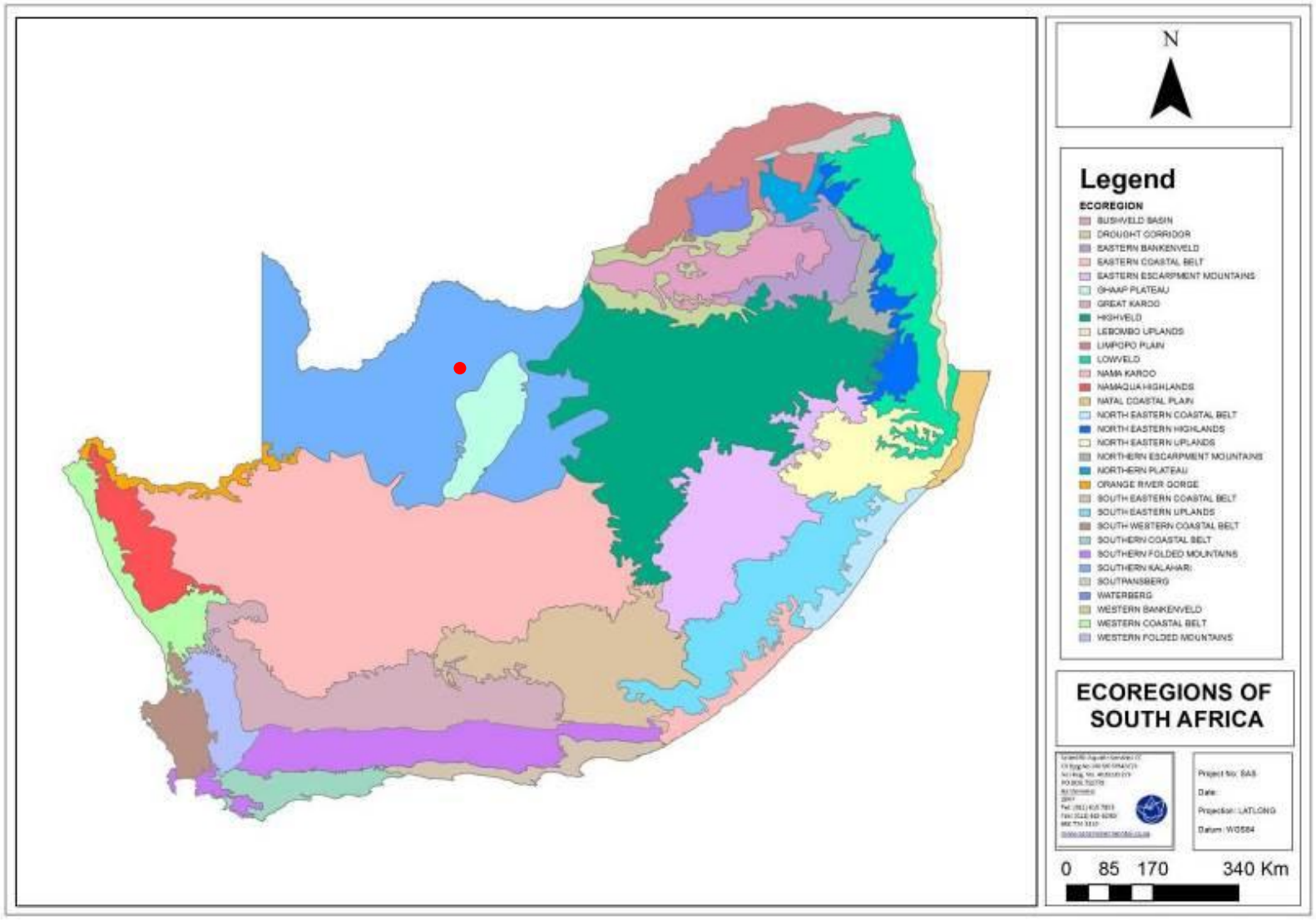

Figure 1: Map of Level 1 Ecoregions of South Africa, with the approximate position of the study area indicated in red.

Level 3: Landscape Setting

At Level 3 of the proposed classification System, for Inland Systems, a distinction will be made between four Landscape Units on the basis of the landscape setting (i.e. Topographical position) within which an HGM Unit is situated, as follows (Ollis *et al*., 2013):

- **Slope**: an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor**: The base of a valley, situated between two distinct valley side-slopes;
- **Plain**: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench** (hilltop/saddle/shelf): an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system, on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **River**: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland**: a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland**: a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland**: the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;

- **Depression**: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat**: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep**: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. Gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms will be used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2008).

3.2 Wet-Ecoservices (2008)

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[2] The assessment of the ecosystem services supplied by the identified wetlands will be conducted according to the guidelines as described by Kotze *et al*. (2008). An assessment will be undertaken to examine and rate the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;

[2] Department of Water Affairs and Forestry, South Africa *Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999*

- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics will be used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic will be scored to give the likelihood that the service is being provided. The scores for each service will then be averaged to give an overall score to the wetland.

Table 3: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

3.3 WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management (Kleynhans *et al*., 2005).

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; and
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions, and interventions that take place in wetland systems and their catchments: hydrology (water

inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention, and outputs), and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems.

Quantification of Present State of a wetland

The overall approach will be to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This will take the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity will then be combined to determine an overall magnitude of impact. The impact scores and Present State categories are provided in the table below.

Table 4: Impact scores and categories of present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or from within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology, and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table 5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change scores	Symbol
Substantial improvement	The state is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	The state is likely to improve slightly over the next 5 years	1	↑
Remain stable	The state is likely to remain stable over the next 5 years	0	→
Slight deterioration	The state is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	The state is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM units have been assessed, a summary of health for the wetland as a whole will be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM unit. Recording the health assessments for the hydrology, geomorphology and vegetation components will provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM units and for the entire wetland.

3.4 Ecological Importance and Sensitivity (EIS)

The method that will be used for the EIS determination was adapted from the method as provided by DWA (1999) for wetlands. The method takes into consideration Present Ecological State (PES) scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed.

A series of determinants for the EIS will be assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The median of the determinants will then be used to assign the EIS category as listed in the table below.

Table 6: Descriptions of the EIS Categories.

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

3.5 Recommended Ecological Class (REC)

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure" (DWA, 1999).

The REC was determined based on the results obtained from the PES, reference conditions, and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same class for the PES, as the REC if the wetland is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as to enhance the PES of the wetland feature.

Table 7: Description of REC classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified
E/F	Unacceptable/intolerable

3.6 Wetland Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act (NWA, 1998) as “land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

The wetland zone delineation took place according to the method presented in the DWAF (2005) document “A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). In addition, pans noted during the field assessment were defined as Wetland Pans or Terrestrial Depression Pans. Based on these delineation principles the foundation of the method is based on the fact that wetland zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoxymorphic soil feature, which are morphological signatures that appear in soils with prolonged periods of saturation.

By observing the evidence of these features, in the form of indicators, wetland zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA 2005 and 2008).

Wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant periods of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

4 SENSITIVITY MAPPING

All sensitive features and or habitats (including the localities wetlands and rivers) will be mapped utilising a Geographical Positioning System (GPS) and a sensitivity map will be compiled. This sensitivity map will aim to guide the design of the study area in order to have the least ecological impact on the receiving environment.

5 RESULTS OF WETLAND INVESTIGATION

5.1 Wetland system characterisation

Of thestudy area assessed, only one unit can be considered wetland habitat, according to the “classification system” (Ollis et al., 2013) namely the Wetland Depressions. The result of the wetland system characterisation is illustrated in the table below.

Table 8: Classification for wetland features within the study area (Ollis et al., 2013).

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit	
			HGM Type	Longitudinal zonation / landform
Inland: An ecosystem that has no existing connection to the ocean, but which is inundated or saturated with water, either permanently or periodically.	**Southern Kalahari:** The study area falls within the Southern Kalahari ecoregion and the following wetveg group: Eastern Kalahari Bushveld Group 1 (Least Threatened)	**Bench:** An area of mostly level or nearly level high ground.	**Depressions:** A landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth.	**Endorheic:** Without channelled inflow.

5.2 Wetland Habitat Unit

5.2.1 Wetland Depressions

Four wetland pans/depressions are located within the study area. These depressions are dominated by the facultative wetland species *Eragrostis bicolor* which was restricted to the temporary zone of the wetland, with a distinctive increase of *Pentzia calcarea* and *Lycium cinereum* within adjacent terrestrial areas. Two of the depressions have been affected by excavation and general topographic alteration, while two were in a more natural state. Furthermore, an artificial dam was also encountered near the abandoned homestead, however no facultative wetland species were encountered within the dam. Wetland

depressions are considered to be of increased sensitivity and ecological importance as they provide the habitat necessary to sustain wetland dependent floral species in a relatively dry region.

Figure 2: Wetland depression identified within the study area.

5.2.2 Ephemeral Drainage Lines

When considering the terrain units within the landscape, two drainage lines are evident within the study area that would convey water during and immediately after rainfall events. However, the drainage lines do not retain water long enough for the formation of hydromorphic soils that would support facultative floral species. As a result, these systems cannot be defined as wetlands (DWA, 2005) and the National Water Act in terms of Section 21 and GN no. 1199 of 2009 as it relates to the National Water Act will not apply. Although no hydromorphic soil was encountered within the features, the abundance of woody vegetation (*Tarchonanthus camphoratus, Diospyros lycioides, Grewia flava* and *Ziziphus mucronata*) along each drainage line did increase. This is considered a result of soil being transported by water forming areas with increased soil depth that are able to support larger tree species. However, the drainage lines are not considered to be sensitive from a floral ecological perspective as the floral species composition was similar to the surrounding terrestrial habitat and thus not unique.

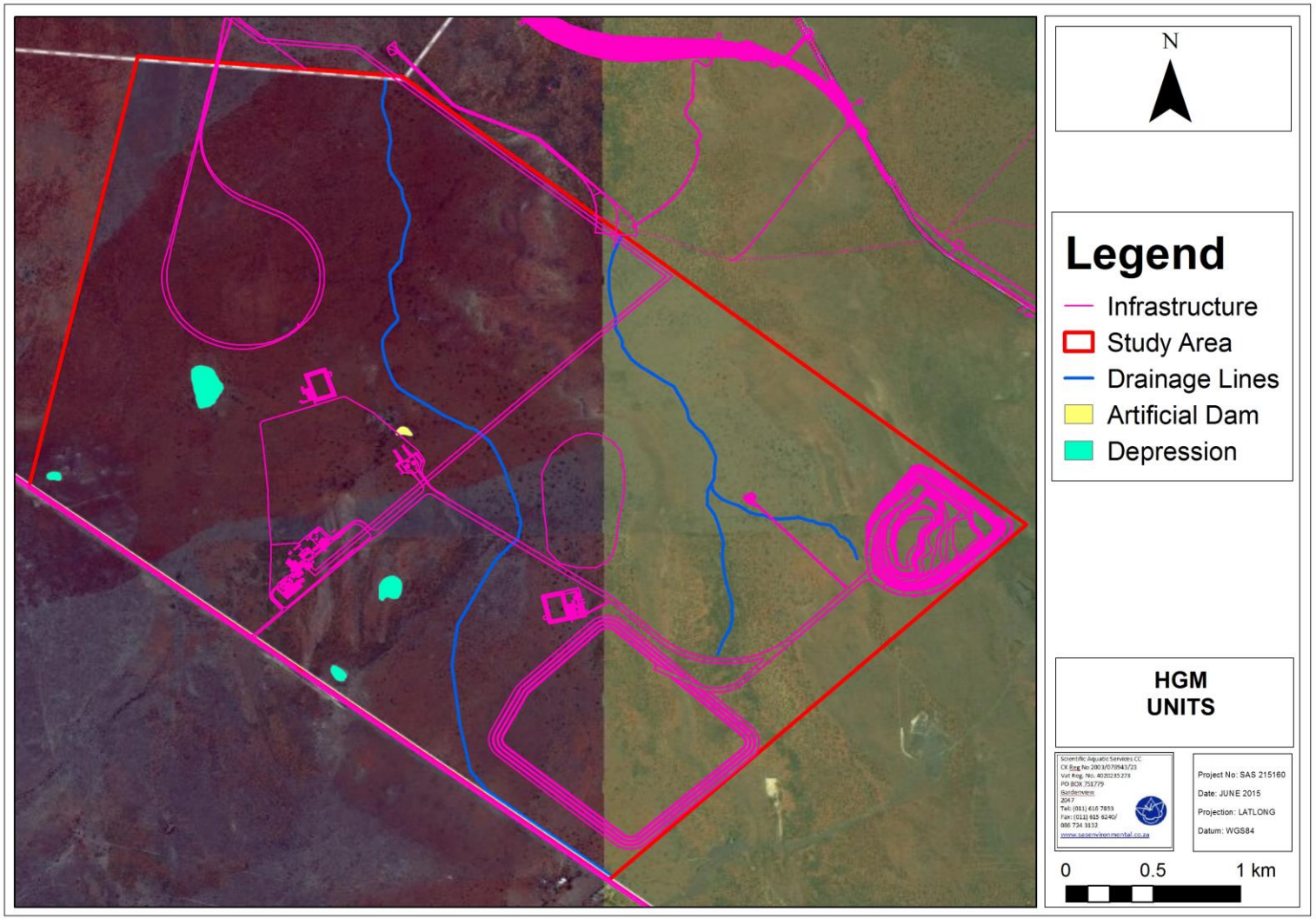

Figure 3: The wetlands, artificial dam and drainage lines in relation to the study area.

5.3 WET-Health Assessment

A Level 1 WET-Health assessment was applied to the disturbed and undisturbed depression wetland features. Three modules were assessed, namely hydrology, geomorphology and vegetation, and the results for each wetland feature are presented in the following sections.

5.3.1 Disturbed Depressions

The summarized results of the WET-Health assessment for the disturbed depressions are presented in the table below:

Table 9: Summary of the overall health of the disturbed depressions based on impact score and change score.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
E	↓	D	↓↓	D	↓↓

The overall score for the wetland system that aggregates the scores for the assessed three modules, namely hydrology, geomorphology and vegetation, was calculated using the formula[3] as provided by the WET-Health methodology. The overall score calculated was 5.5, falling within Category D (A large change in ecosystem processes and loss of natural habitat and biota and has occurred).

Impacts on the hydrology of the wetland features include the increased runoff volumes and nutrient enrichment from surrounding agricultural areas. In addition, the most significant impact has resulted from the excavation of material from the wetlands, further contributing to changes in the hydrology of the features placing this module within a Category E.

During the field assessment, it was furthermore evident that topographic alterations associated with excavation activities have taken place within the features, resulting in geomorphological modifications falling within Category D.

The vegetation assemblage, which has undergone moderate to high levels of transformation as a result of the above disturbances, obtained a score which placed the

[3] ((Hydrology score) x 3 + (geomorphology score) x2 + (vegetation score) x 2))/ 7 = PES

module in a Category D. Vegetation composition has been largely altered by excavation activities with number of introduced alien and/or ruderal species present.

5.3.2 Undisturbed Depressions

The summarized results of the WET-Health assessment are presented in the table below:

Table 10: Summary of the overall health of the undisturbed depressions based on impact score and change score.

Hydrology		Geomorphology		Vegetation	
Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
C	→	C	→	B	→

The overall score for the wetland system that aggregates the scores for the assessed three modules, namely hydrology, geomorphology and vegetation, was calculated using the formula[4] as provided by the WET-Health methodology. The overall score calculated was 2.2, falling within Category C (A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact).

Impacts on the hydrology of the wetland features include the increased runoff volumes form surrounding agricultural areas and associated increased silt load and nutrient load, placing this module within a Category C. Topographic alterations associated with surrounding agricultural activities have affected the geomorphology of the systems, resulting in geomorphological modifications falling within Category C.

The vegetation assemblage, which has undergone relatively minor levels of transformation as a result of surrounding agricultural activities and alien floral invasion, obtained a score which placed the module in a Category B, which means that vegetation within the undisturbed pans was mostly intact.

5.4 Wetland Function Assessment

The wetland function and service provision of the wetlands was assessed utilising the WET-Ecoservices (Kotze *et. al*. 2009) method as previously described. The results of the assessment are tabulated below and depicted in the radar plot in the figure that follows.

[4] ((Hydrology score) x 3 + (geomorphology score) x2 + (vegetation score) x 2))/ 7 = PES

Table 11: Functions and service provision for the wetland features in the study area.

Ecosystem service	Wetland	
	Undisturbed Depressions	Disturbed Depressions
Flood attenuation	1.2	0.8
Streamflow regulation	0.0	0.0
Sediment trapping	3.2	2.2
Phosphate assimilation	3.1	2.2
Nitrate assimilation	3.1	2.2
Toxicant assimilation	3.1	2.2
Erosion control	0.0	0.0
Biodiversity maintenance	3.0	2.5
Carbon Storage	3.0	1.0
Water Supply	1.6	1.0
Harvestable resources	1.0	0.8
Cultivated foods	1.0	0.8
Cultural significance	0.0	0.0
Tourism and recreation	0.0	0.0
Education and research	1.2	0.0
SUM	**24.5**	**15.7**
Average score	**1.6**	**1.0**

The undisturbed depressions encountered within the study area are not regarded to be of exceptional importance in terms of function and service provision, and obtained an intermediate score (1.6). This is mainly as a result of lack of water for extended periods of time limiting the ability to support diverse aquatic ecological communities or support a more diverse wetland floral community, that would also in turn increase the wetland features assimilation capacity as well as sediment trapping ability.

The undisturbed depressions are endorheic systems which are hydrologically isolated. As a result, these systems will not play any role in terms of stream flow regulation and would only be of limited importance in terms of flood attenuation. The depressions calculated the highest score for sediment and nutrient trapping as they are situated in an agricultural area and also for biodiversity maintenance, due to them providing breeding and foraging habitat for amphibians, avifauna and aquatic invertebrates when surface water is present.

The disturbed depressions encountered within the study area are also not regarded to be of exceptional importance in terms of function and service provision, and obtained a moderately low score (1.0). This is mainly as a result of their small size, isolated nature and high levels of transformation as a result of agricultural activities which has, in most cases, completely isolated them from surrounding natural areas. As a result, these systems will not play any role in terms of stream flow regulation and would only be of

limited importance in terms of flood attenuation and sediment trapping. The disturbed depressions calculated the highest score for biodiversity maintenance, due to them providing niche habitat fir fauna and flora when surface water is present.

Thus, it is clear that the undisturbed depressions are of intermediate importance and the disturbed depressions of moderately low importance. Should any surface infrastructure negatively affect the undisturbed depressions, the impact significance is likely to be high, while a moderate to low impact significance is expected should the disturbed depressions be affected by the surface footprint.

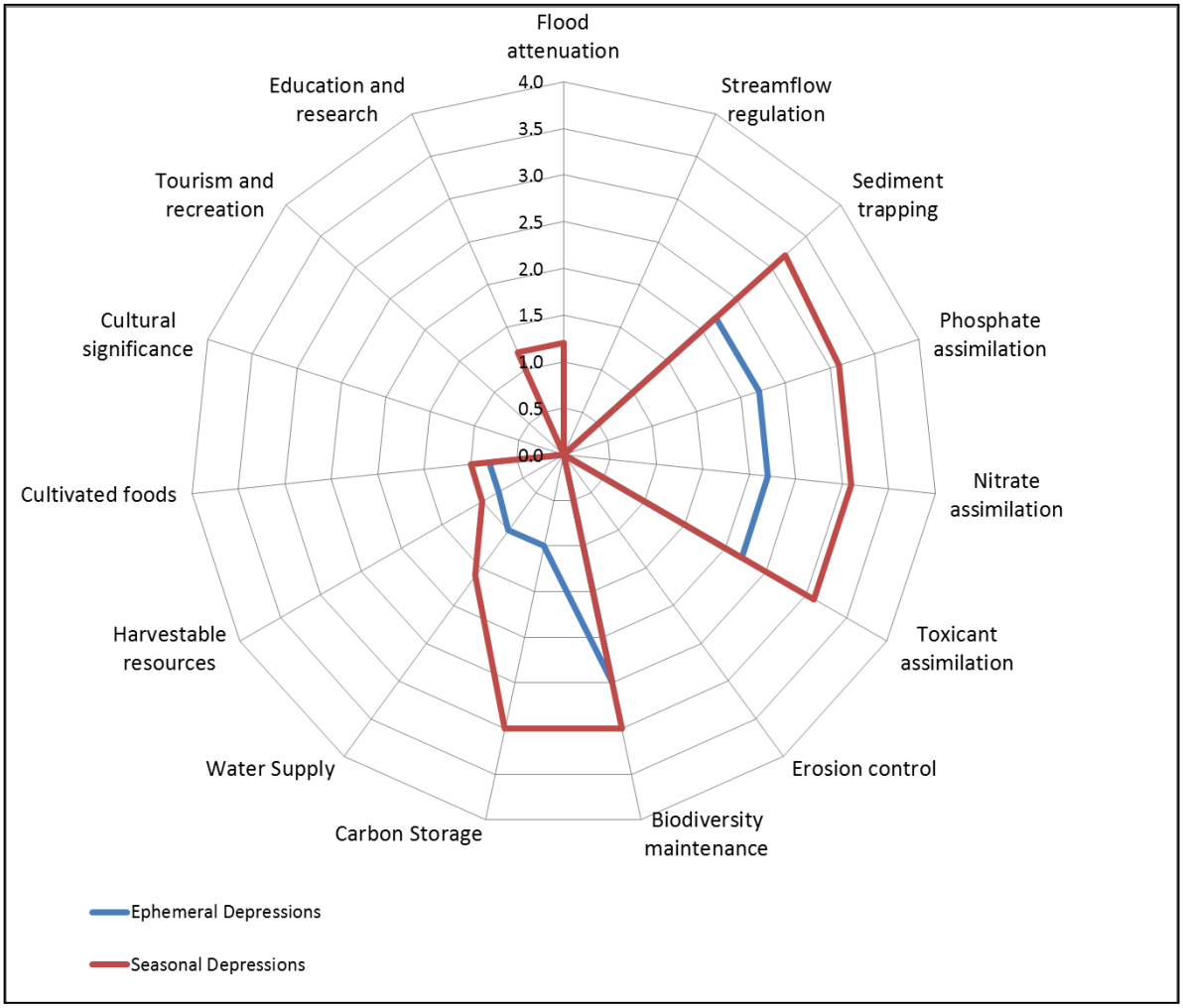

Figure 4: Radar plot of wetland services provided by the wetland features within the study area.

5.5 Ecological Importance and Sensitivity Assessment

The EIS method was applied to each wetland in order to ascertain its sensitivity to flow and habitat modifications. The results of the assessment are presented below.

Table 12: Score sheet for determining the EIS of the wetlands identified within the study area.

Determinant	Score	Confidence	Score	Confidence
Wetland system	**Undisturbed Depressions**		**Disturbed Depressions**	
PRIMARY DETERMINANTS				
1. Rare & Endangered Species	2	4	1	4
2. Populations of Unique Species	2	4	1	4
3. Species/taxon Richness	2	4	1	4
4. Diversity of Habitat Types or Features	2	4	1	4
5 Migration route/breeding and feeding site for wetland / aquatic species	2	4	1	4
6. PES as determined by WET- Health assessment	3	4	1	4
7. Importance in terms of function and service provision	2	4	1	4
MODIFYING DETERMINANTS				
8. Protected Status according to NFEPA Wetveg	1	4	1	4
9. Ecological Integrity	3	4	1	4
TOTAL	**18**		**9**	
MEAN	**2**		**1.0**	
OVERALL EIS	**B**		**D**	

The score achieved for the EIS assessment places the undisturbed depressions within Category B (Wetlands that are considered to be ecologically important and sensitive.). These features feature did not score a high importance in terms of habitat diversity or unique species, however, they provide an intermediate level of ecological services and are of moderate ecological integrity. The disturbed depressions fall within Class D (Wetlands that are not ecologically important and sensitive at any scale), as they received a moderately low score in terms of ecoservice provision and are considered to be largely modified.

Thus, it is clear that the undisturbed depressions are of high sensitivity and the disturbed depressions of low sensitivity. Should any surface infrastructure negatively affect the undisturbed depressions, the impact significance is likely to be high, while a moderate to low impact significance is expected should the disturbed depressions be affected by the surface footprint.

5.6 Recommended Ecological Category (REC)

All results obtained from the sections above were used in the determination of the appropriate REC for each feature.

The results of the wetland function assessment and WET-Health assessment, together with the results of the EIS assessment, were used to inform the REC, which is deemed to

be a Class B (largely natural with few modifications) for the undisturbed depression wetlands and for the disturbed depressions, a Class D (largely modified) is recommended.

5.7 Wetland Delineation and Sensitivity Mapping

During the assessment, the following indicators of the wetland temporary zone were used:

- Terrain units were used to determine in which parts of the landscape the wetland features are most likely to occur.
- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50cm of the soil surface. This indicator was used to identify gleyed soils where the soil is a greyish/greenish/bluish colour due to the leaching out of iron. Whilst mottling was not extensive, it was present in the temporary zone. These factors were utilised to aid in determining the location of the wetland boundary.
- The vegetation indicator was used in the identification of the wetland boundary through the identification of the distribution of both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Changes in vegetation density and levels of greening were also considered during the delineation process. This indicator was very useful in identifying the boundary of the temporary zone.

A 100m buffer zone is indicated around the wetlands as advocated by Regulation GN 704 of the National Water Act, 1998 which contains Regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that:

No person in control of a mine or activity may-

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;

According to the above, the project footprint must fall outside of the 1:100 year floodline of the wetlands or 100m from the edge of the features, which ever distance is the greatest unless exemption from the GN704 is granted. Furthermore, construction activities planned within 32m of the wetland features require relevant authorisation according to the National

Environmental Management Act (NEMA) 107 of 1998 and Section 21 c and i of the National Water Act 36 of 1998.

The wetland boundaries and their respective EIS are presented in the figure below along with the 32m and 100m buffer zones. The disturbance of the wetland areas and their associated buffer zones should be avoided as far as possible. In this regard special mention is made of the undisturbed depression wetland systems which are of increased ecological sensitivity and importance (Class B). It is however not deemed a fatal flaw to the project should the surface infrastructure affect the disturbed depressions (Class D).

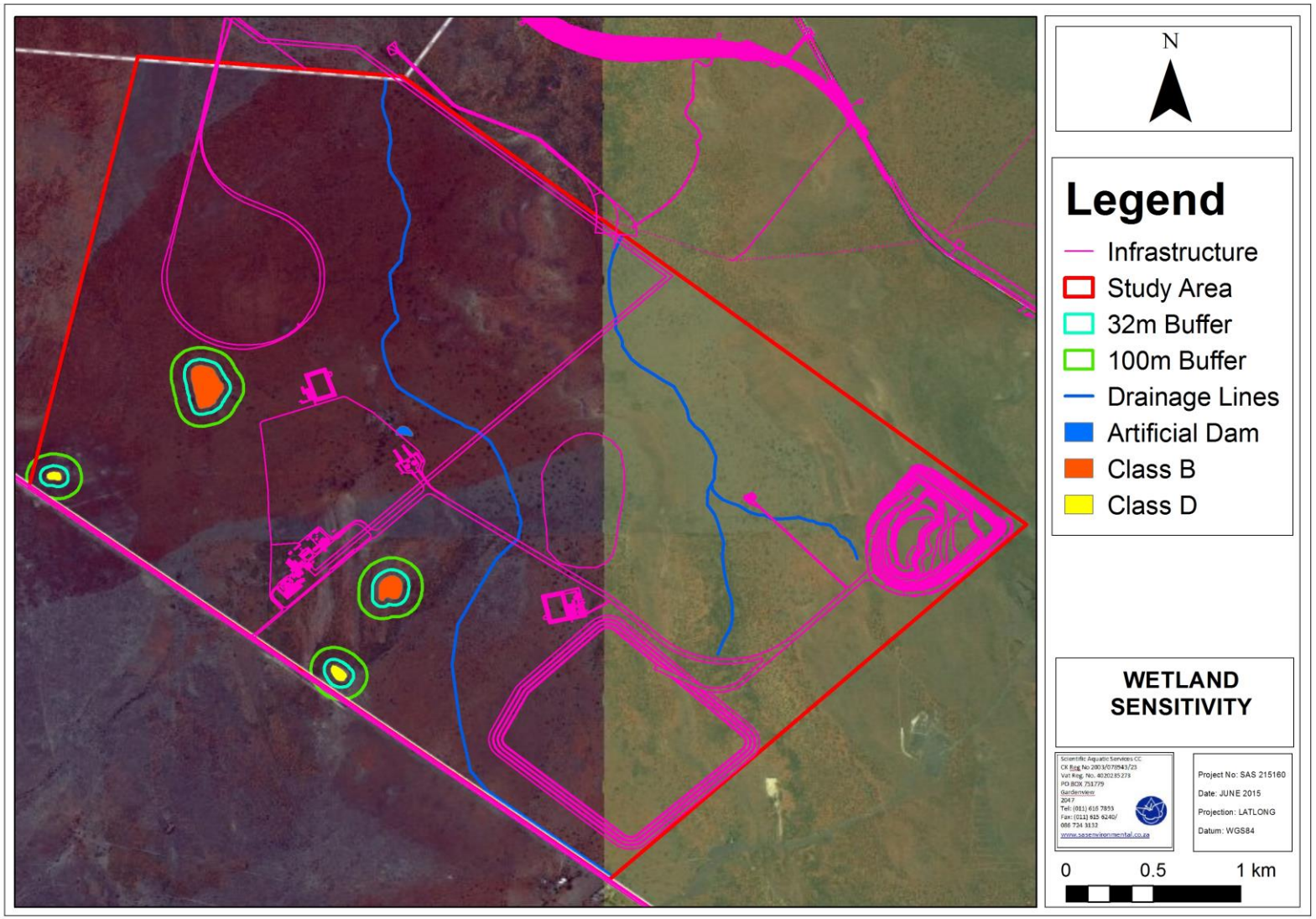

Figure 5: Conceptual presentation of the wetlands within the study area, and their associated sensitivities and buffer zones.

6 REFERENCES

Department of Water Affairs (DWA). 1999. South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, [Appendix W1].

Department of Water Affairs and Forestry (DWA). 1999. South Africa. Version 1.0 of Resource Directed Measures for Protection of Water Resources, [Table G2].

Department of Water Affairs and Forestry (DWA). 1999. South Africa. Version 1.0 of Resource Directed Measures for Protection of Water Resources, [Appendix W3].

Department of Water Affairs and Forestry (DWA). 1999. South Africa. Version 1.0 of Resource Directed Measures for Protection of Water Resources.

Department of Water Affairs (DWA). 2005. "A practical field procedure for identification and delineation of wetlands and riparian areas.

Department of Water Affairs (DWA). 2007. Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

GN 1199 as published in the Government Gazette 32805 of 2009 as it relates to the NWA.

Kleynhans C.J., Thirion C. and Moolman J. 2005. A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2008. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P., and Goge, C. 2008. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

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

National Water Act (NWA) 36 of 1998.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L., and Nienaber, S. 2011. Technical report for the freshwater ecosystem priority areas project: WRC Report No 1801/2/11. Water Research Commission, Pretoria.

Ollis, D.J., Snaddon, C.D., Job, N.M., and Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems*. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

Prepared for

SYNERGISTICS - part of the SLR group

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SECTION E

Impact Assessment and Mitigation

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1. INTEGRATION OF BIODIVERSITY MANAGEMENT INTO PROJECT EXECUTION

1.1 Principles of Decision making to mainstream biodiversity in mining projects

According to the Department of Mineral Resources (DMR) (2013) there are 6 key principles which should guide decision making with regards to any development. The six principles are defined as follows:

1. **Apply the Law:** the utilisation of the law will be viewed as the minimum requirement in ensuring biodiversity compliance attention will be given to all applicable legislation across government sectors including the Department of Water Affairs (DWA), the Department of Environmental Affairs and tourism (DEAT) and the DMR.
2. **Utilise best available biodiversity information:** a wealth of information is available on South African biodiversity with sources of information coming from digital databases, spatial (GIS based) databases as well as extensive literature and technical reports. All these sources allow improved execution of biodiversity assessment projects from inception to finalisation and practical implementation. Specific mention is made of sources of information such as the SANBI GIS databases. During the consultation of desktop information, specific attention will be given to biodiversity priority areas which include:
    - Protected areas
    - World Heritage Sites and their legally proclaimed buffers
    - Critically endangered and endangered ecosystems
    - Critical Biodiversity Areas
    - River and wetland Freshwater Ecosystem Priority Areas (FEPAs)
    - 1km buffer of river and wetland FEPAs
    - Ramsar Sites
    - Protected area buffers
    - Transfrontier Conservation Areas (remaining areas outside of formally
    - proclaimed PAs)
    - High water yield areas
    - Coastal Protection Zone
    - Estuarine functional zones
    - Ecological support areas
    - Vulnerable ecosystems

- Study areas for land-based protected area expansion and study areas or offshore protection.

The results of desktop assessments can then be used to categorise projects and define the significance of the development from a biodiversity conservation point of view. According to the DMR (2013) there are 4 categories of biodiversity importance into which any project could occur. The table below presents a description of each category and the implications for mining. The four categories can briefly be defined as:

- Legally protected areas
- Areas of highest biodiversity importance
- Areas of high biodiversity importance
- Areas of moderate biodiversity importance

Table 1: Description of each category and the implications for mining

Category	Biodiversity priority areas	Risk of mining	Implications for mining
A. Legally protected	• Protected areas (including National Parks, Nature Reserves, World Heritage Sites, Protected Environments, Nature Reserves) • Areas declared under Section 49 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002)	**Mining prohibited**	Mining projects cannot commence as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (No. 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.
B. Highest biodiversity importance	• Critically endangered and endangered ecosystems • Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans • River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1 km buffer around these FEPAs • Ramsar Sites	**Highest risk for mining**	Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licenses, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining project is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into license agreements and/or authorisations.
C. High biodiversity importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves) • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas) • Other identified priorities from provincial spatial biodiversity plans • High water yield areas • Coastal Protection zone	**High risk for mining**	These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, and for maintaining important ecosystem services for particular communities or the country as a whole.

Category	Biodiversity priority areas	Risk of mining	Implications for mining
	• Estuarine functional zone *Note that the status of the buffer areas of World Heritage Sites is subject to a current intra-governmental process.		An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and limitations for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into license agreements and/or authorisations.
D. Moderate biodiversity importance	• Ecological support areas • Vulnerable ecosystems • Study areas for protected area expansion (land-based and offshore protection)	**Moderate risk for mining**	These areas are of moderate biodiversity value. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into license agreements and/or authorisations.

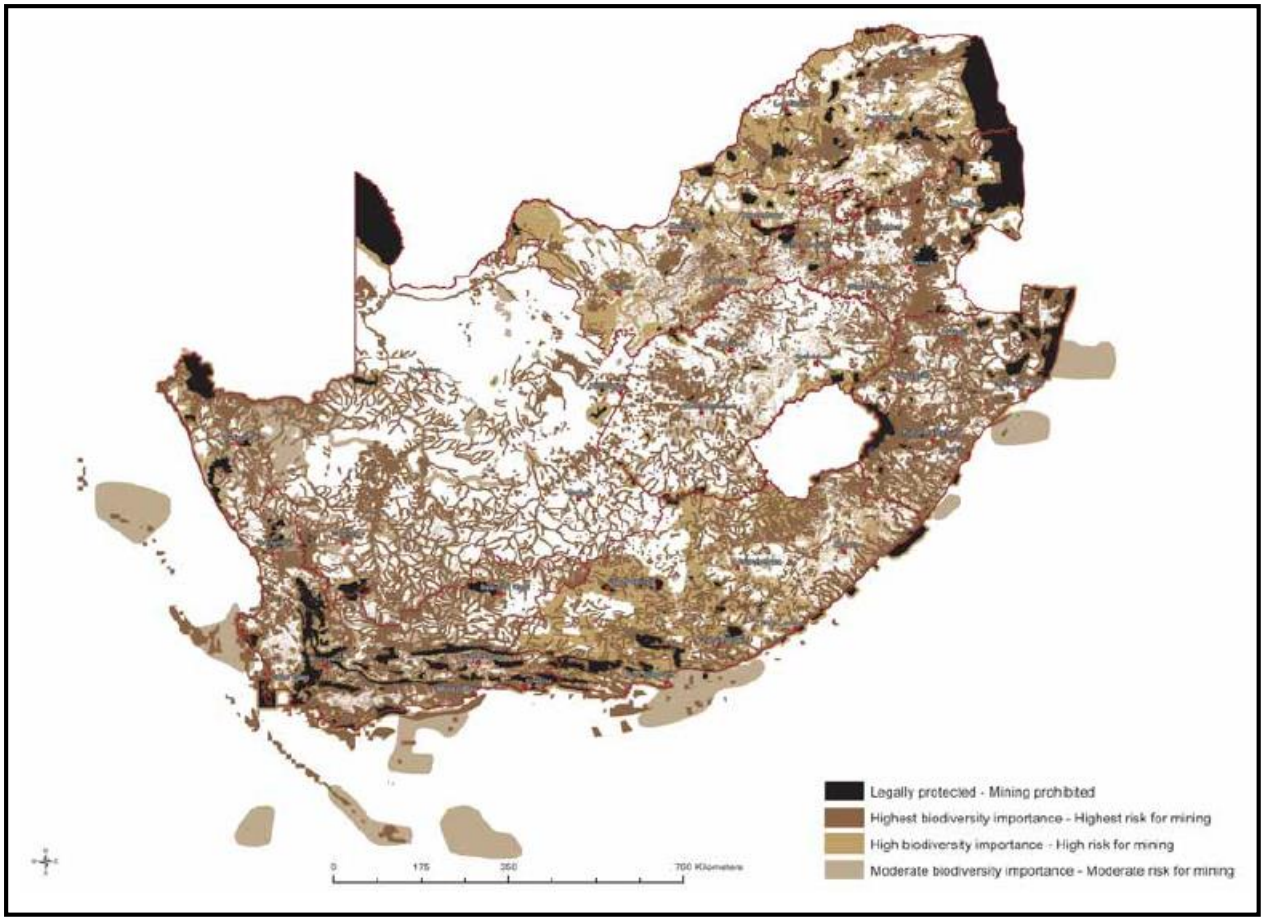

Figure 1: Levels of biodiversity importance in South Africa.

3. **Relevant stakeholder engagement in the assessment and decision making process:** biodiversity studies and plans should address the need for stakeholder engagement through consultation with local and provincial authorities, databases, reference material and where possible local and provincial experts.
4. **Environmental Impact Assessment:** the ecological baseline assessment should include assessments of:
   - The presence of and category of biodiversity priority areas.
   - The condition of ecosystems or habitat.
   - Vegetation type and ecosystem status.
   - The presence of any species of special concern.
   - The presence of any unique or special features.
   - Important spatial components of ecological processes (e.g. ecological corridors).
   - Any known or projected trends in both biodiversity and/or ecosystem services.
   - Contextual analysis of the site/surrounding environment.

Ground-truthing (i.e. a baseline survey) of the biodiversity features in the affected area (receiving environment) is the preliminary requirement to identify environmental constraints.

Additional detailed specialist investigations should be carried out on site and in the wider area as appropriate and proportional to the levels of risk and significance of potentially impacted biodiversity and ecosystem services. The assessment and evaluation must (DMR 2013):

- Take into account any Spatial Development Frameworks approved by the provincial environmental authorities, any Environmental Management Frameworks, bioregional plans and/or other biodiversity plans prepared for the affected area.
- Enable differentiation between biodiversity priority areas and other natural areas, and areas where little to no natural habitat remains at a site scale. The type of biodiversity priority area and natural habitat remaining is important to informed application of the mitigation hierarchy during later phases of the project.
- Demonstrate that it has considered all potential impacts on biodiversity - direct impacts (occurring at the same time and in the same place as the prospecting or mining itself) as well as indirect impacts (occurring beyond or downstream of the prospecting or mining area within the 'area of influence' of the activity, and/ or may be manifest sometime after the activity e.g., groundwater pollution, acid mine drainage).
- Show that the potential impacts of this activity on biodiversity, particularly in biodiversity priority areas and on threatened species, have been evaluated in light of other similar activities that have been authorised and/ or are reasonably foreseeable in the area (i.e. cumulative impacts).
- Identify the current beneficiaries of ecosystem services, identify the biodiversity and ecosystems that underpin those services and any trends affecting them, and show that impacts on both the services and the beneficiaries have been addressed. Capturing the contribution of ecosystem services is important in the comparative evaluation of the significance of impacts (including cumulative impacts) of alternative development/land use activities. This requires understanding how development impacts on ecosystem services, who and where are the beneficiaries of those services who are likely to suffer a cost as a result of the activity (local communities and society), and evaluate the socioeconomic implications. Costs associated with the loss of ecosystem services should be added onto the project costs. Measures to mitigate impacts on ecosystem services must cover all steps of the mitigation hierarchy, giving particular attention to what may be irreplaceable or 'non offsetable' ecosystem services. It is essential also to take into account the mining activity's dependence on ecosystem services, and the risks associated with a change in the quality or availability of these services during the life of the project.
- Consider both the normal operating conditions of the mine and ancillary facilities/activities, as well as emergency or unplanned events (e.g. involving

hazardous wastes, fire, toxic materials, accidental spillage of biocides, etc); the latter require particular mitigation and management responses that should be incorporated into the EMP.

5. **Provide guidelines for the implementation of robust environmental management in line with the mitigation hierarchy:** The biodiversity assessment will aim to provide suitable mitigation measures in line with best practice while not exceeding costs in order to minimise impacts. In the contemplation of mitigation attention will be given to the mitigation hierarchy in order to provide mitigatory solutions in order of preference according to the mitigation hierarchy;
6. **Ensure and support for effective implementation:** The biodiversity assessment will aim to provide sufficient information to allow for successful, robust biodiversity management in line with the mitigation hierarchy. As far as possible consultants will remain available for post submission consultation in an advisory capacity.

1.2 Legislative, Policy and Best Practice Framework For biodiversity Management

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

According to the DMR, (2013) Ecosystem services can be divided into 4 main categories:

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

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

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

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

Pressures on biodiversity are numerous and increasing. According to the DMR; (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[1]:

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

Impacts on biodiversity can largely take place in four ways (DMR 2013):

[1] North West Province Environment Outlook. A Report on the State of the Environment, 2008. Chapter 4.

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

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted in the identification of spatial biodiversity priorities, or biodiversity priority areas.

1.3 Legislative, Policy and Best Practice Framework For biodiversity Management

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other landuse. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DMR 2013):

1. **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases if impacts are expected to be too

high the “no project” option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;

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

loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

According to the DMR (2013) 'Closure' refers to the process for ensuring that mining operations are closed in an environmentally responsible manner, usually with the dual objectives of ensuring sustainable post-mining land uses and remedying negative impacts on biodiversity and ecosystem services.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[2]

2. ECOLOGICAL IMPACT ASSESSMENT METHODOLOGY

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that are possessed by an organisation.

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

- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[3]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[4].

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

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

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

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

Table 2: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

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

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function Largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear features affected < 1000m	2
Local area/ within 1 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	3
Regional within 5 km of the site boundary / < 5000ha impacted / Linear features affected < 10 000m	4
Entire habitat unit / Entire system/ > 5000ha impacted / Linear features affected > 10 000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 3: Significance rating matrix

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

Table 4: Positive/Negative Mitigation Ratings

Significance Rating	Value	Negative Impact management recommendation	Positive Impact management recommendation
Very High	126 - 150	Consider the viability of the project. Very strict measures to be implemented to mitigate impacts according to the impact mitigation hierarchy	Actively promote the project
High	101 - 125	Consider alternatives in terms of project execution and location. Ensure designs take environmental sensitivities into account and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Promote the project and monitor ecological performance
Medium High	76 – 100	Consider alternatives in terms of project execution and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Implement measures to enhance the ecologically positive aspects of the project while managing any negative impacts
Medium Low	51 - 75	Ensure management and housekeeping is maintained and attention to impact minimisation is paid	Implement measures to enhance the ecologically positive aspects of the project while actively managing any negative impacts
Low	26 - 50	Promote the project and ensure management and housekeeping is maintained	Monitor ecological performance and pay extensive attention to minimising potential negative environmental impacts
Low Very	1 - 25	Promote the project	Actively seek measures to implement impact minimisation according to the impact mitigation hierarchy and identify positive ecological aspects to be promoted

The following points were considered when undertaking the assessment:

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

2.1 Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

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

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

3. ECOLOGICAL IMPACT ASSESSMENT

The ecological impact assessments undertaken for each sphere of ecology are presented in the sections below as follows:

1. Floral impact assessment
2. Faunal impact assessment
3. Wetland impact assessment

In all the impact assessments cross cutting impacts are considered and cumulative and residual/latent impacts are considered.

3.1 Floral Impact Assessment

The impact assessment was undertaken on all aspects of floral ecology deemed likely to be affected by the proposed mining project. The sections below present the results of the findings per identified risk/impact for the floral ecology of the study area.

IMPACT 1: IMPACT ON FLORAL HABITAT

Placement of infrastructure and mining activities within intact floral habitat in areas such as the Rocky Ridges and Wetland Depression habitat units is highly likely to have a detrimental impact on local and regional floral habitat conservation.

The data gathered during the baseline floral ecological assessment indicate that the Rocky Ridges and Wetland Depression habitat units are of high sensitivity in terms of ecological functioning and floral habitat integrity.

Activities which are likely to negatively affect the floral habitat integrity of the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities;
- Alien floral invasion and erosion in disturbed areas;
- Dewatering and pollution of watercourses leading to altered wetland floral habitat;
- Increased human populations in the area leading to greater pressure on natural floral habitat.

The above activities are highly likely to have a significant detrimental impact on floral habitat within and around the study area if infrastructure is situated within sensitive floral habitat. The

following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential poor planning of infrastructure placement and design in sensitive floral habitat units.	Site clearing and the removal of vegetation leading to a loss of sensitive floral habitat.	On-going disturbance of soils due to operational activities leading to altered floral habitat.	Ineffective rehabilitation of exposed and impacted areas leading to altered runoff patterns, pit voids and permanent losses of floral habitat.
Failure to initiate the development of a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of floral biodiversity through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of natural habitat	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on floral habitat.
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of floral habitat.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral habitat	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive floral habitat	Seepage affecting soils and the groundwater regime leading to altered floral habitat	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive floral habitat.	Additional pressure on floral habitat by increased human populations associated with the proposed mine leading to a loss of floral habitat.	
	Compaction of soils reducing efficiency of floral re-establishment	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Dust generation during operational activities leading to a loss of floral habitat.	
	Increased fire frequency during construction leading to a loss of sensitive floral habitat	Increased fire frequency during operation leading to a loss of sensitive floral habitat	
	Dust generation during construction leading to a loss of floral habitat.		

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	4	3	5	9	12	108 (High)
Operational phase	5	4	4	3	5	9	12	108 (High)
Decommissioning and closure phase	5	4	4	3	5	9	12	108 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	4	3	2	4	8	9	72 (Medium-Low)
Operational phase	4	4	3	2	4	8	9	72 (Medium-Low)
Decommissioning and closure phase	4	4	3	2	4	8	9	72 (Medium-Low)

IMPACT 2: IMPACT ON FLORAL DIVERSITY

Placement of infrastructure, construction of the mine and mining activities within intact floral habitat in areas such as the Rocky Ridges is highly likely to have a detrimental impact on local and regional floral diversity. Furthermore, during the baseline floral assessment, a high diversity of floral species was recorded in the study area, especially within the Rocky Ridges and Wetland Depression areas, which are of high sensitivity in terms of ecological functioning and floral habitat integrity.

Activities which are likely to negatively affect the floral diversity of the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities leading to altered floral species diversity;
- Alien floral invasion and erosion in disturbed areas;
- Alteration of hydrology and runoff patterns.

The above activities are highly likely to have a significant detrimental impact on floral diversity within and around the study area as the alteration of floral diversity will be highly likely if infrastructure is situated within sensitive floral habitat. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential poor planning of infrastructure placement and design in sensitive floral habitat units	Site clearing and the removal of vegetation leading to a loss of floral diversity	On-going disturbance of soils due to operational activities leading to altered floral diversity	Ineffective rehabilitation of exposed and impacted areas leading to altered runoff patterns and permanent losses of floral diversity
Failure to initiate a biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of floral biodiversity through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of floral diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on floral diversity.
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of floral diversity.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral diversity	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive floral habitat.	Seepage affecting soils and the groundwater regime leading to altered floral diversity	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss floral diversity.	Additional pressure on floral diversity by increased human populations associated with the proposed mine	
	Compaction of soils reducing efficiency of floral re-establishment	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Dust generation during operational activities leading to a loss of floral diversity	
	Increased fire frequency during construction leading to a loss of floral diversity	Increased fire frequency during operation leading to a loss of floral diversity	
	Dust generation during construction leading to a loss of floral diversity.		

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	4	3	5	9	12	108 (High)
Operational phase	5	4	4	3	5	9	12	108 (High)
Decommissioning and closure phase	5	4	4	3	5	9	12	108 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	4	3	2	4	8	9	72 (Medium-Low)
Operational phase	4	4	3	2	4	8	9	72 (Medium-Low)
Decommissioning and closure phase	4	4	3	2	4	8	9	72 (Medium-Low)

IMPACT 3: IMPACT ON FLORAL SPECIES OF CONSERVATION CONCERN

Placement of infrastructure, construction of the mine and mining activities are highly likely to have a detrimental impact on floral species of conservation concern such as *Boscia albitrunca, Vachellia erioloba* and *V. haematoxylon*, *Aloe grandidentata, A. hereroensis, Babiana framesii* and *Anacampseros filamentosa*. Furthermore, the study area is highly likely to provide habitat and play host to additional protected species.

Activities which are likely to negatively affect the flora of conservation concern within and around the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities leading to altered floral species diversity;
- Alien floral invasion and erosion in disturbed areas;
- Increased harvesting pressure on protected and medicinal floral communities;

The above activities are highly likely to have a significant detrimental impact on species of conservation concern within and around the study area if infrastructure is situated within sensitive floral habitat. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially poor planning of infrastructure placement and design in sensitive floral habitat units	Site clearing and the removal of vegetation leading to a loss of sensitive and medicinal species	On-going disturbance of soils due to operational activities leading to a loss of sensitive and medicinal species	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of sensitive and medicinal species
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of sensitive and medicinal species through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of floral diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on sensitive and medicinal
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of sensitive and medicinal species	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral diversity	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive floral habitat.	Seepage affecting soils and the groundwater regime leading to a loss of sensitive and medicinal species	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive and medicinal species.	Additional pressure on sensitive and medicinal species by increased human populations associated with the proposed mine	
	Compaction of soils reducing efficiency of floral re-establishment	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Dust generation during operational activities leading to a loss of sensitive and medicinal species	
	Increased fire frequency during construction leading to a loss of sensitive and medicinal species	Increased fire frequency during operation leading to a loss of sensitive and medicinal species	
	Dust generation during construction leading to a loss of sensitive and medicinal species		

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	5	4	5	9	14	126 (Very High)
Operational phase	5	4	5	4	5	9	14	126 (Very High)
Decommissioning and closure phase	5	4	4	3	5	9	1\2	108 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	4	4	3	4	9	11	99 (Medium-High)
Operational phase	4	4	3	3	4	8	10	80 (Medium-High)
Decommissioning and closure phase	4	4	3	3	4	8	10	80 (Medium-High)

3.2 Faunal Impact Assessment

The impact assessment was undertaken on all aspects of faunal ecology deemed likely to be affected by the proposed mining development. The sections below present the results of the findings per identified risk/impact for the faunal ecology of the study area.

IMPACT 1: IMPACT ON FAUNAL HABITAT

Although all possible measures will be implemented to avoid the encroachment of infrastructure in sensitive areas, placement of infrastructure and mining activities within sensitive faunal habitat such as the Rocky Ridges and Wetland Depression areas is highly likely to have a detrimental impact on faunal habitat, migratory corridors and the overall carrying capacity of the study area. A high diversity of faunal species both within the study area, but also the surrounding areas rely on these habitat types for foraging, migratory and breeding purposes. Although the study area is fenced in, the fences are still relatively permeable to a large number of species, further compounded by the lack of fences in sections.

Activities which are likely to negatively affect the faunal habitat integrity of the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive faunal habitat;
- Destruction of faunal habitat during construction and operational activities;
- Dust generated by mining activities;
- Alien floral invasion and erosion in disturbed areas;
- Increased human populations in the area leading to greater pressure on natural faunal habitat.

The above activities are highly likely to have a significant detrimental impact on faunal habitat within and around the study area if infrastructure is situated within sensitive faunal habitat. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of vegetation leading to a loss of sensitive faunal habitat	On-going disturbance of soils due to operational activities leading to altered faunal habitat	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of faunal habitat
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien plant control plan during the pre-construction phase.	Invasion of alien species in disturbed areas resulting in further habitat loss	Increased introduction and proliferation of alien plant species and further transformation of natural habitat	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on faunal habitat.
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of faunal habitat.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered faunal habitat	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive faunal habitat	Additional pressure on faunal habitat as a result of increased human populations associated with the proposed mine leading to a loss of faunal habitat.	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien plant control plan during the decommissioning and closure phase.
	Construction of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive faunal habitat.	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Dust generation during operational activities leading to a loss of faunal habitat.	
	Increased fire frequency during construction leading to a loss of sensitive faunal habitat	Increased fire frequency during operation leading to a loss of sensitive faunal habitat	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	5	4	5	9	14	126 (Very High)
Operational phase	5	4	5	4	5	9	14	126 (Very High)
Decommissioning and closure phase	5	4	4	4	5	9	13	117 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	2	3	4	7	9	63 (Medium Low)
Operational phase	3	4	2	3	4	7	9	63 (Medium Low)
Decommissioning and closure phase	3	4	2	3	4	7	9	63 (Medium Low)

IMPACT 2: IMPACT ON FAUNAL DIVERSITY

Mining construction and mining activities are likely to have a significant impact on the faunal diversity found within the study area, if infrastructure is placed within the Rocky Ridges and Wetland Depressions. The varying topography and number of different habitat types in the study area give rise to a number of microhabitats being formed, each with a number of species that may only be found within that area, or as is often the case, can be found in a variety of habitat types but often select the most preferable in terms of their survival. This spectrum of habitat types, and associated ecotones between these habitat types gives rise to a higher diversity of faunal species when compared to a homogenous habitat unit.

Activities which are likely to negatively affect the faunal diversity within the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive faunal habitat;
- Destruction of faunal habitat during construction and operational activities;
- Collision of mining vehicles with faunal species;
- Trapping and poaching of faunal species;
- Alien floral invasion in disturbed and eroded areas;

The above activities are likely to have a significant impact on faunal diversity both within and around the study area if infrastructure is placed within sensitive faunal habitat. Many faunal species either occur permanently within the study area, or utilise the study area on a temporary basis for foraging or as a migratory/ movement corridor. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of vegetation leading to a loss of faunal habitat and faunal diversity	On-going disturbance of soils due to operational activities leading to altered faunal diversity	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of faunal diversity
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Faunal habitat alteration through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of faunal diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on faunal diversity.
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of faunal habitat and diversity.	Risk of contamination from all operational facilities may pollute receiving environment leading to altered faunal diversity	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss faunal diversity.	On-going disturbance may lead to erosion and sedimentation resulting in a loss of faunal diversity	
	Collision of faunal species with construction vehicles	Increased fire frequency during operation leading to a loss of faunal diversity	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase	Collision of faunal species with operational vehicles	
	Increased fire frequency during construction leading to a loss of faunal diversity	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Poaching and trapping of faunal species	Poaching and trapping of faunal species	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	5	4	5	9	14	126 (Very High)
Operational phase	5	4	5	4	5	9	14	126 (Very High)
Decommissioning and closure phase	5	4	4	4	5	9	13	117 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	2	3	4	7	9	63 (Medium Low)
Operational phase	3	4	2	3	4	7	9	63 (Medium Low)
Decommissioning and closure phase	3	4	2	3	4	7	9	63 (Medium Low)

IMPACT 3: IMPACT ON FAUNAL SPECIES OF CONSERVATION CONCERN

Placement of infrastructure, construction of the mine and mining activities are highly likely to have a detrimental impact on faunal species of conservation concern that were observed and are likely to occur within the study area. Species which are likely to be affected as a result of the proposed mining are *Ardeotis kori* (Kori Bustard).

Activities which are likely to negatively affect fauna of conservational concern within and around the study area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive faunal habitat;
- Destruction of faunal habitat during construction and operational activities;
- Blasting and vibrations from mining;
- Alien floral invasion and erosion in disturbed areas;
- Increased risk of poaching/trapping and persecution of faunal SCC within the area.

The above activities are likely to have a significant impact on species of conservation concern within and around the study area. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of vegetation leading to a loss of sensitive species	On-going disturbance of habitat due to operational activities leading to a loss of sensitive species	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of sensitive species
Failure to initiate a biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Collision of vehicles with faunal SCC.	Increased introduction and proliferation of alien plant species and further transformation of faunal diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on sensitive species
Placement of open pits, topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Increased risk of poaching and trapping of sensitive species	Risk of contamination from operational facilities may pollute receiving environment leading to a loss of faunal SCC	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive faunal habitat.	Increased risk of poaching and trapping of sensitive species	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive species.	Collision of vehicles with faunal species.	
	Increased fire frequency during construction leading to a loss of sensitive species	Additional pressure on sensitive species by increased human populations associated with the proposed mine	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien plant control plan during the construction phase.	Increased fire frequency during operation leading to a loss of sensitive species	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	4	4	4	4	8	12	96 (Medium High)
Operational phase	4	4	4	4	4	8	12	96 (Medium High)
Decommissioning and closure phase	4	4	4	4	4	8	12	96 (Medium High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	4	3	4	7	11	77 (Medium High)
Operational phase	3	4	3	3	4	7	10	70 (Medium-Low)
Decommissioning and closure phase	3	4	2	3	4	7	9	63 (Medium-Low)

3.3 Wetland Impact Assessment

The impact assessment was undertaken on all aspects of wetland ecology deemed likely to be affected by the proposed project. The sections below present the results of the findings per identified risk/impact for the wetland ecology of the study area.

IMPACT 1: LOSS OF WETLAND HABITAT AND ECOLOGICAL STRUCTURE

Construction related activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure and infrastructure to support mining will lead to destruction of habitat and overall loss of wetland habitat and ecological structure and indirect impacts on wetland resources may occur. Although all possible measures will be implemented to avoid the encroachment of infrastructure in sensitive areas, mining activities will result in permanent impacts on the wetland features if infrastructure is to be placed within the depression wetlands.

Activities which are likely to negatively affect wetland systems within and around the study area include, but are not limited to, the following:

- Placement of mining infrastructure within wetland areas;
- Destruction of wetland habitat during construction and operational activities;
- Dewatering of drainage lines;
- Discharge and/or spills and seepage from mining infrastructure;
- Diversion of surface water systems;
- Construction of clean and dirty water separation areas and a loss of catchment yield.

The above activities are highly likely to have a significant detrimental impact on the wetland habitat within and around the study area should mining infrastructure be placed within the

depression wetlands. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within wetland areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
Inadequate design of infrastructure leading to changes to wetland habitat	Earthworks in the vicinity of wetland resources leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure
	Topsoil stockpiling adjacent to wetland areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Movement of construction vehicles within wetland areas	Dumping of hazardous and non-hazardous waste into the wetland areas	Decommissioning activities may lead to wetland habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland areas	Erosion and sedimentation of wetland leading to loss of wetland and riparian habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland and riparian areas
		Loss of wetland floral biodiversity	Loss of wetland floral biodiversity

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	**5**	**3**	**4**	**2**	**4**	**8**	**10**	**80 (Medium High)**
Operational phase	**5**	**3**	**4**	**3**	**4**	**8**	**11**	**88 (Medium High)**
Decommissioning and closure phase	**5**	**3**	**3**	**2**	**5**	**8**	**10**	**80 (Medium High)**

Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium Low)
Operational phase	5	3	2	3	4	8	9	72 (Medium Low)
Decommissioning and closure phase	5	3	2	2	5	8	9	72 (Medium Low)

From the results of the impact significance determination it is evident that prior to mitigation the impacts in all phases of the mining operation can be considered to be of moderately high significance. With mitigation impacts can be reduced to moderately low levels in all phases of the mining project.

IMPACT 2: CHANGES TO WETLAND ECOLOGICAL AND SOCIOCULTURAL SERVICE PROVISION

Construction related activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure, will lead to destruction of habitat and overall loss of wetland ecological and sociocultural service provision such as cultural value, biodiversity maintenance and nutrient and toxicant assimilation.

Operational activities will likely result in the contamination of wetland soils and water, which will lead to the alteration or loss of wetland ecological and sociocultural service provision.

Activities which are likely to negatively affect wetland systems within and around the mining footprint area include, but are not limited to, the following:

- Placement of mining infrastructure within wetland areas;
- Destruction of wetland habitat during construction and operational activities;
- Dewatering of preferential flow paths;
- Discharge and/or spillage and seepage from mining infrastructure;
- Diversion of surface water systems;
- Loss of catchment yield through the separation of clean and dirty water systems.

The above activities are highly likely to have a significant detrimental impact on wetland ecological and sociocultural service provision within and around the study area and also downstream should mining infrastructure be placed within the depression wetlands. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within wetland areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Potential inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
Potential inadequate design of infrastructure leading to changes to wetland habitat	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure
	Topsoil stockpiling adjacent to wetland areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Movement of construction vehicles within wetland areas	Dumping of hazardous and non-hazardous waste into the wetland areas	Decommissioning activities may lead to wetland habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland areas	Erosion and sedimentation of wetland areas leading to loss of wetland habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland areas
		Loss of wetland floral biodiversity	Loss of wetland floral biodiversity

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	**5**	**1**	**4**	**2**	**4**	**6**	**10**	**60 (Medium Low)**
Operational phase	**5**	**2**	**4**	**3**	**4**	**7**	**11**	**77 (Medium Low)**
Decommissioning and closure phase	**5**	**1**	**4**	**2**	**5**	**6**	**11**	**66 (Medium Low)**

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	**5**	**1**	**3**	**2**	**4**	**6**	**9**	**54 (Medium Low)**
Operational phase	**5**	**1**	**4**	**2**	**4**	**6**	**10**	**60 (Medium Low)**
Decommissioning and closure phase	**5**	**1**	**3**	**2**	**5**	**6**	**10**	**60 (Medium Low)**

From the results of the impact significance determination it is evident that prior to mitigation the impacts in all phases of the mining operation can be considered to be of a moderately low significance. Even with mitigation impacts remain moderately low levels in all phases of the development but some reduction in impact scores is evident.

IMPACT 3: IMPACTS ON WETLAND HYDROLOGICAL FUNCTION AND SEDIMENT BALANCE

Mining and construction activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure, will lead to disturbances of wetland hydrological function and sediment balance.

Activities which are likely to negatively affect wetland systems within and around the study area include, but are not limited to, the following:

- Placement of mining infrastructure within wetland areas;
- Destruction of wetland habitat during construction and operational activities;
- Dewatering of preferential flow paths;
- Discharge and/or spillage and seepage from mining infrastructure;
- Diversion of surface water systems;
- Loss of catchment yield through the separation of clean and dirty water systems.

The above activities are highly likely to have a significant detrimental impact in the immediate vicinity of the provision within and around the study area and also downstream should mining infrastructure be placed within the depression wetlands. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within wetland areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Potentially inadequate design of infrastructure leading to changes to wetland habitat	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure
	Topsoil stockpiling adjacent to wetland areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Decommissioning activities may lead to wetland habitat transformation and alien plant species proliferation
	Movement of construction vehicles within wetland areas	Erosion and sedimentation of wetland areas leading to loss of wetland habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland areas
		Loss of wetland floral biodiversity	Loss of wetland floral biodiversity

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	2	3	4	4	7	11	77 (Medium High)
Operational phase	5	4	4	4	4	9	12	108 (High)
Decommissioning and closure phase	5	2	3	4	5	7	12	84 (Medium High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial 3scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	2	3	3	4	7	10	70 (Medium Low)
Operational phase	5	2	3	3	4	7	10	70 (Medium Low)
Decommissioning and closure phase	3	2	3	3	4	5	10	50 (Low)

From the impact analyses it is evident that prior to mitigation the impacts of the construction and decommissioning phase are medium high while operational phase impacts are high. With mitigation the impacts in all phases can be substantially reduced with construction phase impacts considered moderately low, operational phase impacts moderately low and decommissioning phase impacts low.

3.4 Impact assessment conclusion

Based on the above assessment there are three possible impacts on the floral resources, three possible impacts on the faunal resources and three possible impacts on the wetland resources. The tables below summarise the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

From the results of the floral impact assessment it is evident that prior to mitigation all impacts on the receiving floral environment are high in the construction and decommissioning and closure phases and high in the operational phase. Mitigation measures available will likely minimise the impacts on the receiving floral environment and impact significance is reduced to medium low after mitigation, which includes placing infrastructure outside of sensitive areas.

Table 5: Summary of impact significance on floral resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for floral species	High	Medium Low
2: Impact on floral diversity	High	Medium Low
3: Impact on species of conservation concern	Very-High	Medium High
Operational Phase		
Impact	**Unmanaged**	**Managed**

1: Impact on habitat for floral species	High	Medium Low
2: Impact on floral diversity	High	Medium Low
3: Impact on species of conservation concern	Very High	Medium High
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for floral species	High	Medium Low
2: Impact on floral diversity	High	Medium Low
3: Impact on species of conservation concern	High	Medium High
Summary	**High**	**Medium Low**

From the results of the faunal impact assessment it is evident that prior to mitigation all impacts on the receiving faunal environment are medium high, high to very high in the construction, operational and decommissioning and closure phases. Mitigation measures available, which include placing infrastructure outside of sensitive areas, will alleviate some of the impacts on the receiving faunal environment and with mitigation measures in place the impact significance can be reduced to mostly medium low levels.

Table 6: Summary of impact significance on faunal resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	Very High	Medium-Low
2: Impact on faunal diversity	Very High	High
3: Impact on species of conservation concern	Medium High	Medium High
Operational Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	Very High	Medium-Low
2: Impact on faunal diversity	Very High	Medium High
3: Impact on species of conservation concern	Medium High	Medium Low
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	High	Medium Low
3: Impact on species of conservation concern	Medium High	Medium Low
Summary	**Very High**	**Medium**

From the results of the wetland impact assessment it is evident that prior to mitigation impacts on the wetland systems are very high throughout all phases. Mitigation measures available, which includes placing infrastructure outside of sensitive areas, will minimise the impacts on the receiving wetland environment and impact significance will be reduced to medium low significance.

Table 7: Summary of impact significance on wetland resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Changes to riparian habitat and ecological structure	Medium High	Medium Low
2: Changes to riparian ecological and sociocultural service provision	Medium Low	Medium Low
3: Impact on hydrological function and sediment balance	Medium High	Medium Low
Operational Phase		
Impact	**Unmanaged**	**Managed**

1: Impact on habitat for faunal species	Medium High	Medium Low
2: Impact on faunal diversity	Medium Low	Medium Low
3: Impact on species of conservation concern	High	Medium High
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	Medium High	Medium Low
2: Impact on faunal diversity	Medium Low	Medium Low
3: Impact on species of conservation concern	Medium High	Low
Summary	**Medium High**	**Medium**

4. INTEGRATED IMPACT MITIGATION

4.1 Floral Impact Mitigation

4.1.1 Mitigation measures

Based on the findings of the floral ecological assessment, several recommendations are made to minimise the impact on the floral ecology of the area, should the proposed mining project proceed:

- Any disturbance of sensitive floral habitat and species of conservation concern must be avoided as far as possible;
- If any mining activities are to be authorised, it is strongly recommended that the surface footprint of the proposed mine be reduced to the minimum;
- The footprint and daily operation of surface infrastructure must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding sensitive floral habitat. The significance of the impact on the ecology of the area will be largely linked to the degree to which this can be implemented;
- Sensitive floral habitat and associated buffer zones beyond the immovable footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas;
- An effective dust management plan bust be designed and implemented in order to mitigate the impact of dust on flora throughout all mining phases;
- Adequate stormwater management must be incorporated into the design of the proposed development throughout all phases in order to prevent erosion of topsoil and the loss of floral habitat. In this regard, special mention is made of:

    - Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed;
    - Runoff from paved surfaces should be slowed down by the strategic placement of berms; and

- All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff of the facilities;

- An alien floral 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 5 years after decommissioning and closure;
- No collection of firewood, SCC/Protected or medicinal floral species must be allowed by mining personnel;
- No illicit fires must be allowed during any phases of the proposed mining development;
- Concurrent/progressive rehabilitation must be implemented at all times and disturbed areas must be rehabilitated as soon as possible. This will not only reduce the total disturbance footprint, but will also reduce the overall rehabilitation effort and cost;
- A nursery must be developed in conjunction with a suitably qualified specialist where indigenous/endemic plant species must be propagated with focus on rehabilitation;
- Rehabilitation trials must be continuously undertaken from the commencement of construction in order to determine the efficiency of rehabilitation methods and the suitability of flora propagated in the nursery for rehabilitation;
- The nursery plan and rehabilitation plan must be continuously updated in accordance with the trial results in order to ensure that optimal rehabilitation measures are employed;
- Rehabilitation efforts must be implemented for a period of at least 5 years after decommissioning and closure;
- A floral SCC relocation, monitoring and management plan must be designed and implemented by a suitably qualified specialist and should address all species which can be successfully rescued and relocated;
- During the surveying and site-pegging phase of surface infrastructure, all SCC/protected species which will be affected by surface infrastructure must be marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. If relocation is impossible or any of the protected species are destroyed, 2 plants for every protected plant destroyed must be propagated in the nursery. The relevant permits must be applied for as indicated in the baseline floral assessment;

4.1.2 Probable Latent Impacts

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

- Destruction of ecologically intact, irreplaceable floral habitat;
- Permanent loss of niche floral habitat;
- Permanent loss of and altered floral species diversity;
- Alien floral invasion;
- Permanent loss of SCC/protected floral species and suitable habitat; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and significant loss of floral habitat, species diversity and SCC/protected floral species will most likely be permanent.

4.1.3 Floral monitoring

A floral monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must be established in areas surrounding the surface infrastructure and rehabilitated areas. These plots must be designed to accurately monitor the following parameters on an annual basis:
  - Measurements of crown and basal cover;
  - Species diversity;
  - Species abundance;
  - Impact of dust on flora;
  - Recruitment of indigenous species;
  - Alien vs. Indigenous plant ratio;
  - Recruitment of alien and invasive species;
  - Erosion levels and the efficacy of erosion control measures;
  - Vegetation community structure including species composition and diversity which should be compared to pre-development conditions;
- Monitoring of rehabilitation trials in light of the above parameters must also take place throughout all phases of the proposed mining development and for a period of 5 years after decommissioning and closure;
- The rehabilitation plan must 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 development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent.

- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

4.2 Faunal Impact Mitigation

4.2.1 Mitigation measures

Based on the findings of the faunal ecological assessment, several recommendations are made to minimise the impact on the faunal ecology of the area, should the proposed mining project proceed. Please note that many of the mitigation measures applicable to floral ecology are applicable to faunal ecology and to avoid repetition were omitted. However, all floral mitigation measures must be implemented in conjunction with faunal mitigation measures:

- No areas falling outside of the footprint area may be cleared for construction or mining purposes;
- As far as possible avoid placing any infrastructure within sensitive areas;
- The footprint of the proposed mine should be kept to the minimum;
- The footprint and daily operation of surface infrastructure must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding habitat units. The significance of the impact on the ecology of the area will be largely linked to the degree to which this can be implemented;
- No trapping, collecting or hunting of faunal species must be allowed during any phases of the proposed mining development;
- Sensitive faunal habitat and associated buffer zones adjacent to footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas;
- All voids, or open pits must be fenced off in order to prevent faunal species falling into such features;
- As far as possible the existing road network is to be used, limiting further impact as a result of the construction of new roads;
- Restrict vehicles to designated roadways to limit the ecological footprint of the construction and operational activities as well as to reduce the possibility of collisions with faunal species;
- Prohibit uncontrolled fires within the study area;
- Site clearing should occur within phases, enabling faunal species to naturally move to surrounding natural areas. During this time of clearing it is recommended that fences are removed in the affected sections so as to enable easy movement of faunal species out of the areas being cleared;

- Where possible the removal of large established trees must be avoided, as these provide breeding and roosting sites for raptor species occurring within the region; and

4.2.2 Probable Latent Impacts

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

- Loss of ecologically important faunal habitat;
- Loss of faunal habitat diversity;
- Loss of and altered faunal species diversity;
- Loss of SCC and associated suitable habitat; and

4.2.3 Faunal Monitoring

A faunal monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved It is recommended that monitoring activities be conducted on an annual basis. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- It is recommended that monitoring points must be established in areas surrounding the mining area. These points must be designed to accurately monitor the following parameters:
  - Species diversity (mammal, invertebrate, amphibian, reptile and avifaunal);
  - Species abundance; and
  - Faunal community structure including species composition and diversity which should be compared to pre-development conditions.
- The following methods aim to guide the monitoring plan, although more detailed, site specific methods must be employed during the development and implementation of the monitoring plan:
  - Monitoring activities must take place on an annual basis as a minimum;
  - Pitfall traps can be installed to monitor invertebrate diversity;
  - Sherman traps can be installed to monitor small mammal diversity;
  - Fixed and random points for bird counts to determine species composition and diversity trends;

- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent.
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

4.3 Wetland Ecological Impact Mitigation

4.3.1 Mitigation measures

Based on the findings of the wetland ecological assessment, several recommendations are made to minimise the impact on the wetland ecology of the area, should the proposed mining project proceed:

- Measures to contain and reuse as much water as possible within the mine process water system and water from dewatering of operational areas should be sought;
- All storm water and pollution control dams should be lined;
- Very strict control of water consumption must take place and detailed monitoring must take place and where all water usage must continuously be optimised;
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas which recharge the receiving wetland environment;
- All mining infrastructure should remain out of the wetland zones and associated buffer zones in line with the requirements of Regulation GN704 of the National water Act;
- No dirty water runoff must be permitted to reach the wetland resources during the entire life of mine, and clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from entering the receiving aquatic environment. Clean and dirty water runoff systems should be constructed before construction of any other infrastructure takes place;
- Strict control of sewage water treatment must take place and the sewage system should form part of the mine's closed process water system;
- All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs;
- Any dirty water runoff containment facilities must remain outside of the defined wetland areas and their buffers as a measure to minimise the impact on the receiving environment;
- Adequate storm water management must be incorporated into the design of the proposed mine development in order to prevent erosion and the associated sedimentation of the wetland areas. In this regard special mention is made of:

- Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed;
- Runoff from paved surfaces should be slowed down by the strategic placement of berms; and
- All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff of the facilities;

➢ During any construction phase or exploration drilling activities no vehicles should be allowed to indiscriminately drive through the wetland systems and vehicles must remain on designated roadways;

➢ During the construction and operational phases of the proposed mining development erosion berms should be installed on roadways to prevent gully formation and siltation of the wetland resources. The following points should serve to guide the placement of erosion berms:

- Where the track has slope of less than 2%, berms every 50m should be installed;
- Where the track slopes between 2% and 10%, berms every 25m should be installed;
- Where the track slopes between 10%-15%, berms every 20m should be installed;
- Where the track has slope greater than 15%, berms every 10m should be installed;

➢ No dumping of waste should take place within the riparian wetland. If any spills occur, they should be immediately cleaned up;

➢ All areas affected by stockpiling during the operational phase of the mine should be rehabilitated and stabilised using cladding or a suitable grass mix to prevent sedimentation of the wetland resources in the area;

➢ Throughout the life of mine measures to control alien vegetation must be implemented;

4.3.2 Wetland Monitoring

➢ Close monitoring of surface water quality must take place. Monitoring of water quality should take place at a minimum frequency of once a month during which time major salts and basic metals, are monitored along with basic parameters such as pH, TSS and TDS, dissolved oxygen and EC;

➢ Toxicity testing of the mine process water facilities should take place concurrently with the biomonitoring program in order to monitor the toxicological risk of the process water system to the receiving environment. Tests should include the following test organisms as a minimum:

- *Vibrio fischeri;*
- *Poecilia reticulata*

- *Daphnia pulex; and*
- Algal Growth Potential.

➢ The mine must be managed as a zero discharge facility, however definitive toxicological testing according to the DEEEP protocol should take place should it become evident that process water discharge or decant of groundwater will occur for safety reasons in order to define safe discharge volumes and ensure sufficient dilution;

4.3.3 Probable Latent Impacts

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

➢ Altered wetland vegetation structures;
➢ Ongoing impacts on water quality in local water courses due to runoff from the impacted mine area;and
➢ Loss of some species less tolerant of water quality changes is likely on a localised scale.

4.4 Additional measures

In order to ensure that impact mitigation takes place to an adequate level should mining proceed it is deemed essential that a Biodiversity Action Plan (BAP) be developed which contains details on all actions that need to be undertaken to manage impacts on the ecology of the region. In addition the BAP and its implementation should be overseen by an environmental panel which should include representatives from the mine and any relevant local stakeholders like farmers. The BAP should also be seen as a living document and must be continuously updated based on the findings of management and the ecological monitoring program. The actions required from the BAP should be implemented into a fully automated Environmental Management System (EMS).

5. IMPACT STATEMENT

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal and wetland assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the COZA Iron Ore Project on the farm Jenkins 562 near the town Postmasburg within the Northern Cape Province.

The study area is situated approximately 20 km south of the town of Kathu, 11 km south of the Sishen mine and the south western boundary of the study area is situated adjacent to the R325 roadway.

The COZA Iron Ore Project will involve the mining of iron ore from three Farms namely the remaining extent of Driehoekspan 435, Portion 1 of Doornpan 445 and Jenkins 562. Specialist studies have been undertaken on the farms Driehoekspan and Doornpan, thus only the Jenkins farm will be investigated and discussed in this assessment. The life of the mine (LOM) is 7 years whereby the Jenkins farm will be mined throughout the LOM and Driehoekspan will be mined from year 3 and the Doornpan farm will be mined from year 5. Since the resources are of a shallow nature it was thought ideal to mine by an opencast mining method which will be conducted by means of conventional truck and shovel open pit mining operations.

This report, after consideration and description of the ecological integrity of the mining rights area and mining footprint area, must guide the Environmental Assessment Practitioner (EAP), authorities and potential developers, by means of recommendations, as to viability of the proposed mining development from an ecological point of view.

The objective of this study was to provide sufficient information on the ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to compared and considered along with the need to ensure 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 resources on the subject property will be made in support of the principle of sustainable development.

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

Prepared for

SYNERGISTICS - part of the SLR group

January 2016

SECTION A – INTRODUCTION AND BACKGROUND INFORMATION

Prepared by:	**Scientific Aquatic Services**
Report author	**E. van der Westhuizen**
Report reviewer	**S. van Staden (Pri. Sci. Nat)**
Report Reference:	**SAS 215160**
Date:	**January 2016**

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Declaration

This report has been prepared according to the requirements of Section 23 (5) of the Environmental Impact Assessments EIA Regulations, 2014 (No. R. 982). We (the undersigned) declare the findings of this report free from influence or prejudice.

Project Manager:

Stephen van Staden *Pr Sci Nat* (Ecological Sciences) 400134/05
BSc. Hons (Aquatic Health) (RAU);
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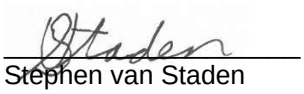
Field of expertise:
Wetland, aquatic and terrestrial ecology.



Stephen van Staden

Date: 22/01/2016

EXECUTIVE SUMMARY

Based on the findings of the ecological assessment it is the opinion of the ecologists that the proposed mining project be considered favorably. However, all mitigation measures and recommendations presented in this report should be adhered to and integrated into the EMP as to ensure the ecology within the proposed mining areas as well as surrounding zone of influence is protected or adequately rehabilitated in order to minimize the deviations from the Present Ecological State. Particular attention needs to be paid to the location and extent of wetland systems in order to ensure that infrastructure does not encroach upon the wetlands and associated buffers.

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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 resources on the subject property will be made in support of the principle of sustainable development.

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

NEMA Regs (2014) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	**Section A:** Cover Page
The expertise of that person to compile a specialist report including a curriculum vitae	**Section A:** Annexure A
A declaration that the person is independent in a form as may be specified by the competent authority	**Section A:** Page ii

NEMA Regs (2014) - Appendix 6	Relevant section in report
An indication of the scope of, and the purpose for which, the report was prepared	**Section A:** Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	**Section A:** Section 2.1
A description of the methodology adopted in preparing the report or carrying out the specialised process	**Section B:** Section 3 **Section C:** Section 2 **Section D:** Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	**Section B:** Section 9 **Section D:** Section 5.7
An identification of any areas to be avoided, including buffers	**Section B:** Section 9 **Section D:** Section 5.7
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Section B:** Section 9 **Section D:** Section 5.7
A description of any assumptions made and any uncertainties or gaps in knowledge;	**Section A**: Section 1.3
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	**Section F**
Any mitigation measures for inclusion in the EMPr	**Section F**
Any conditions for inclusion in the environmental authorisation	**Section F**
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	**Section F**
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	**Section A:** Executive summary **Section F**
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	**Section A:** Executive summary **Section F**
A description of any consultation process that was undertaken during the course of carrying out the study	**Public consultation process undertaken by SLR**
A summary and copies if any comments that were received during any consultation process	**No comments received during consultation process**
Any other information requested by the competent authority.	**N/A**

FAUNAL, FLORAL AND WETLAND ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE JENKINS PROJECT NEAR THE TOWN POSTMASBURG WITHIN THE NORTHERN CAPE PROVINCE

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ACRONYMS

BGIS	Biodiversity Geographic Information System
°C	Degree Celsius
CARA	Conservation of Agricultural Resources Act
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EC	Ecological Class
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
ES	Ecological Sensitivity
FEPA	Freshwater Ecosystem Priority Area
GIS	Geographic Information System
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
LOM	Life of Mine
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
m	metre
mm	millimetre
NBA	National Biodiversity Act
NCNCA	Northern Cape Nature Conservation Act
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NPAES	National Protected Area Expansion Strategy
NPSDF	Northern Cape Provincial Spatial Development Framework
NWA	National Water Act

PES	Present Ecological State
POC	Probability of Occurrence
RDL	Red Data Listed
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SCC	Species of Conservational Concern
SCC	The term SCC in the context of this report refers to all RD (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.
SCCSIS	Species of Conservational Concern Sensitivity Index Score
SQ	Sub-quaternary
SQR	Sub-Quaternary Reach
subWMA	Sub-water Management Area
WMA	Water Management Area

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal and wetland assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the COZA Iron Ore Project on the farm Jenkins 562 near the town Postmasburg within the Northern Cape Province.

The study area is situated approximately 20 km south of the town of Kathu, 11 km south of the Sishen mine and the south western boundary of the study area is situated adjacent to the R325 roadway (Figure 1 and 2).

The COZA Iron Ore Project will involve the mining of iron ore from three Farms namely the remaining extent of Driehoekspan 435, Portion 1 of Doornpan 445 and Jenkins 562. Specialist studies have been undertaken on the farms Driehoekspan and Doornpan, thus only the Jenkins farm will be investigated and discussed in this assessment. The life of the mine (LOM) is 7 years whereby the Jenkins farm will be mined throughout the LOM and Driehoekspan will be mined from year 3 and the Doornpan farm will be mined from year 5. Since the resources are of a shallow nature it was thought ideal to mine by an opencast mining method which will be conducted by means of conventional truck and shovel open pit mining operations.

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

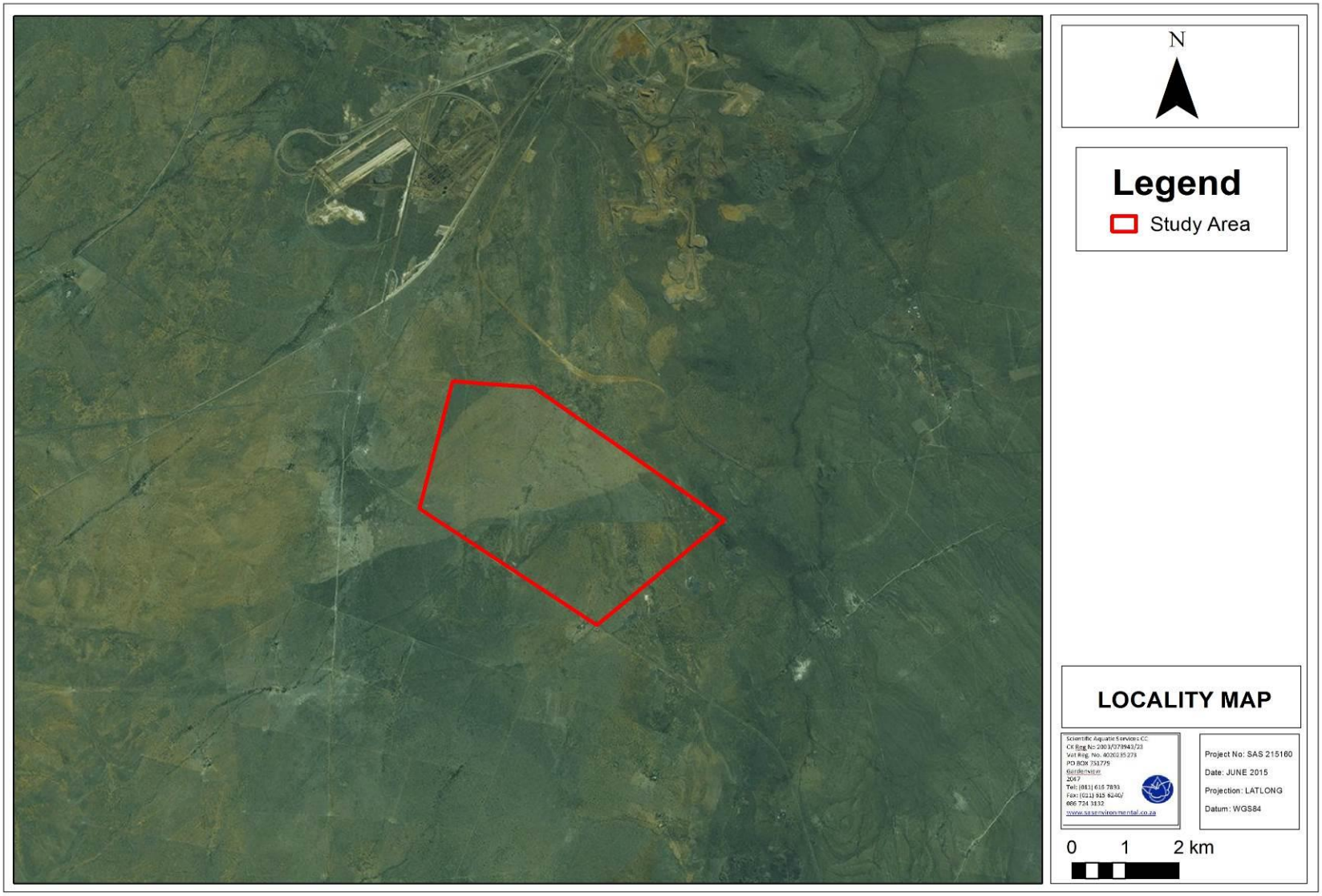

Figure 1: A digital satellite image depicting the location of the study area in relation to the surrounding area.

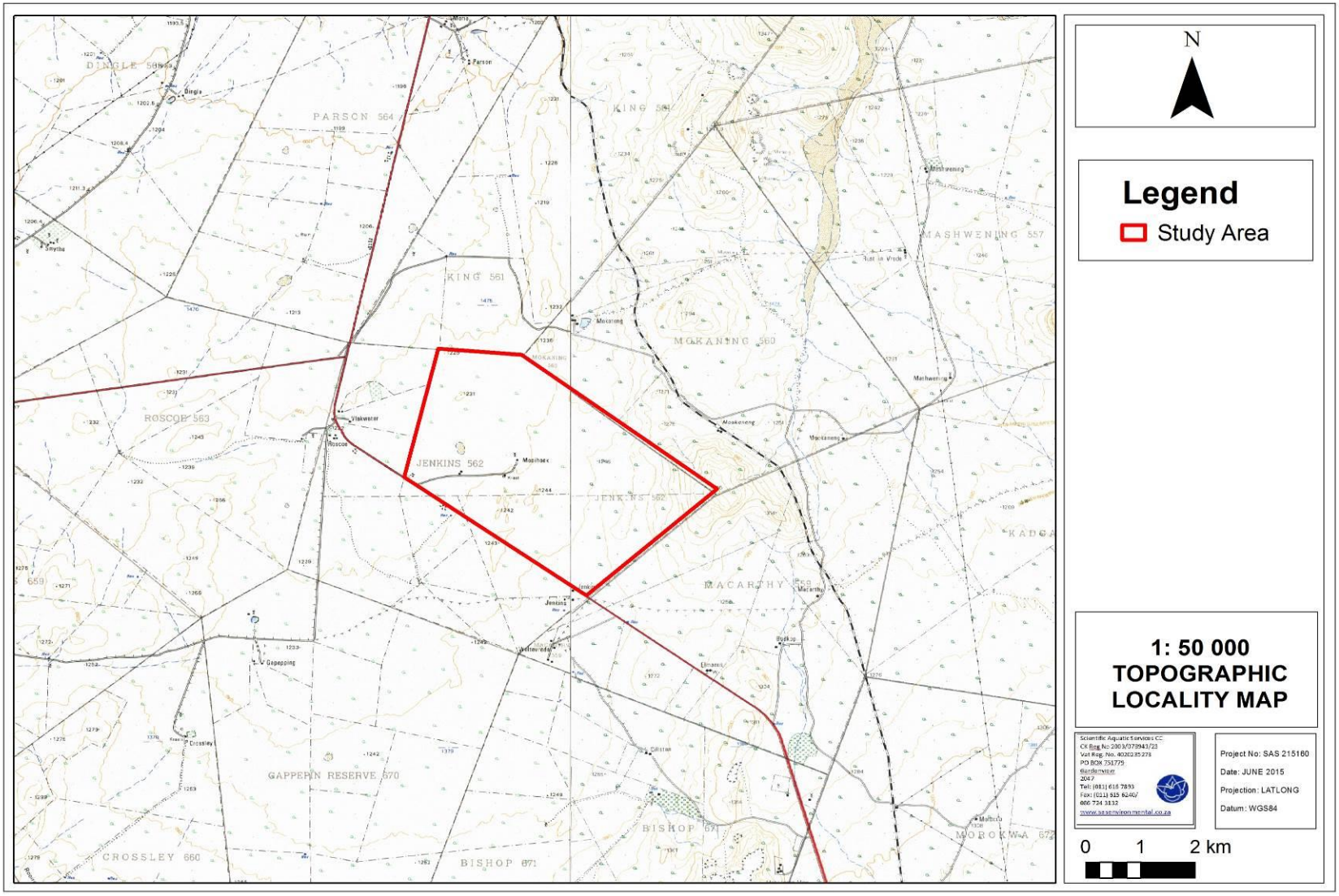

Figure 2: The study area depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.2 Project Scope

Terrestrial Assessment

Specific outcomes in terms of the terrestrial assessment report are outlined below:

- Faunal and floral inventories of species as encountered within the study area, are provided;
- Habitat units were determined and described in terms of communities and ecological state;
- A list of flora and fauna Species of Conservational Concern (SCC) list was compiled (desktop level), including the habitat for these species to occur within the study area. The Probability of Occurrence (POC) and a Species of Conservational Concern Sensitivity Index Score (SCCSIS) for listed species was implemented and calculated;
- All sensitive landscapes including rocky ridges, wetlands and/or any other special features were identified and described;
- Environmental impacts of the proposed activity on the terrestrial ecology within the study area was determined; and
- Possible management and mitigation measures, which should be included in the Environmental Management Programme (EMPr) of the development to assist in minimising the impact on the receiving environment, are presented.

Wetland Assessment

Specific outcomes in terms of the wetland assessment report are outlined below:

- A desktop study was compiled with all relevant information as presented by the South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (GIS) website (http://bgis.sanbi.org) as well as the location of Freshwater Ecosystem Priority Area (FEPA) in relation to the three candidate sites;
- The classification of wetland features according to the "Classification System for Wetlands and other Aquatic Ecosystems in South Africa" as defined by Ollis *et al*., (2013) was applied;
- The wetland services provided by the resources located on the study area according to the method of Kotze *et al.,* (2008) was determined;
- The wetland-Health according to the resource directed measures guideline as defined by Macfarlane *et al*., (2008) was determined;

- The wetland temporary zone was delineated according to the method of Department of Water and Sanitation (DWS) “A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones, 2005”;
- The Environmental Importance and Sensitivity (EIS) was determined;
- A Recommended Ecological Category (REC) was recommended, where applicable, based on the findings of the EIS assessment;
- The environmental impact on the wetland was determined;
- Mitigatory measures to minimise impacts are recommended should the proposed activities proceed; and

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The terrestrial and wetland assessment was confined to the study area and therefore does not include the neighbouring and adjacent properties. These were, however, considered as part of the desktop assessment;
- The time of the assessment took place over a period where rainfall was low. Thus, not all species would have been noted that would normally occur within a higher rainfall period;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the study areamay therefore have been missed during the assessment;
- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked;
- Due to the majority of wetland features being highly ephemeral within the region where the study area is located, very few areas were encountered that displayed more than one wetland characteristic as defined by the DWA (2005) method. As a result, the identification of the outer boundary of temporary zones proved difficult in some areas and in particular in the areas where wetland conditions are marginal.
    - The wetland delineation as presented in this report is regarded as a best estimate of the wetland boundary based on the site conditions present at the time of assessment within the pans and drainage line features; and
    - The outer boundary of the temporary wetland zones of the pans was not mapped since the wetland area in most pans was extremely small and

isolated to a small area in the deepest part of the pan. Instead, the entire pan was delineated as either a Wetland pan or a Terrestrial pan.

- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required the wetland will need to be surveyed and pegged according to surveying principles;
- Wetlands and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative wetland species. Within this transition zone some variation of opinion on the wetland boundary may occur, however, if the DWA (2005) method is followed, all assessors should get largely similar results; and
- The level of detail undertaken in the study is considered sufficient to ensure that the results of this assessment accurately define the Ecological Importance and Sensitivity (EIS) and the Present Ecological State (PES) of the study area and to provide the relevant planners and decision makers with sufficient information to formulate an opinion on the viability of the proposed development from an ecological conservation viewpoint.

1.4 Indemnity and Terms of Use of this Report

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

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report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section of the main report.

1.5 Legislative requirements

1.5.1 National Environmental Management Act, (NEMA, Act 107 of 1998)

The guiding principles of NEMA (Act 107 of 1998) refer specifically to biodiversity management in the following Clause:

- (4) (a) *Sustainable* development requires the consideration of all relevant factors including the following:

  (i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.

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

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

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

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

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity

being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.

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

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

1.5.3 The Northern Cape Nature Conservation Act (NCNCA, Act No 9 of 2009)

Restricted activities involving specially protected plants:

49 (1) No person may, without a permit-

(a) Pick;
(b) Import;
(c) Export;
(d) Transport;
(e) Possess;
(f) Cultivate; or
(g) Trade in, a specimen of a specially protected plant

Restricted activities involving protected plants

50 (1) Subject to the provision of section 52, no person may, without a permit-

(a) Pick;
(b) Import;
(c) Export;
(d) Transport;
(e) Cultivate; or
(f) Trade in, a specimen of a protected plant.

1.5.4 National Water Act (Act 36 of 1998)

The National Water Act (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by DWS.

Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWA in terms of Section 21 of the National Water Act.

1.5.5 GN 1199 as published in the Government Gazette 32805 of 2009 as it relates to the NWA

Wetlands are extremely sensitive environments and as such, the Section 21 (c) and (i) water use General Authorisation does not apply to any wetland or any water resource within a distance of 500 meters upstream or downstream from the boundary of any wetland or estuary. The DWS is currently drafting a replacement of Regulation GN1199 which may allow for a standardised risk assessment tool to be applied, which, if it proves that all risks are low level risks will allow the proposed activity to be licenced by means of a General authorisation.

2 IMPACT ASSESSMENT

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[1]. The interaction of an aspect with the environment may result in an impact;
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly,

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

where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;

- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Frequency of activity** refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial extent** refers to the geographical scale of the impact; and
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

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

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

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model

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

outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table 1: Criteria for assessing significance of impacts.

LIKELIHOOD DESCRIPTORS

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

CONSEQUENCE DESCRIPTORS

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

Permanent	5

Table 2: Significance rating matrix.

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

Table 3: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact management recommendation	Positive Impact management recommendation
Very High	126 - 150	Consider the viability of the project. Very strict measures to be implemented to mitigate impacts according to the impact mitigation hierarchy	Actively promote the project
High	101 - 125	Consider alternatives in terms of project execution and location. Ensure designs take environmental sensitivities into account and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Promote the project and monitor ecological performance
Medium High	76 – 100	Consider alternatives in terms of project execution and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Implement measures to enhance the ecologically positive aspects of the project while managing any negative impacts
Medium Low	51 - 75	Ensure management and housekeeping is maintained and attention to impact minimisation is paid	Implement measures to enhance the ecologically positive aspects of the project while actively managing any negative impacts
Low	26 - 50	Promote the project and ensure management and housekeeping is maintained	Monitor ecological performance and pay extensive attention to minimising potential negative environmental impacts
Low Very	1 - 25	Promote the project	Actively seek measures to implement impact minimisation according to the impact mitigation hierarchy and identify positive ecological aspects to be promoted

The following points were considered when undertaking the assessment:

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

2.1 Mitigation Measure Development

The following points present the key concepts considered in the development of mitigation measures for the proposed construction.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[3] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
    - Avoidance or prevention of impact;
    - Minimisation of impact;
    - Rehabilitation; and if necessary
    - Offsetting
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and

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

- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, wherever possible.

2.2 Recommendations

Recommendations were developed to address and mitigate potential impacts on the wetland ecology associated with the study area.

3 ECOLOGICAL DESKTOP DESCRIPTION

The following sections (Sections 2.1 – 2.11) present data accessed as part of the desktop assessment. This section is divided into terrestrial (includes floral and faunal assessments) as well as wetland conservational importance. It is important to note, that although all data sources used provide useful and often verifiable, high quality data, the various databases used does not always provide an entirely accurate indication of the study area's actual site characteristics. This information is however considered useful as background information in the study. Thus, this data was used as a guideline to inform the assessment and special attention will be afforded to areas indicated to be of higher conservation importance.

3.1 National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptional high conservation value (SANBI, BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) the study area falls into a "least threatened" ecosystem in terms of the original and the remaining extent of the associated vegetation type.

3.2 The National Protected Area Expansion Strategy (NPAES, 2010)

The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets, provide maps of the most important areas and makes recommendations on mechanisms for protected area expansions. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

According to the NPAES database, the study area does not fall within or close to a formal or informal protected area.

3.3 The National Biodiversity Assessment (NBA, 2011)

The recently completed NBA has provided an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine, and marine environments. The NBA was led by the SANBI in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment (2004), broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial, and local levels (SANBI BGIS).

The assessment of ecosystem level is then evaluated as the proportion of each vegetation type protected relative to the biodiversity target. According to the NBA, the study area is currently located within an area that is not protected.

3.4 National Land Cover (2009)

Land cover and land use changes often indicate major impacts on biodiversity, especially if those changes show the loss of natural habitat due to urban sprawl, cultivation, etc. The study area is indicated to be natural land (Figure 3).

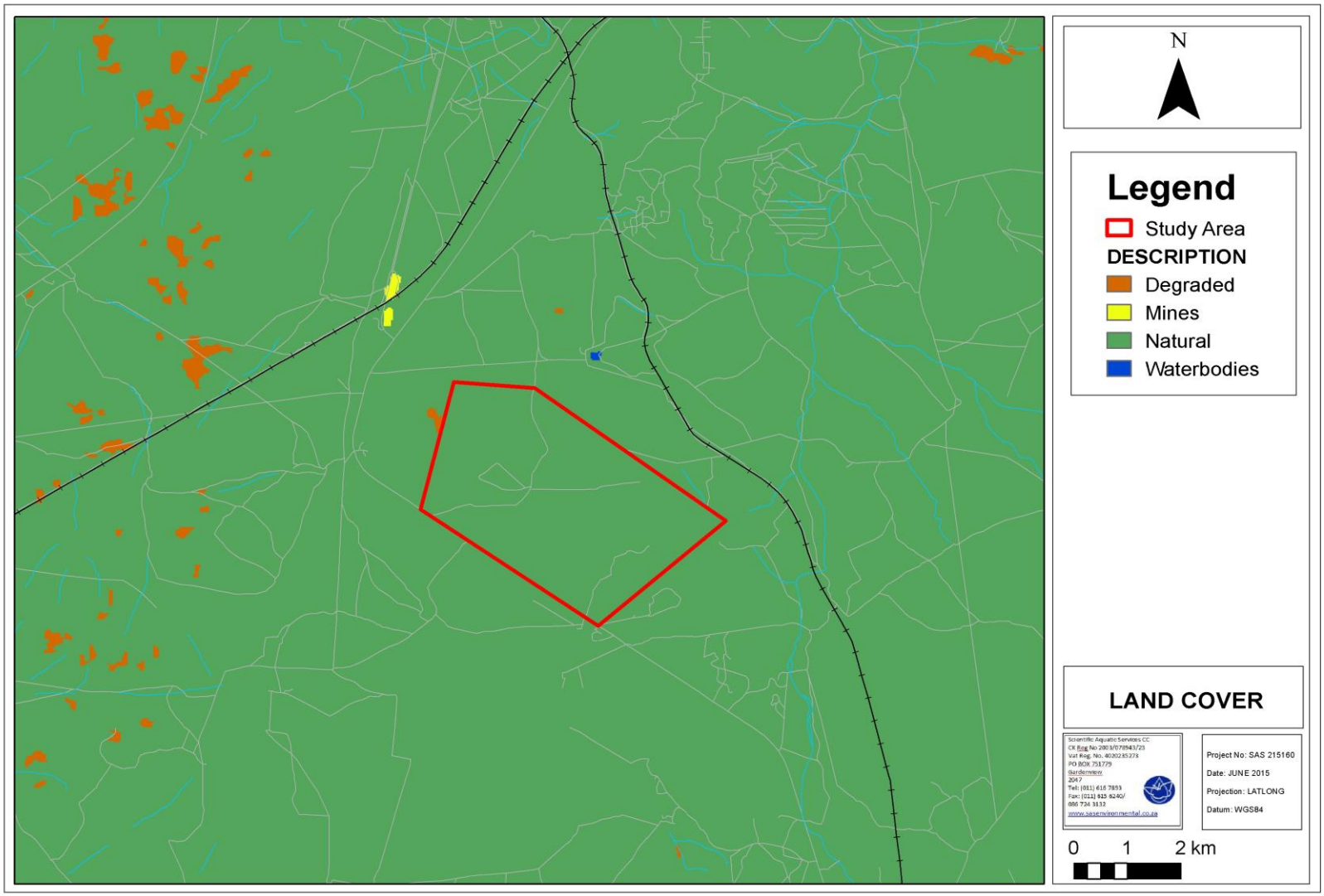

Figure 3: The land cover indicated for the study area (2009).

3.5 Griqualand West Centre of Endemism

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

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

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

All vegetation within the study area has been disturbed to some degree and would therefore not add to the conservation of intact GWC vegetation.

3.6 Importance According to the Northern Cape Provincial Spatial Development Framework (NPSDF, 2012)

According to the NPSDF (2012), the study area is located within Griqualand West Centre of Endemism in the Northern Cape Province (Figure 4) and is located within an area that is still intact, although extremely poorly conserved.

3.7 Importance According to the Mining and Biodiversity Guideline (2012)

The Mining Biodiversity Guideline (2012) provides explicit direction in terms of where mining-related impacts are legally prohibited, where biodiversity priority areas may present high risks for mining projects, and where biodiversity may limit the potential for mining. The Guideline distinguishes between four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view as well as the implications for mining. These categories include: Legally Protected Areas,

Highest Biodiversity Importance, High Biodiversity Importance and Moderate Biodiversity Importance.

According to the Mining and Biodiversity Guidelines, no importance is indicated for the study area.

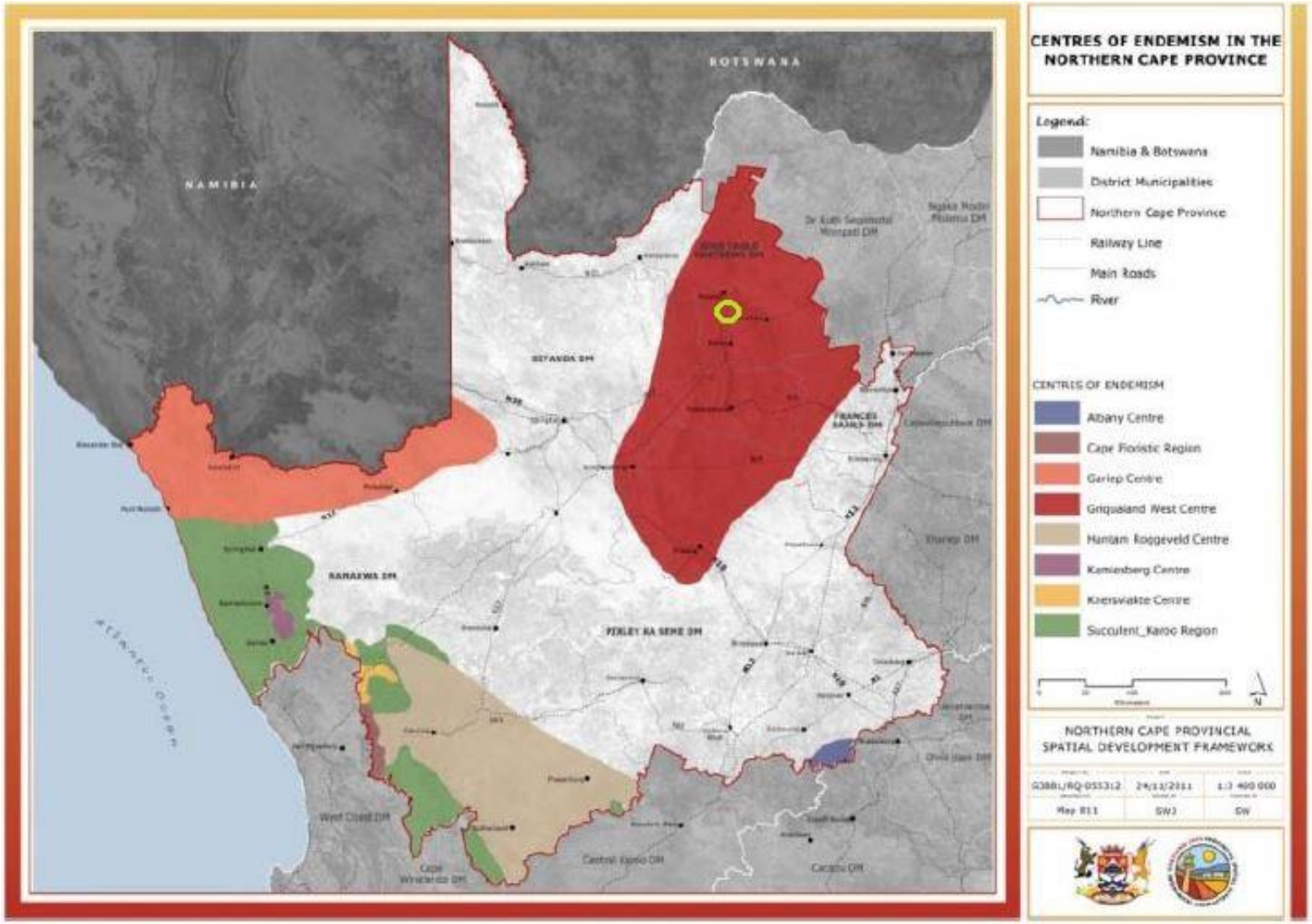

Figure 4: Centers of endemism of the Northern Cape Province: the study area indicated by a yellow circle (Northern Cape Provincial Spatial Development Framework, 2012.

3.8 Biomes and Bioregions

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The study area falls within the Savanna biome (Figure 5) (Rutherford and Westfall, 1994). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. The study area falls within the Eastern Kalahari Bushveld Bioregion (Mucina and Rutherford, 2006) (Figure 6).

3.9 Vegetation Type

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that is expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site.

When the boundaries of the study area is superimposed on the vegetation types of the surrounding area (Figure 7), it is evident that the study area falls within the Kathu Bushveld and the Kuruman Thornveld vegetation types. The characteristics of these vegetation types are discussed in the section below (Mucina and Rutherford, 2006).

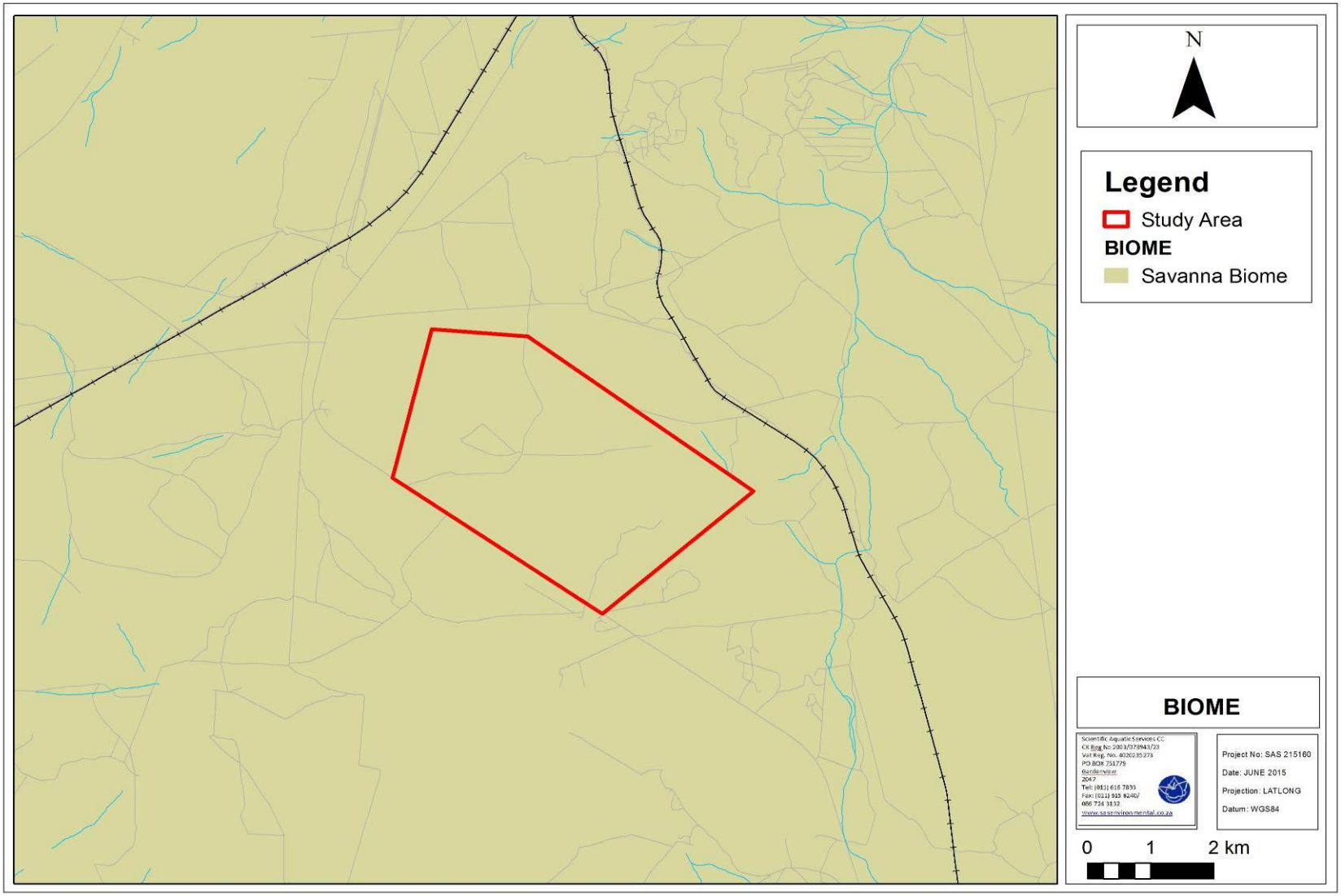

Figure 5: The biome associated with the study area (Mucina and Rutherford, 2006

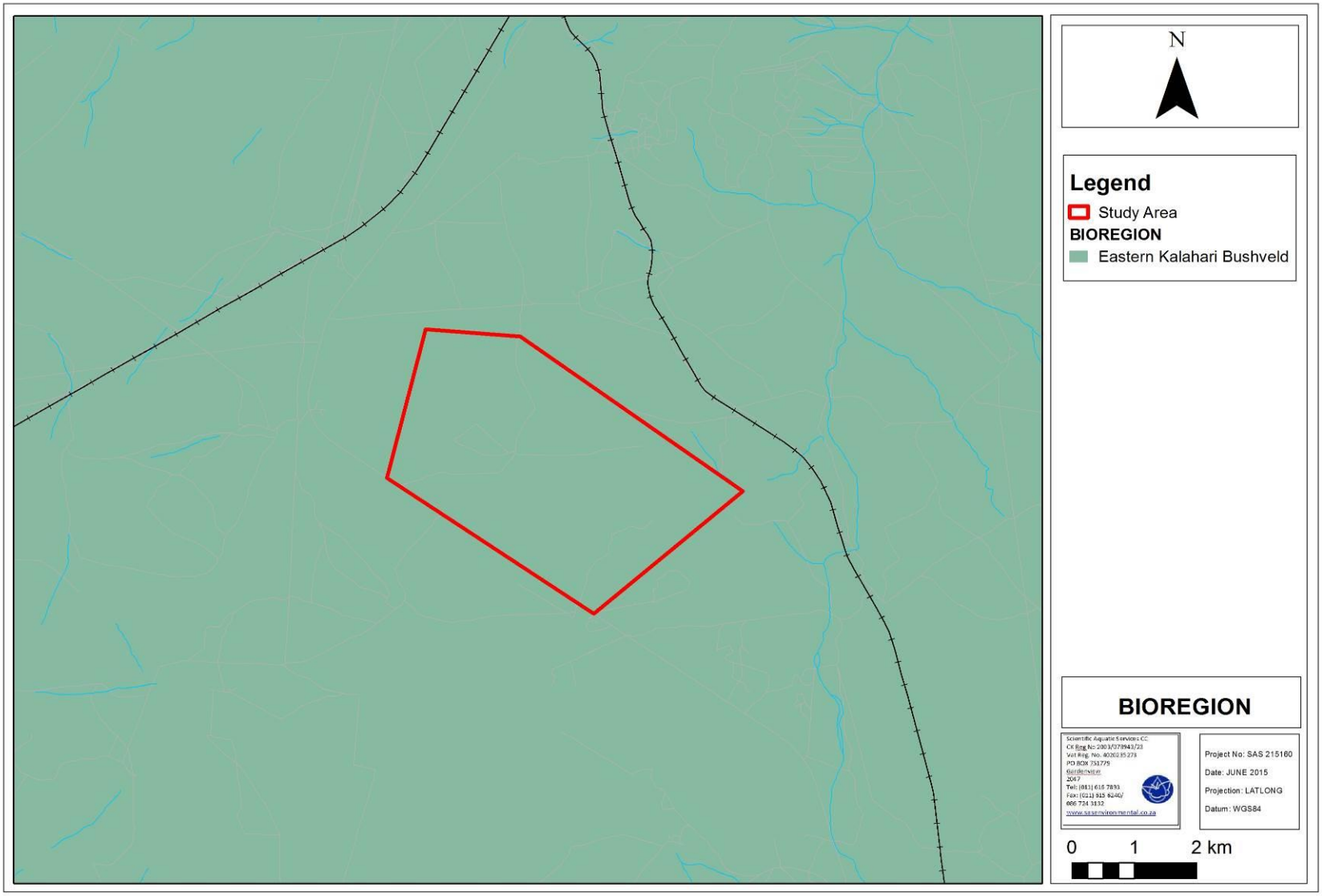

Figure 6: The bioregion associated with the study area (Mucina and Rutherford, 2006).

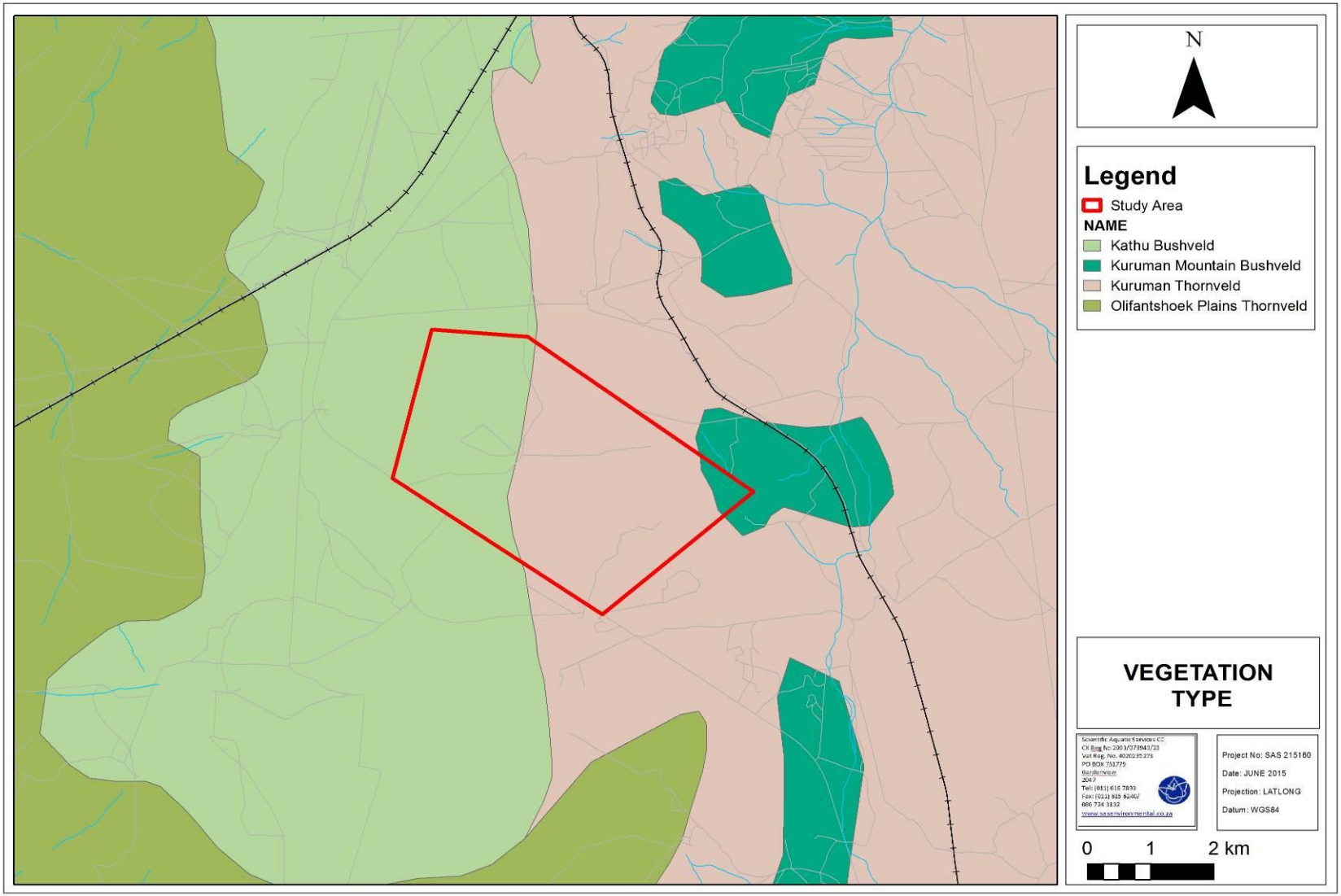

Figure 7: The vegetation type associated with study area (Mucina and Rutherford, 2006).

3.9.1 Kuruman Thornveld

Distribution

The Kuruman Thornveld vegetation is distributed in the North-West and Northern Cape Provinces, on flats from the vicinity of Postmasburg and Danielskuil in the south extending via Kuruman to Tsineng and Dewar in the north at an altitude of 1100-1500m (Mucina and Rutherford, 2006).

Climate

The Kuruman Thornveld falls within a summer and autumn rainfall region with very dry winters. The mean annual precipitation (MAP) is between 300-450mm, with frost being frequent in winter. The mean monthly maximum and minimum temperatures for Kuruman is 35.9°C and -3.3°C for January and June (Mucina and Rutherford, 2006).

Table 4: General climatic information for Kuruman Thornveld vegetation type (Mucina and Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Eastern Kalahari Bushveld	Kuruman Thornveld	1100 - 1500	368	17.5	2786	84

Conservation

The Kuruman Thornveld vegetation type is considered to be least threatened. None of the unit is conserved in statutory conservation areas, but very little has been transformed. Erosion is very low in this area (Mucina and Rutherford, 2006).

Important Taxa

Tall trees: *Acacia erioloba* (d),

Small Trees: *Acacia mellifera* subsp. d*etinens* (d), *Boscia albitrunca* (d).

Tall Shrubs: *Grewia flava* (d), *Lycium hirsutum* (d), *Tarchonanthus camphoratus* (d), *Gymnosporia buxifolia.*

Low Shrubs: *Acacia hebeclada* subsp. h*ebeclada* (d), *Monechma divaricatum* (d), *Gnidia polycephala, Helichrysum zeyheri, Hermannia comosa, Pentzia calcarea, Plinthus sericeus.*

Geoxylic Suffrutex: *Elephantorrhiza elephantine.*

Graminoids: *Aristida meridionalis* (d), *A. stipitata* subsp. *stipitata* (d), *Eragrostis lehmanniana* (d), *E. echinochloidea, Melinis repens.*

Herbs: *Dicoma schinzii, Gisekia Africana, Harpagophytum procumbens* subsp. *procumbens, Indigofera daleoides, Limeum fenestratum, Nolletia ciliaris, Seddera capensis, Tripteris aghillana, Vahlia capensis* subsp. *vulgaris.*

Biogeographically Important Taxa:

Small Trees: *Acacia luederitzii var. leuderitzii, Terminalia sericea.*

Tall Shrub: *Acacia haematoxylon.*

Low Shrub: *Blepharis marginata.*

Graminoid: *Digitaria polyphylla.*

Herb: *Corchorua pinnatipartitus.*

Endemic Taxon: Herb: *Gnaphalium englerianum*

3.9.2 Kathu Bushveld

Distribution

The Kathu Bushveld vegetation is distributed in the Northern Cape Province, on plains from Kathu and Dibeng in the south, through Hotazel in the vicinity of Frylinckspan to the Botswana border roughly between Van Zylsrus and McCarthysrus (Mucina and Rutherford, 2006).

Climate

The Kathu Bushveld falls within a summer and autumn rainfall region with very dry winters. The mean annual precipitation (MAP) is between 220-380mm, with frost being frequent in winter. The mean monthly maximum and minimum temperatures for Sishen is 37.0°C and -2.2°C for December and August (Mucina and Rutherford, 2006).

Table 5: General climatic information for Kathu Bushveld vegetation type (Mucina and Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Eastern Kalahari Bushveld	Kathu Bushveld	960-1300	300	18.5	2883	85

Conservation

Least concern with a target of 16%. None conserved in statutory conservation areas. More than 1% already transformed, including the manganese ore mining locality at Sishen, one of the biggest open-cast mines in the world. Erosion is very low (Mucina & Rutherford, 2006).

Important Taxa:

Tall Tree: *Acacia erioloba* (d).

Small Trees: *Acacia mellifera* subsp. *detinens* (d), *Boscia albitrunca* (d), *Terminalia sericea.*

Tall Shrubs: *Diospyros lycioides* subsp. *lycioides* (d), *Dichrostachys cinerea, Grewia flava, Gymnosporia buxifolia, Rhigozum brevispinosum.*

Low Shrubs: *Aptosimum decumbens, Grewia retinervis, Nolletia arenosa, Sida cordifolia, Tragia dioica.*

Graminoids: *Aristida meridionalis* (d), *Brachiaria nigropedata* (d), *Centropodia glauca* (d), *Eragrostis lehmanniana* (d), *Schmidtia pappophoroides* (d), *Stipagrostis ciliate* (d), *Aristida congesta, Eragrostis biflora, E. chloromelas, E. heteromera, E. pallens, Melinis repens, Schmidtia kalahariensis, Stipagrostis uniplumis, Tragus berteronianus.*

Herbs: *Acrotome inflate, Erlangea misera, Gisekia Africana, Heliotropium ciliatum, Hermbstaedtia fleckii, H. odorata, Limeum fenestratum, L. viscosum, Lotononis platycarpa, Senna italic* subsp. *arachoides, Tribulus terrestris.*

Biogeographically Important Taxa:

Small Tree: *Acacia luederitzii var. luederitzii.*

Graminoids: *Anthephora argentea, Megaloprotachne albescens, Panicum kalaharense.*

Herb: *Neuradopsis bechuanensis*

3.9.3 Kuruman Mountain Bushveld

Distribution

Kuruman Mountain Bushveld is distributed within the Northern Cape and North West Provinces from the Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman town and re-emerging as isolated hills, i.e. Makhubung and the hills around Pomfret in the north. Altitude ranges from 1100 – 1800m (Mucina & Rutherford, 2006).

Climate

The *Kuruman Mountain Bushveld* vegetation type has summer and autumn rainfall with very dry winters, with a MAP about 250-500mm and frost is frequent in winter (Mucina & Rutherford, 2006).

Conservation

This vegetation type is considered least concern with a target of 16%, with nothing conserved in statutory conservation areas. Very little of the vegetation is transformed and erosion is very low to low, however, some parts in the north are heavily utilised for grazing (Mucina & Rutherford, 2006).

Floral characteristics of the Kuruman Mountain Bushveld vegetation type

The *Kuruman Mountain Bushveld* vegetation type occurs on rolling hills with generally gentle to moderate slopes and hill pediment areas with an open shrubveld with *Lebeckia*

macrantha prominent in places and a well-developed grass layer (Mucina & Rutherford, 2006).

The following flora is indicators of the *Kuruman Mountain Bushveld* vegetation type:
Small trees: *Rhus lancea*
Tall shrubs: *Diospyros austro-africana, Euclea crispa* subsp. *crispa, E. undulata, Olea europea* subsp*. africana, Searsia pyroides* var. *pyroides, S. tridactyla, Tarchonanthus camphoratus, Tephrosia longipes;*
Low Shrubs: *Searsia ciliata* (d), *Amphiglossa triflora, Anthospermum rigidum* subsp. *pumilum, Gomphocarpus fruticosus* subsp. *fruticosus, Helichrysum zeyheri, Lantana rugosa, Wahlenbergia nodosa;*
Succulent shrubs*: Ebracteola wilmaniae, Hertia pallens;*
Herbaceous climber*: Rhyncosia totta;*
Graminoids: *Andropogon chinensis* (d), *A. schirensis* (d), *Anthephora pubescens* (d), *Aristida congesta* (d), *Digitaria eriantha* subsp. *eriantha* (d), *Themeda triandra* (d), *Triraphis andropogonoides* (d), *Aristida diffusa, Brachiaria nigropedata, Bulbostylis burchellii, Cymbopogon caesius, Diheteropogon amplectens, Elionurus muticus, Eragrostis chloromelas, E. nindensis, Eustachys paspaloides, Heteropogon contortus, Melinis repens, Schizachyrium sanguineum, Trichoneura grandiglumis;.*
Herb: *Dicoma anomala, D. schinzii, Geigeria ornativa, Helichrysum cerastioides, Heliotropium strigosum, Hibiscus marlothianus, Kohautia cynanchica, Kyphocarpa angustifolia;*
Geophytic herbs*: Boophone disticha, Pellaea calomelanos.*

Biogeographically Important Taxa (Griqualand West endemics):
Tall shrub: *Lebeckia macrantha* (d)
Low shrubs*: Justicia puberula, Tarchonanthus obovatus;*
Succulent shrub: *Euphorbia wilmaniae;*
Graminoids: *Digitaria polyphylla*
Herb: *Sutera griquensis*.

Endemic Taxon
Succulent shrub: *Euphorbia planiceps*

3.10 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the site is located within. This knowledge allows for improved

interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The study area falls within the Southern Kalahari Aquatic Ecoregion and fall within the D41J quaternary catchment (Figure 8). The results of the assessment are summarised in the tables below.

Table 6: Main attributes of the Southern Kalahari Ecoregion (Kleynhans *et al,* 2005).

MAIN ATTRIBUTES	SOUTHERN KALAHARI
Terrain Morphology: Broad division (dominant types in bold) (Secondary)	**Plains: Low relief;** **Plains: Moderate relief;** Lowlands, Hills and Mountains; Moderate and High Relief (limited); **Open Hills; Lowlands; Mountains; Moderate to High Relief**; and Closed Hills; Mountains; Moderate and High Relief.
Vegetation types (dominant types in bold) (Primary)	Orange River Nama Karoo (limited); Karroid Kalahari Bushveld; **Shrubby Kalahari Dune Bushveld;** Thorny Kalahari Dune Bushveld (limited); Kalahari Mountain Bushveld; **Kalahari Plains Thorn Bushveld;** Kalahari Plateau Bushveld; **Kimberley Thorn Bushveld**
Altitude (m a.m.s.l) (modifying)	500-1700; 1700-1900 (limited)
MAP (mm) (Secondary)	0 to 500
Coefficient of Variation (% of annual precipitation)	30 to 40
Rainfall concentration index	50 to 65
Rainfall seasonality	Mid to very late summer
Mean annual Temp. (°C)	14 to 22
Mean daily max. Temp. (°C): February	28 to >32
Mean daily max. Temp. (°C): August	14 to 22
Mean daily min. Temp. (°C): February	14 to 22
Mean daily min Temp. (°C): August	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60

Table 7: Summary of the ecological status of quaternary catchment D41J (DWS, 2012).

SQ* REACH	SQR* NAME	PES ASSESSED BY EXPERTS? (IF TRUE = Y)	PES CATEGORY MEDIAN	MEAN EI *** CLASS	MEAN ES† CLASS	STREAM ORDER	DEFAULT EC# (BASED ON MEDIAN PES AND HIGHEST OF EI OR ES MEANS)
D41J-02430	-	-		MODERATE	VERY LOW	1,0	C
D41J-02504	-	-		MODERATE	VERY LOW	1,0	C
D41J-02511	Olifantsloop	-		MODERATE	VERY LOW	1,0	C
D41J-02554	-	-		MODERATE		1,0	C

SQ* REACH	SQR* NAME	PES ASSESSED BY EXPERTS? (IF TRUE = Y)	PES CATEGORY MEDIAN	MEAN EI *** CLASS	MEAN ES† CLASS	STREAM ORDER	DEFAULT EC# (BASED ON MEDIAN PES AND HIGHEST OF EI OR ES MEANS)
D41J-02604	-	-		MODERATE	LOW	1,0	C
D41J-02608	-	-		MODERATE	LOW	1,0	C
D41J-02620	-	-		MODERATE	LOW	1,0	C
D41J-02650	Ga-Mogara	-		LOW	LOW	1,0	D
D41J-02536	Ga-Mogara	Y	B	MODERATE	LOW	2,0	C
D41J-02543	-	-		MODERATE		2,0	C
D41J-02558	Ga-Mogara	Y	B	LOW	LOW	2,0	D
D41J-02419	Ga-Mogara	Y	C	MODERATE	VERY LOW	3,0	C
D41J-02464	Ga-Mogara	Y	D	LOW	VERY LOW	3,0	D
D41J-02531	Ga-Mogara	Y	B	MODERATE	VERY LOW	3,0	C

*SQ = Sub-quaternary
**SQR = Sub-Quaternary Reach
***EI = Ecological Importance
†ES = Ecological Sensitivity
#EC = Ecological Class

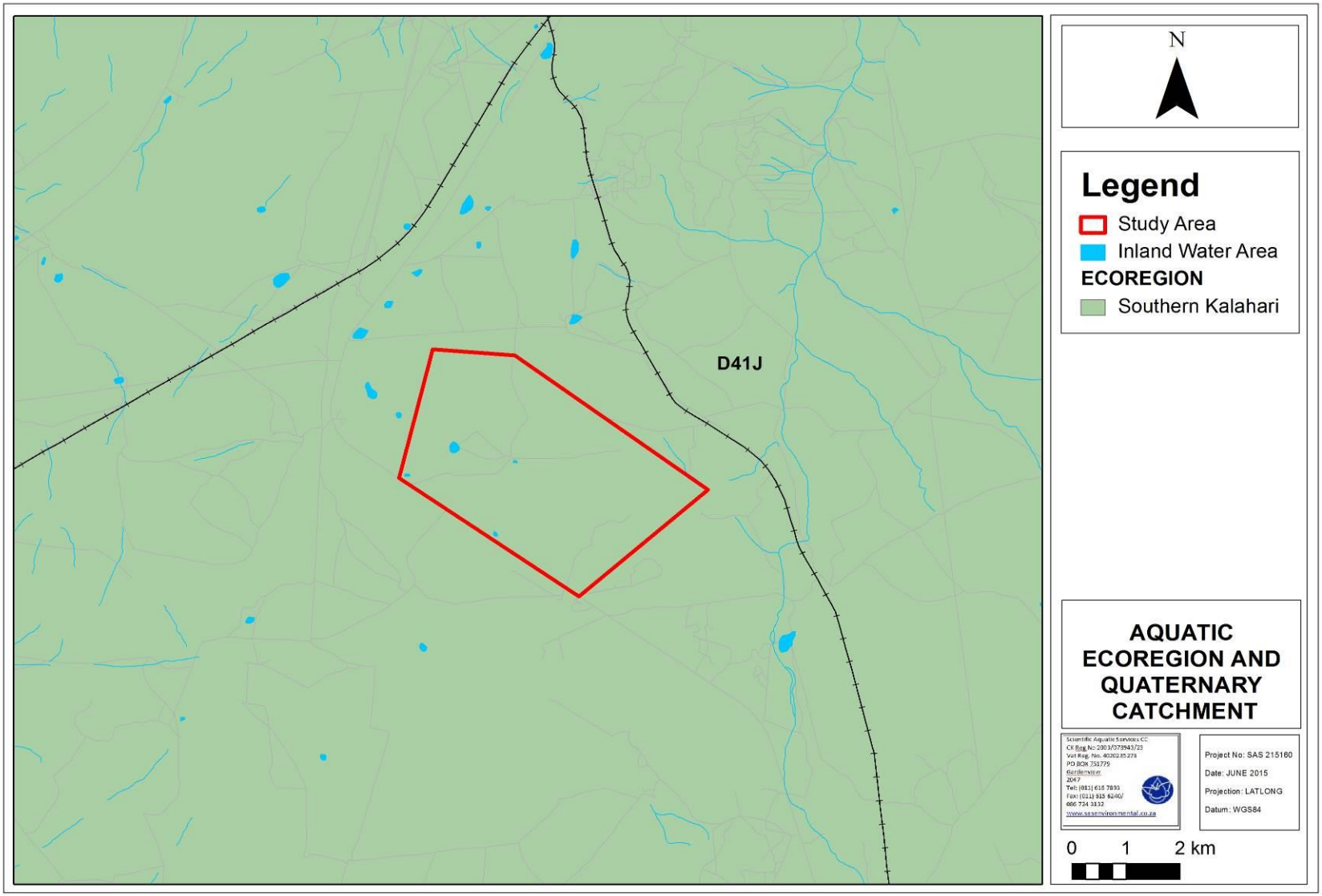

Figure 8: Ecoregion and quaternary catchment associated with the study area.

3.11 Freshwater Ecosystem Priority Area (FEPA; 2011)

The Freshwater Ecosystem Priority Area (FEPA) database was consulted to define the aquatic ecology of the wetland and riverine systems close to or within the study area that may be of ecological importance.

Aspects applicable to the study area are discussed below:

- The study area falls within the Lower Vaal Water Management Area (WMA). Each WMA is divided into several sub-Water Management Areas (subWMA), where catchment or watershed is defined as a topographically defined area, which is drained by a stream, or river network. The subWMA indicated for the study area is the Molopo subWMA;
- The subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or migration corridors or important in terms of translocation and relocation zones for fish;
- The subWMA is not listed as a fish Freshwater Ecosystem Priority Area (FEPA);
- The subWMA is listed as an upstream water management area;
- A water course is located approximately 1.7 km east of the study area, namely the unnamed tributary of the Ga-Mogara, (the location is depicted in Figure 9 below),
- The unnamed tributary of the Ga-Mogara River is an ephemeral system classified as a Class B (largely natural) river. This river system is a free flowing system, but is not classified as a flagship river; however, the river is located within a sub-quaternary catchment classified as a River FEPA. River FEPAs have been defined in order to achieve biodiversity targets for river ecosystems and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources;
- According to the NFEPA database numerous natural wetland features are located within and around the study area;
    - The wetland features include slope depression, unchannelled valley bottom wetlands (Figure 10);
    - Conditions of wetland features within and surrounding the study area include (refer to Figure 11):
        - Category AB Percentage natural land cover > 75%; PES equivalent: Good or natural condition.
    - The wetland features within and surrounding the study area were ranked according to the general importance (Figure 12):

- Rank 4: Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as having biodiversity importance, but with no valid reasons documented or wetlands in a C condition associated with more than 3 other wetlands;
- Rank 5: Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing working for wetland sites; and
- Rank 6: All other wetlands (no importance).

- The wetland features are not indicated as Ramsar wetlands;
- The wetland features are not indicated to fall within 500m of an International Union for Conservation of Nature (IUCN) threatened frog point locality;
- The wetland features are not indicated as FEPA priority wetlands; and
- The study area fall within the Eastern Kalahari Bushveld Group 1 Wetveg group, classified as least threatened.

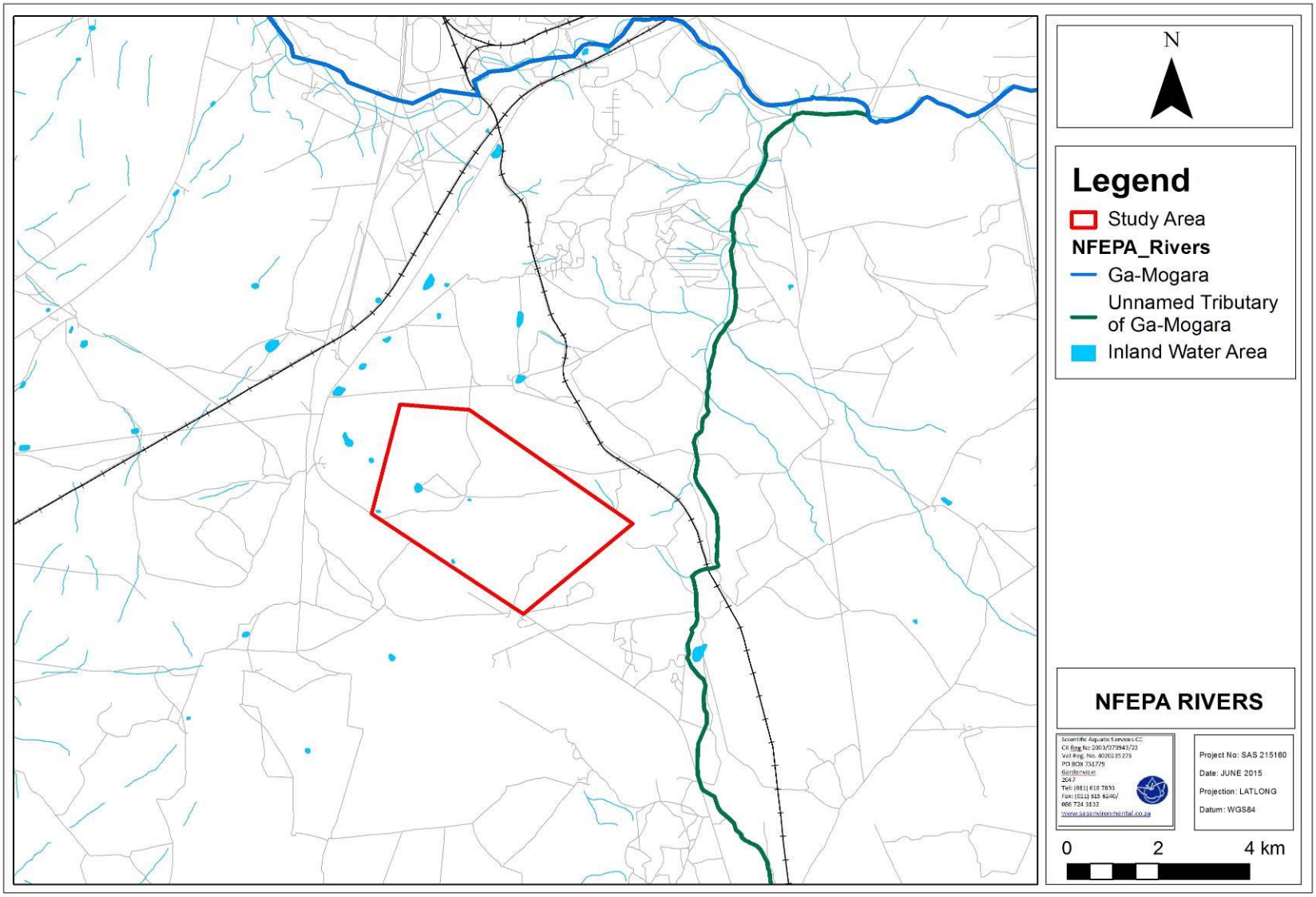

Figure 9: Watercourses surrounding the study area.

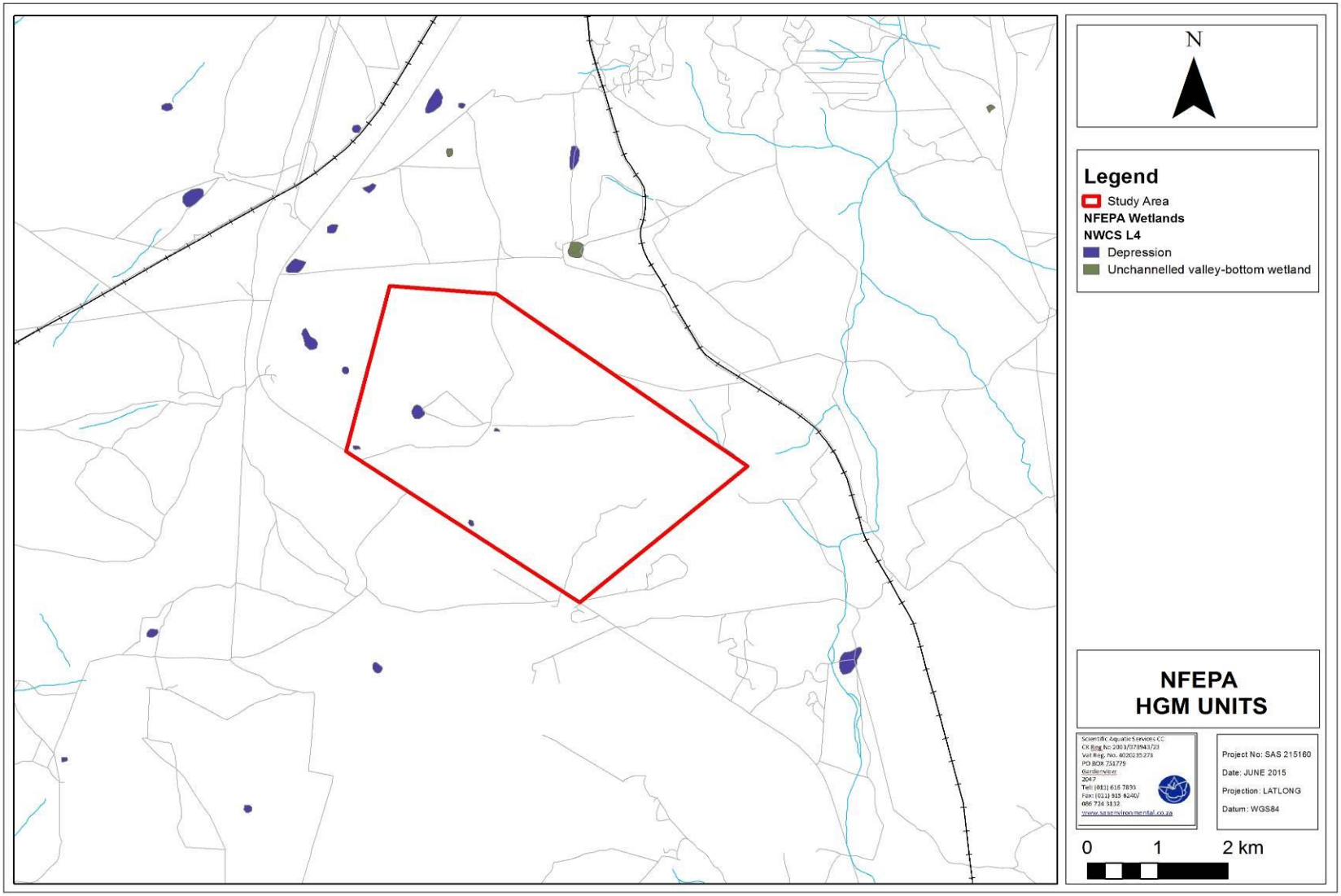

Figure 10: Wetland types identified within and surrounding the study area.

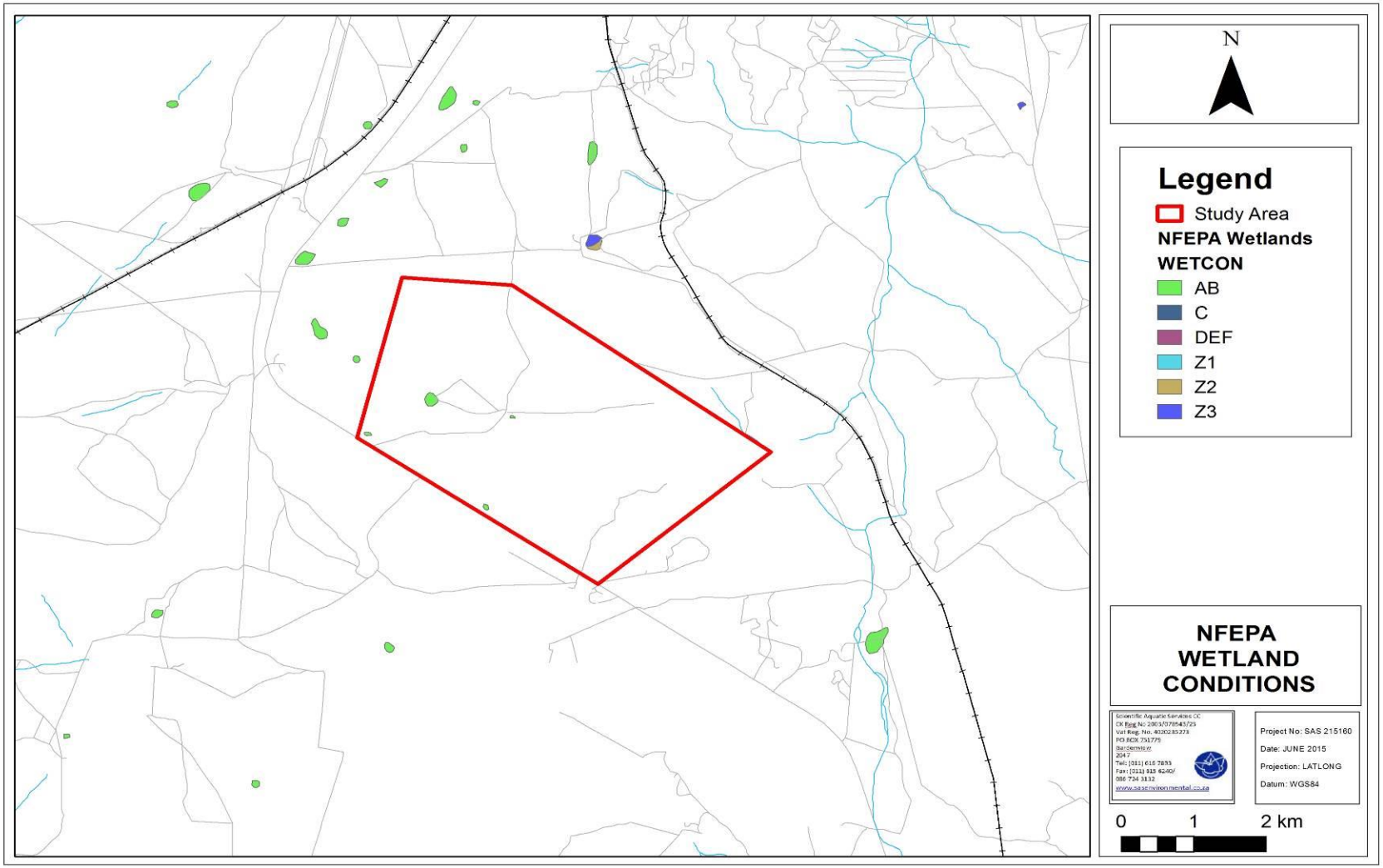

Figure 11: Wetland conditions of the features identified within the study area[4].

[4] [4] Category AB Percentage natural land cover > 75%; PES equivalent: Good or natural condition.

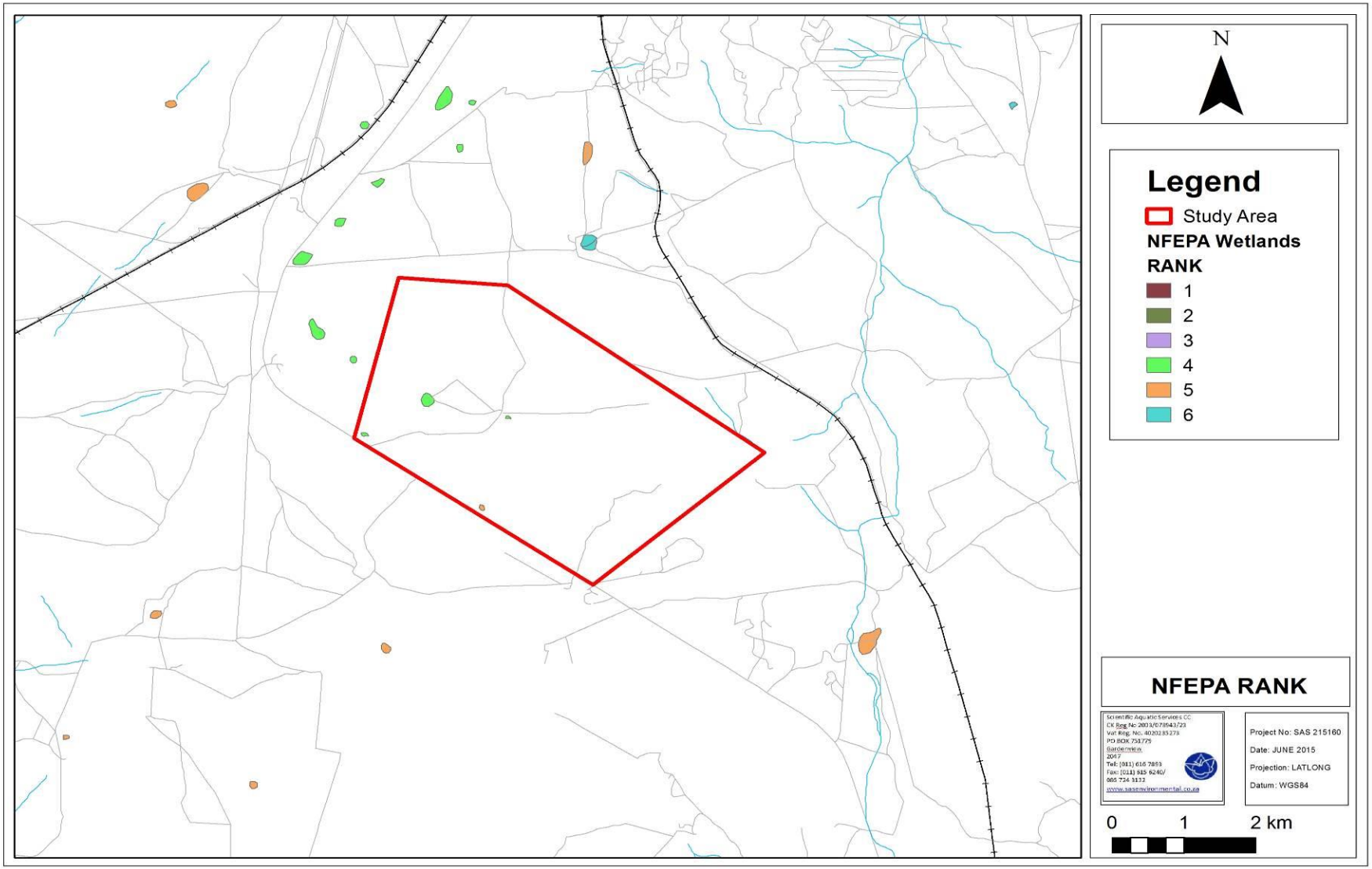

Figure 12: Wetland ranks of the features identified within the surrounding area of the three candidate sites.

4 STRUCTURE OF THE REPORT

Section A of this report served to provide an introduction to the study area, the general approach to the study as well as the method of impact assessment. Section A also presents the results of general desktop information reviewed as part of the study including the information generated by the relevant authorities as well as the context of the site in relation to the surrounding anthropogenic activities and ecological character. The section also indicates that the requirements for mitigation, monitoring and rehabilitation are addressed in each section.

Section B addresses all the issues pertaining to the assessment of the floral ecology of the study area.

Section C addresses all the issues pertaining to the assessment of the faunal ecology of the study area.

Section D addresses all the issues pertaining to the assessment of the wetland ecology of the study area.

Section E addresses all the issues pertaining to the assessment of the impacts of the proposed project on the study area.

5 REFERENCES

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

Department of Water Affairs (DWA) 2005. Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2008. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands*. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P., and Goge, C. 2008. *WET-Health: A technique for rapidly assessing wetland health*. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

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

National Environmental Management Act (NEMA) 107 of 1998.

National Environmental Management: Biodiversity Act (NEMBA) 10 of 2004.

National Water Act (NWA) 36 of 1998.

GN 1199 as published in the Government Gazette 32805 of 2009 as it relates to the NWA.

The Northern Cape Nature Conservation Act (NCNCA) 9 of 2009.

Ollis, D.J., Snaddon, C.D., Job, N.M., and Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems*. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Present Ecological State, Ecological Importance and Ecological Sensitivity database for Primary Drainage Region D as developed by the RQS Department of the DWS (2012). Available at http://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx retrieved 17th March 2015.

Provincial Development and Resources Management Plan / Provincial Spatial Development Framework (PSDF) 2012. Department of Co-operative Governance, Human Settlements, and Traditional Affairs.

Rutherford, M.C. 1997. Categorization of biomes. In: Cowling RM, Richardson DM, Pierce SM (eds.) *Vegetation of Southern Africa*. Cambridge University Press, Cambridge, pp. 91-98 ISBN 0-521-57142-1.

Rutherford, M.C. and Westfall, R.H. 1994. *Biomes of Southern Africa*: An objective categorization. National Botanical Institute, Pretoria, RSA.

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) *[online].* URL: http://bgis.sanbi.org as retrieved on 03/03/2015.

Van Wyk A.E. and Smith, G.F. 2001. *Regions of Floristic Endemism in Southern Africa*. UMDAUS Press, Hatfield, RSA.

ANNEXURE A – Consultants CV's

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)

Accredited River Health practitioner by the South African River Health Program (RHP)

Member of the South African Soil Surveyors Association (SASSO)

Member of the Gauteng Wetland Forum

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2002
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2000
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	1999

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe

Eastern Africa – Tanzania

West Africa – Ghana, Liberia, Angola, Guinea Bissau

Central Africa – Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Development compliance studies

- Project co-leader for the development of the EMP for the use of the Wanderers stadium for the Ubuntu village for the World Summit on Sustainable Development (WSSD).
- Environmental Control Officer for Eskom for the construction of an 86Km 400KV power line in the Rustenburg Region.
- Numerous Environmental Impact Assessment (EIA) and EIA exemption applications for township developments and as part of the Development Facilitation Act requirements.
- EIA for the extension of mining rights for a Platinum mine in the Rustenburg area by Lonmin Platinum.
- EIA Exemption application for a proposed biodiesel refinery in Chamdor.
- Compilation of an EIA as part of the Bankable Feasibility Study process for proposed mining of a gold deposit in the Lofa province, Liberia.
- EIA for the development of a Chrome Recovery Plant at the Two Rivers Platinum Mine in the Limpopo province, South Africa.
- Compilation of an EIA as part of the Bankable Feasibility Study process for the Mooihoek Chrome Mine in the Limpopo province, South Africa.

- Mine Closure Plan for the Vlakfontein Nickel Mine in the North West Province.

Specialist studies and project management

- Development of a zero discharge strategy and associated risk, gap and cost benefit analyses for the Lonmin Platinum group.
- Development of a computerised water balance monitoring and management tool for the management of Lonmin Platinum process and purchased water.
- The compilation of the annual water monitoring and management program for the Lonmin Platinum group of mines.
- Analyses of ground water for potable use on a small diamond mine in the North West Province.
- Project management and overview of various soil and land capability studies for residential, industrial and mining developments.
- The design of a stream diversion of a tributary of the Olifants River for a proposed opencast coal mine.
- Waste rock dump design for a gold mine in the North West province.
- Numerous wetland delineation and function studies in the North West, Gauteng and Mpumalanga Kwa-Zulu Natal provinces, South Africa.
- Hartebeespoort Dam Littoral and Shoreline PES and rehabilitation plan.
- Development of rehabilitation principles and guidelines for the Crocodile West Marico Catchment, DWAF North West.

Aquatic and water quality monitoring and compliance reporting

- Development of the Resource quality Objective framework for Water Use licensing in the Crocodile West Marico Water management Area.
- Development of the Resource Quality Objectives for the Local Authorities in the Upper Crocodile West Marico Water management Area.
- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Lonmin Platinum groups water monitoring program.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Initiation and management of a physical, chemical and biological monitoring program, President Steyn Gold Mine Welkom.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for African Rainbow Minerals Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several Gold mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for the Valpre bottled water plant (Coca Cola South Africa).
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane for all their Waste Water Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in southern, central and west Africa.

Wetland delineation and wetland function assessment

- Wetland biodiversity studies for three copper mines on the copper belt in the Democratic Republic of the Congo.
- Wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Terrestrial and wetland biodiversity studies for developments in the mining industry.
- Terrestrial and wetland biodiversity studies for developments in the residential commercial and industrial sectors.
- Development of wetland riparian resource protection measures for the Hartbeespoort Dam as part of the Harties Metsi A Me integrated biological remediation program.
- Priority wetland mammal species studies for numerous residential, commercial, industrial and mining developments throughout South Africa.

Terrestrial ecological studies and biodiversity studies

- Development of a biodiversity offset plan for Xstrata Alloys Rustenburg Operations.
- Biodiversity Action plans for numerous mining operations of Anglo Platinum throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Assmang Chrome throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Xstrata Alloys and Mining throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plan for the Nkomati Nickel and Chrome Mine Joint Venture.
- Terrestrial and wetland biodiversity studies for three copper mines on the copperbelt in the Democratic Republic of the Congo.
- Terrestrial and wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.

- Numerous terrestrial ecological assessments for proposed platinum and coal mining projects.
- Numerous terrestrial ecological assessments for proposed residential and commercial property developments throughout most of South Africa.
- Specialist Giant bullfrog (*Pyxicephalus adspersus*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist Marsh sylph (*Metisella meninx*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Project management of several Red Data Listed (RDL) bird studies with special mention of African grass owl (*Tyto capensis*).
- Project management of several studies for RDL Scorpions, spiders and beetles for proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist assessments of terrestrial ecosystems for the potential occurrence of RDL spiders and owls.
- Project management and site specific assessment on numerous terrestrial ecological surveys including numerous studies in the Johannesburg-Pretoria area, Witbank area, and the Vredefort dome complex.
- Biodiversity assessments of estuarine areas in the Kwa-Zulu Natal and Eastern Cape provinces.
- Impact assessment of a spill event on a commercial maize farm including soil impact assessments.

Fisheries management studies

- Tamryn Manor (Pty.) Ltd. still water fishery initiation, enhancement and management.
- Verlorenkloof Estate fishery management strategising, fishery enhancement, financial planning and stocking strategy.
- Mooifontein fishery management strategising, fishery enhancement and stocking programs.
- Wickams retreat management strategising.
- Gregg Brackenridge management strategising and stream recalibration design and stocking strategy.
- Eljira Farm baseline fishery study compared against DWAF 1996 aquaculture and aquatic ecosystem guidelines.

CURRICULUM VITAE OF EMILE BASSON VAN DER WESTHUIZEN

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

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

EDUCATION

Qualifications

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

Short Courses

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

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State, Eastern Cape.

Mozambique (Tete, Sofala and Manica Provinces)

Democratic Republic of the Congo (Katanga and Kivu Provinces)

Ghana (Western and Greater Accra Provinces)

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment for the proposed Modikwa Platinum Mine South 2 Shaft Project, Burgersfort, Limpopo Province.
- Floral assessment for the proposed New Clydesdale Colliery Stoping Project, Vandyksdrift, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Harriet's Wish PGM Project, Limpopo Province.
- Floral assessment as part of the environmental authorisation process for the proposed Shanduka Coal Argent Colliery in the vicinity of Argent, Mpumalanga.
- Floral assessment for the Auroch Resources Manica Gold Mining Project, Manica, Mozambique.
- Floral assessment for the Namoya Gold Mine project in Namoya, Democratic Republic of Congo.
- High level floral risk assessment and alternatives analysis for the proposed new Tete Airport, Tete, Mozambique.
- Floral assessment for the proposed Richards bay Harbour Compactor Slab development, Richards bay, Kwa-Zulu-Natal Province.
- Site walkdown and floral ecological input prior to the construction of the proposed 180km Mfolozi-Mbewu powerline, Richards bay, Kwa-Zulu-Natal Province.
- Floral assessment as part of the EIA process for the proposed Peerboom Colliery, Lephalale, Limpopo Province.
- Floral assessment as part of the EIA process for the proposed Overvaal Underground Coal Mine Project, Ermelo, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed King's City Takoradi 3000 hectare development, Takoradi, Ghana
- Floral assessment as part of the EIA process for the proposed Aquarius Platinum Fairway Platinum Mine, Steelpoort, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Geniland Lubumbashi City 4000 hectare development, Likasi, Katanga Province, Democratic Republic of Congo.
- Floral, faunal, aquatic and wetland assessment as part of the EIA process for the proposed Appollonia City Accra 3000 hectare

development, Accra, Ghana.
- Floral assessment as part of the EIA process for the proposed Leeuw Colliery, Utrecht, Kwa-Zulu Natal Province.
- Floral assessment as part of the EIA process for the proposed Lubembe Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Kinsenda Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Lonshi Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Jozini Shopping Mall, Jozini, Kwa-Zulu Natal Province.

Floral assessment as part of the Biodiversity Action Plan for the Assmang Chrome Dwarsrivier Mine, Steelpoort, Mpumalanga Province.

CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	24 June 1986
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape,

Freestate

Zimbabwe

SELECTED PROJECT EXAMPLES

Faunal Assessments
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Mzimvubu Water Project, Eastern Cape.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Setlagole Mall Development, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Expansion and Upgrade of the Springlake Railway Siding, Hattingspruit, Kwa-Zulu Natal.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Styldrift tailings storage facility, return water dams, topsoil stockpile and other associated infrastructure, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Brand se Baai, Western Cape.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Doringbaai, Western Cape.
- Vegetation composition and subsequent loss of carrying capacity for the Rand Water B19 and VG Residue Pipeline Project,

Freestate.

- Faunal assessment as part of the environmental assessment and authorisation process for the Evander Shaft 6 Plant Upgrade, New Tailings Dam Area and Associated Tailings Delivery and Return Water Pipeline, Evander, Mpumalanga.

Previous Work Experience

- Spotted Hyaena Research Project, Phinda Private Game Reserve, KwaZulu Natal.
- Camera Trap Survey as part of the Munyawana Leopard Project, Mkuze Game Reserve, KwaZulu Natal.
- Lowveld Wild Dog Project, Savé Valley Conservancy, Zimbabwe.
- Lion collaring and Tracking as part lion management program, Savé Valley Conservancy, Zimbabwe.
- Junior Nature Conservator, Gauteng Department of Rural Development and Land Reform.