April 2019

AN ECOLOGICAL REPORT ON THE FLORA & FAUNA:

Cuchron (Pty) Ltd and Steamboat Graphite on the farms Steamboat and Inkom, Limpopo Province

A report commissioned by
Dr E Gouws

ENVIROGUARD ECOLOGICAL SERVICES CC
PO Box 703
Heidelberg
1438

Cell: 082 4641021
envguard@telkomsa.net

CONTENTS

CONDITIONS RELATING TO THIS REPORT

Declaration of interest

Enviroguard Ecological Services cc and its members/co-workers:

- Have no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development.
- Is not a subsidiary, legally or financially of the proponent.
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).
- Declare that remuneration for services provided by Enviroguard Ecological Services cc and its members/co-workers is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA.
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.
- Is committed to biodiversity conservation but concomitantly recognize the need for economic development. We reserve the right to form and hold our own opinions within the constraints of our specialities and experience, and therefore will not submit willingly to the interests of other parties or change our statements to appease them.

The study was undertaken by Prof. LR Brown (PhD UP) and Mr CL Cook (MSc UP). Prof Brown and Mr Cook are registered as a Professional Natural Scientists with the following details:

Prof LR Brown: Reg. No. 400075/98 (Botanical Science and Ecological Science).
Mr C Cook: Reg. No. 400084/08 (Zoological Science)

They have the following qualifications:

SPECIALIST	QUALIFICATION
Prof. L.R. Brown	PhD Terrestrial plant ecology MSc. Water ecology BSc Hons (Botany) BSc (Ed) (Botany, Zoology, Education) Wetland and Riparian Delineation *(DWAF Accredited Course)*

	Soil Classification and Wetland Delineation Short Course – TERRASOIL Science
Mr C Cook	MSc Zoology (Aquatic Science) BSc Hons Zoology BSc Botany & Zoology Wetland and Riparian Delineation *(DWAF Accredited Course)*

Indemnity

Although Enviroguard Ecological Services cc exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Enviroguard Ecological Services cc and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. .Enviroguard Ecological Services cc accepts no liability, and the client, by receiving this document, indemnifies Enviroguard Ecological Services cc and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Enviroguard Ecological Services cc and by the use of the information contained in this report.

Factors limiting the quality of this study

Flora: A once off survey was conducted while the study was done on March 2019. Thus, only those flowering plants that flowered at the time of the visit could be identified with high levels of confidence. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could therefore increase the chances to record a larger portion of the total species complex associated with the area. . The survey was restricted to the proposed approximately 300 ha study area. Dense impenetrable thickets restricted the survey in some places. The survey of the study site is however considered as successful with a correct identification of the different vegetation units.

Fauna: It must be stressed that no comprehensive faunal surveys of animal species occurring on the site were conducted but merely an assessment of available and specialised habitat. By surveying the site for specialised habitats, as well as the remaining vegetation and specific habitats, one can make an assumption of the possible presence or absence of threatened animal species. In order to ascertain actual species lists more

intensive surveys are required over several seasons. All animals (mammals, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. The majority of threatened species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years this is especially pertinent to the highly elusive and secretive Brown Hyaena, Serval, Leopard, South African Hedgehog, African Pangolin and Giant Bullfrog. There is a limitation of historic data and available databases for the majority of threatened species within the study area. The surveys were restricted to the proposed approximately 300 ha study area and was restricted within the adjacent privately fenced off properties.

Large areas of the site have impenetrable thicket vegetation which restricts the survey to existing livestock pathways and off-road vehicle tracks. The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records and previous surveys conducted in similar habitats within the Blouberg-Alldays area

Copyright

Approach

Conclusions reached, and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant or animal species are absent.

Prof LR Brown *Pri.SciNat*; MGSSA
Enviroguard Ecological Services cc

INTRODUCTION

The natural resources of southern Africa, with its highly complex and diversified society, are continually under threat from development especially in areas richly endowed with natural resources. Uncontrolled and ill-planned development is one of the biggest threats to the naturally evolved life forms on earth. Past development in many parts of the world has led to the destruction of various plant and animal species and their habitats. Urbanisation causes land transformation and fragmentation and resultant loss of biodiversity. The achievement of balanced development satisfying the human needs and simultaneously conserving the natural resources/habitats is one of the biggest challenges faced by decision-makers. In practice, a foundation for sustainability entails natural resources, for example to link the vegetation of a site directly or indirectly to its closest natural surroundings, to establish green corridors and to create functional landscapes that maintain biodiversity (Pickett & Cadenasso, 2008).

Cities are constantly changing and increasing in size due to human population increase and an influx of people from rural areas into cities. Currently the design of new developments in cities focuses on human needs mainly without taking the environment into account. In many areas urban development has led to a total destruction of ecosystems while also affecting the climate at a local scale. Humans have been influencing the environment for thousands of years and in many cases have shown no consideration for the environment. As a result humans have been responsible for the extinction of many species through their various activities (e.g. agriculture, mining, ill-planned urban development, deforestation, soil erosion etc.) which has not only affected the local ecosystems negative, but also had negative effects on a regional landscape scale.

In order to prevent the destruction of any ecosystem, it is important that systematic planning and co-ordination of human activities and development should receive priority. This planning should include studies of the natural environment (soil, water, vegetation, animals and cultural / historical aspects). The planning and design of urban areas must therefore be done in such a way as to ensure that important ecosystem functions and services of the environment is maintained. Biodiversity must be protected to ensure the continued existence of plant and animal life in an area. It is therefore important that urban developers, landscapers and environmentalists together design development within urban areas. Before any development can take place it is important that all aspects of the environment is first

assessed to identify areas of concern and inform the planning of the proposed development.

Plant communities are regarded as fundamental units of an ecosystem and therefore form the base for environmental planning and the compilation of environmental management plans. Plant species assemblages reflect habitat and ecosystem health and rarity and are therefore imperative for an Environmental Impact Assessment.

AIMS OF THE STUDY

This report aims to present ecological report on the flora and fauna of Cuchron (Pty) Ltd and Steamboat Graphite (Pty) Ltd: farms Steamboat and Inkom, Limpopo Province (hereafter referred to as the study area).
The objectives of this study were to:

- Identify, describe and delineate the different vegetation units present on the study site.
- Provide a description of the fauna (**mammals, reptiles, amphibians**) occurring on the study site.
- Identify species of conservation importance that could possibly occur on the proposed site.
- To provide a sensitivity map of the study area (where applicable).
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed development.

STUDY AREA

Location

The proposed site is situated approximately 132 km north-west of Polokwane and 36 km south-west of Alldays. The Blouberg national park is situated 58 km to the south-east and the Soutpansberg 58km to the south-east.

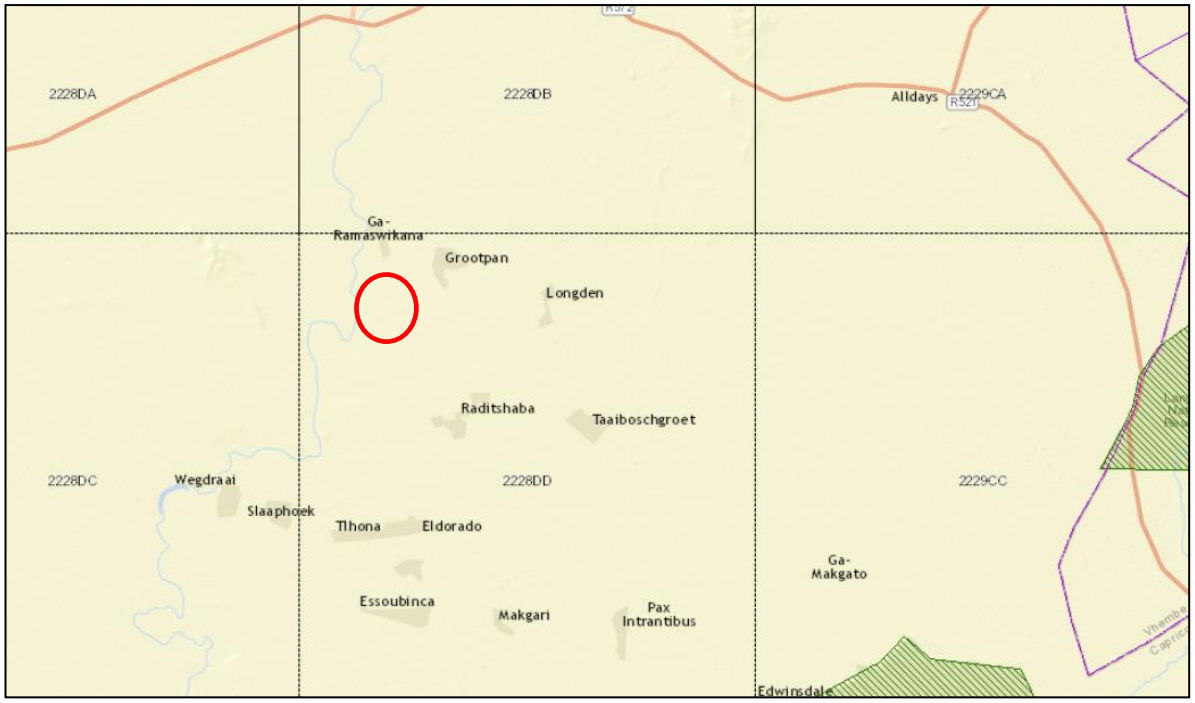

Figure 1. Approximate location of the study area (Source: SANBI GIS).

METHODS

VEGETATION

The Braun-Blanquet survey principles to survey and describe plant communities as ecological units were used for this study. This vegetation survey method has been used as the basis of a national vegetation survey of South Africa (Mucina et al. 2000) and is considered to be an efficient method of classifying and describing vegetation (Brown *et al.* 2013). The study is based on the floristic composition of the different vegetation units. An overview of the vegetation was first obtained from relevant literature. The vegetation was stratified into relative homogeneous units using Google Earth images and topographic maps. All these units were verified on foot and vegetation sample plots placed in each. The different vegetation units (ecosystems) are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for sensitive/red data plant species. Ecological sensitivity and conservation value of the plant communities were assessed and categorised according to habitat and plant species assemblages (even though red data species or suitable habitat for such species could be absent an area could still have pristine habitat comprising a high diversity of climax species giving it a high conservation value).

Data recorded included:

Data pertaining to the vegetation physiognomy and floristic composition (species richness and canopy cover of each species) was gathered. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence.

Red data species

An investigation was also carried out on rare and protected plants that might possibly occur in the region. For this investigation the National Red List of Threatened Plants of South Africa, Lesotho & Swaziland, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) as well as the Limpopo Environmental Management Act 2003 (Act No. 7 of 2003) were used. Internet sources were also consulted on the distribution of these species in the area. Other information used included:

- Publication of lists of species that are threatened or protected, activities that are prohibited and exemption from restriction from the National Environmental Management: Biodiversity Act, 2004 (ACT NO. 10 OF 2004).

- The IUCN conservation status categories on which the Threatened Species Programme, Red List of South African Plants (2013) is based, was also obtained.

The presence of rare and protected species or suitable habitat was recorded during the field visit.

QDG data as well as other red data lists are used as guidelines to assist when conducting the field work. Unless a specific species was recorded previously on the specific site under investigation, the QDG lists cannot be used as meaning that the species listed do occur on the site. These lists are not comprehensive and continually change as people find and record new habitats and red data species. It could therefore mean that a red data species found in an adjacent QDG or one even further away, could potentially occur in another QDG. However, since no study has been done in that grid it will result in it not being listed for that QDG. The fact that it is not listed does however, not mean that the species or suitable habitat is not present. It is therefore imperative that a **physical site visit is conducted** to determine firstly, the presence of the listed red data species or suitable habitat on the site, and secondly, and most importantly the suitability of the site for the presence other red data species also.

Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers. The conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Grassland and Savanna biomes of South Africa. The following four conservation priority categories were used for each vegetation unit:

High:	Area with natural vegetation with a high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.
Medium-high:	Natural area with a relatively high species richness and diversity; not a threatened or unique ecosystem; moderate habitat diversity; between 5-10% pioneer/alien plant species present; that would need low financial input and management to improve its current condition; and where low-density development could be considered with limited impact on the vegetation /

ecosystem. It is recommended that larger sections of the vegetation are maintained**.**

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species diversity; between 11-20% pioneer/alien plant species present; that would need moderate to major financial input to rehabilitate to an improved condition; and where medium density development could be considered with limited impact on the vegetation / ecosystem. Where possible certain sections of the vegetation could be maintained**.**

Low-medium: Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

Impact analysis

An **impact analysis** was done for the vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria. For impact assessment the **potential impacts** on the vegetation was assessed by using the NEMA 2014 guidelines and criteria. To further quantify the severity of each impact, values were assigned to criteria ratings (Table 1).

Table 1: Criteria, criteria ratings and values (in brackets) used in this study to assess possible impacts on vegetation during the proposed development

Criteria	Rating (value)
Extent of impact	Site (1), Region (2), National (3), International (4)
Duration of impact	Short term (1), Medium term (3), Long term (4), Permanent (5)
Magnitude of impact	Low (2), Moderate (6), High (8)
Probability of impact	Improbable (1), Probable (2), Highly probable (4), Definite (5)

FAUNA

This faunal survey focused mainly on mammals, birds, reptiles and amphibians within the proposed graphite mining pit and adjacent 300 ha mining site. The survey focused on the current status of threatened animal species occurring, or likely to occur within the approximately 300ha mining site, describing the available and sensitive habitats, identifying potential impacts resulting from the graphite mining activities within the open woodland Bushveld within the study site; and providing mitigation measures for the identified impacts of the proposed graphite mining project.

Predictive methods

Satellite imagery of the area was obtained from Google Earth™ was studied in order to get a three-dimensional impression of the topography and current land use.

Literature Survey

A detailed literature search was undertaken to assess the current status of threatened fauna that have been historically known to occur within the 2228 DD Quarter Degree Grid Cell (QDGC) in which the Rayton graphite mining site is situated. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red List of Mammals of South Africa, Swaziland and Lesotho* (Taylor *et al.* 2016) as well as ADU's MammalMAP (http://vmus.adu.org.za/vm_sp_list.php) for mammals. Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). 2005. *Roberts- Birds of Southern Africa VIIth ed*. And BARNES, K.N. (ed.) (2000) *The 2014/2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* (Taylor *et al.* 2015) for avifauna (birds) as well as the internet SABAP2 (http://sabap2.adu.org.za). *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers (Revised edition) 2017) and *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians as well as SAFAP FrogMAP (http://vmus.adu.org.za). The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and Atlas *and Red List of the Reptiles of South Africa, Lesotho and Swaziland* (Bates *et. al.* 2014) as well as SARCA (http://sarca.adu.org.za) for reptiles.

Site Investigation Methodology

A preliminary faunal habitat assessment of the status, spatial requirements and habitat preferences of all priority faunal species (mammals, birds, reptiles and amphibians) likely to occur within or surrounding the graphite mining site was undertaken. For certain species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

A survey of the proposed graphite mining site was carried out on foot during daylight hours in March 2019. The temperature was warm ranging between 21-28°C with rainfall 24 hours prior to site visitation. The survey was heavily augmented with previous faunal surveys conducted in the Blouberg National Park and Alldays area between 2000 and 2019. No specialist survey techniques; including camera trapping, pitfall and funnel trapping were used during the brief field verification of the mammals, reptiles and amphibians on the site. No nocturnal surveys were undertaken.

RESULTS OF THE VEGETATION SURVEY

Vegetation units

Except for the riverine area the total study area consists mostly of one large woodland vegetation unit but has been divided into two vegetation units based mainly on the topography and the soil present namely: 1) Low-lying woodland; 2) Rocky woodland; and 3) Riverine area (Figure 2).

1. Low-lying woodland

Status	Degraded woodland (68.7 ha)		
Vegetation structure:	Open to closed woodland		
Topography:	Level to slight southern slopes (3^0)	**Soil**	Shallow rocky
Rock cover:	10%		
Need for rehabilitation	Medium-high		
Conservation Priority	**Low-medium**		

This vegetation unit occurs in the northern and south-western sections of the study area. The red loamy soil is moderately deep with single large rocks found in some areas covering less than 5% of the area.

The vegetation of this unit is characterised by an open to closed woodland with a degraded herbaceous layer. The woody species *Terminalia prunelloides, Dichrostachys cinerea, Grewia flava, Grewia flavescens, Vachellia tortilis* and *Dovyalis caffra* are prominent throughout this unit in the woody layer. The herbaceous layer is sparse and include the grasses *Enneapogon scoparius, Schmidtia pappophoroides, Aristida stipitata* and the forbs *Blepharis subvolubilis, Evolvulus alsinoides, Thesium utile, Bidens pilosa, Sansevieria aethiopica, Kyphocarpa angustifolia* and *Ipomoea crassipes.*

Red data species

No red data species or suitable habitat were found within this unit, and it is unlikely that such species would be present due to the degraded condition thereof. One protected tree species, *Boscia albitrunca* was found within this unit.

Alien plant species

Opuntia stricta

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Cat	Species name	Class
	Achyranthes aspera	G
	Aristida stipitata	G
	Bidens pilosa	F
	Blepharis subvolubilis	F
	Boscia albitrunca	W
	Boscia foetida	W
	Cassia italica	F
	Commiphora pyracanthoides	W
	Corchorus asplenifolius	F
	Cucumis spp	F
	Dichrostachys cinerea	W
	Dovyalis caffra	W
	Ehretia rigida	W
	Enneapogon scoparius	G
	Eragrostis biflora	G
	Evolvulus alsinoides	F
	Grewia bicolor	W

Grewia flava	W
Grewia flavescens	W
Hermbstaedtia odorata	F
Ipomoea crassipes	F
Justicia spp	F
Kyphocarpa angustifolia	F
Limeum viscosum	F
Melinis repens	G
Opuntia stricta	F
Panicum maximum	G
Plectranthus madagascariensis	F
Portulaca spp	F
Sansevieria aethiopica	F
Schmidtia pappophoroides	G
Senegalia burkei	W
Senegalia nigrescens	W
Senegalia tortilis	W
Solanum panduriforme	F
Tephrosia capensis	F
Terminalia prunelloides	W
Thesium utile	F
Tragus berteronianus	G
Tribulus terrestris	F
Urochloa panicoides	G
Zornia milneana	F

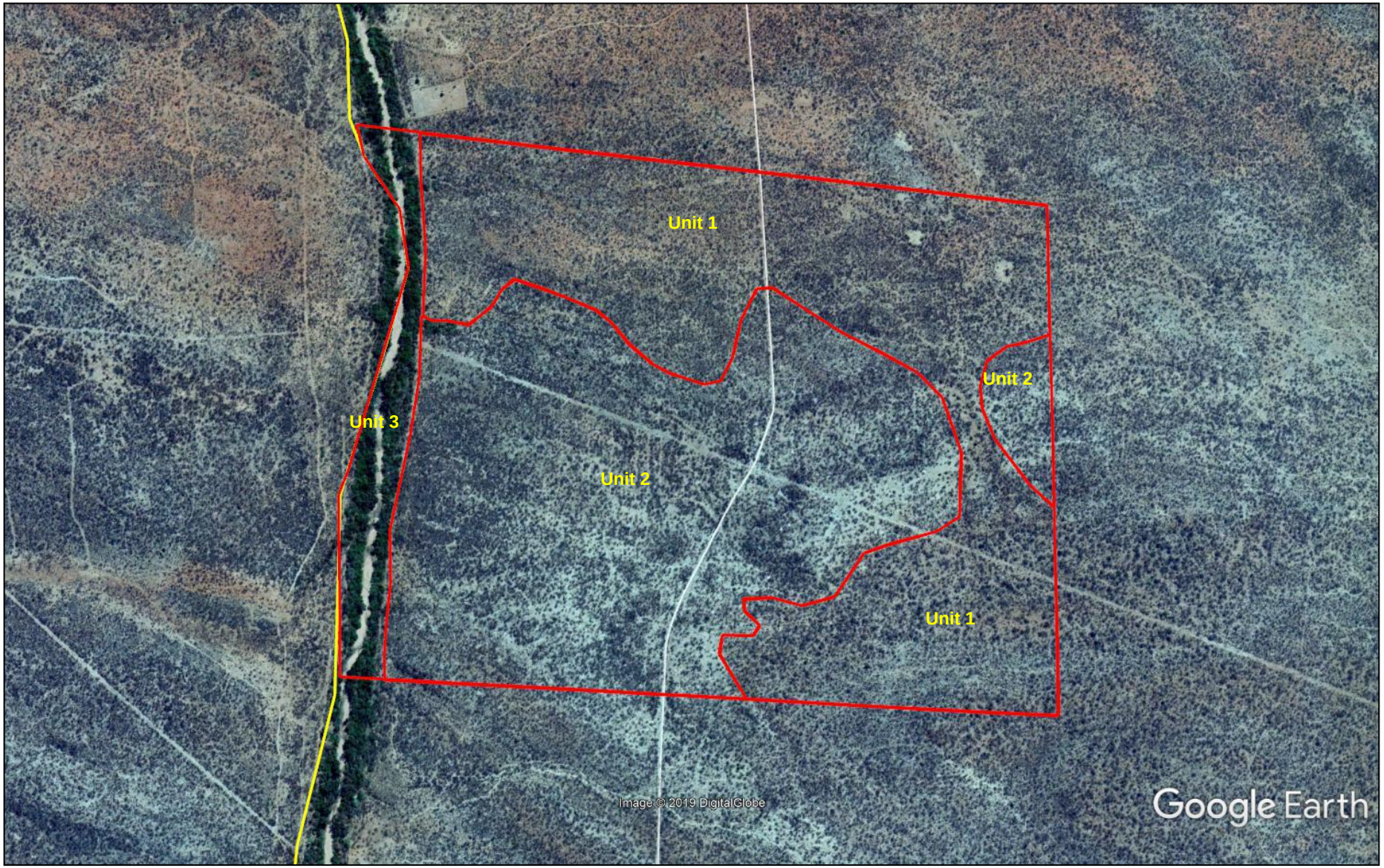

Figure 2. Vegetation units of the study area (Image obtained from Google Earth 2018).

2. Rocky woodland

Status	Natural encroached woodland (78.5 ha)		
Vegetation structure:	Dense woodland		
Topography:	Level to undulating	**Soil**	Shallow rocky - sodic
Rock cover:	10-35%		
Need for rehabilitation	Medium		
Conservation Priority	**Medium**		

This unit is located on the undulating and slightly higher-lying southern rocky section of the site. The area has mostly shallow soil with rocks covering up to 45% of the area.

The vegetation is characterised by a relatively dense woody vegetation layer and a degraded herbaceous layer. The vegetation is dominated by the woody species *Vachellia tortilis, Terminalia prunelloides, Dichrostachys cinerea, Catophractes alexandri, Vachellia robusta, Senegalia senegal,* while *Senegalia nigrescens, Combretum apiculatum* and *Cadaba aphylla* are locally prominent. The herbaceous layer is degraded though patches of the grasses *Enneapogon scoparius, Schmidtia pappophoroides* and *Eragrostis lehmanniana* are present in-between dense woody clumps, covering up to 15% of the area.

Common forbs include *Hermbstaedtia odorata, Indigofera filipes, Leonotis ocymifolia, Chenopodium album* and *Selaginella dregei.*

Red data species

No red data species were found within this unit, and it is not thought that the habitat is suitable for such species due to the degraded herbaceous layer.

Alien plant species

Opuntia stricta

The following is a list of plant species identified in unit 1a during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Cat	Species	Class
	Asparagus retrofractus	W
	Asparagus suaveolens	W
	Boscia albitrunca	W
	Boscia foetida	W
	Cadaba aphylla	W
	Cenchrus ciliaris	G
	Chenopodium album	F
	Combretum apiculatum	W
	Dichrostachys cinerea	W
	Digitaria eriantha	G
	Ehretia rigida	W
	Enneapogon scoparius	G
	Evolvulus alsinoides	F
	Grewia bicolor	W
	Grewia flava	W
	Grewia flavescens	W
	Hibiscus spp	F
	Indigofera filipes	F
	Justicia flava	F
	Kyphocarpa angustifolia	F
	Leonotis ocymifolia	F
	Lycium cinereum	W
	Piaranthus atrosanguineus	F
	Plectranthus madagascariensis	F
	Rhynchosia totta	F
	Schmidtia pappophoroides	G
	Senegalia erubescens	W

Senegalia nigrescens	W
Senegalia senegal	W
Sterculia spp	F
Tephrosia capensis	F
Terminalia prunelloides	W
Urochloa panicoides	G
Vachellia nilotica	W
Vachellia robusta	W
Vachellia tortilis	W

3. Riverine area

Status	Mostly natural (10.4 ha)		
Vegetation structure:	Tall riverine forest		
Topography:	N/A	**Soil**	Deep clay and sand
Rock cover:	5%		
Need for rehabilitation	Medium		
Conservation Priority	**High**		

The Riverine area (Mogalakwena River) forms the western boundary of the property and comprises a seasonally wet river with small pools remaining throughout the year. The riverbed has deep sandy soil while the riverbank has dark loamy-clayey soil with few rocks present.

The vegetation is dominated by the trees *Combretum erythrophyllum, Faidherbia albida, Ficus sur,* and *Senegalia ataxacantha,* while the tree *Ziziphus mucronata* is prominent. The herbaceous layer is degraded with the alien invasive weed *Ricinus communis* and *Xanthium strumarium* forming dense clumps all along the embankments. Other species present include the woody species *Senegalia erubescens, Gymnosporia buxifolia, Terminalia prunelloides,* the grasses *Brachiaria deflexa, Panicum maximum, Urochloa*

panicoides, and the forbs *Alternanthera pungens, Gomphocarpus fruticosus,* and *Gomphrena celosioides.*

Red data species

No red data species were noted within this unit.

Alien plant species

Crotalaria agatiflora, Verbena bonariensis.

The following is a list of plant species identified in unit 1a during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Cat	Species	Class
	Achyranthes aspera	F
	Alternanthera pungens	F
	Brachiaria deflexa	G
	Celtis africana	W
	Combretum erythrophyllum	W
	Crotalaria agatiflora	W
	Cynodon dactylon	G
	Faidherbia albida	W
	Ficus sur	W
	Gomphocarpus fruticosus	F
	Gomphrena celosioides	F
	Gymnosporia buxifolia	W
	Panicum maximum	G
	Ricinus communis	F
	Senegalia ataxacantha	W
	Senegalia burkei	W
	Senegalia erubescens	W
	Terminalia prunoides	W
	Urochloa panicoides	G
	Vachellia robusta	W
	Xanthium strumarium	
	Ziziphus mucronata	W

RESULTS OF THE FAUNAL SURVEY

The faunal survey focused on mammals, birds, reptiles and amphibians of the study area. The preliminary survey focused on the current status of threatened animal species occurring, or likely to occur within the proposed mining area, describing the available and sensitive habitats, identifying potential impacts resulting from the graphite mining development and providing mitigation measures for the identified impacts. Faunal surveys should ideally be conducted over extended periods during the summer rainy season between November and March. Faunal data was obtained during the 1 day survey of the site carried out on foot. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify mammals. Birds were identified with the use of binoculars (10x50), Newman's Field Guide as well as by individual calls. Amphibians were identified by visual observations of adults as well as sweep and dip-netting for juveniles (tadpoles). Reptiles were actively searched for and identified by actual specimens or observations of specimens. The data was supplemented by previous surveys conducted in the Blouberg-Alldays area, literature investigations, personal records and historic data.

General observations applicable across the vegetation of the entire site are as follows:

- The majority of the site and adjacent Limpopo Sweet Bushveld is heavily degraded due to previous as well as current high levels of disturbances associated with the surrounding residential areas to the south.
- Basal cover was low throughout the property especially adjacent to current off-road tracks, livestock pathways as well as eroded patches.
- Forb species diversity was low throughout the property due to utilisation of the property for livestock (Cattle, donkeys and goats) grazing activities and harvesting of traditional medicinal plants by the surrounding communities
- Wood harvesting on the site as well as within the closed woodland riparian zone of the Mogalakwena River.
- Weed and alien invader floral species where observed on site especially along the edges of the active channel of the Mogalakwena after recent high-flows. Several invasive species such as Syringa (*Melia azedarach**), Castor Oil Plant (*Ricinus communis**), Large Cockelbur (*Xanthium strumarium*), American Aloe (*Agave americana**), Prickly Pear (*Opuntia ficus-indica**), Imbricate Cactus (Opuntia imbricata) and Lantana (*Lantana camara**).
- The overgrazed and trampled areas on the site showed the most sign of transformation and degradation from the natural state with more weed and invaders

evident in conjunction with bush encroachment by *Dichrostachys cinerea, Senegalia erubescens and Senegalia mellifera.* *Acacia ataxacantha* has formed dense thickets in the disturbed riparian zone of the Mogalakwena River.

- Several dog tracks were observed on the site. Hunting with dogs has a high impact on remaining faunal species.

Amphibians

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Frog populations throughout the world have crashed dramatically in the last twenty years. Deforestation, wetland draining, and pollution are immediately obvious causes. But other, more fundamental, man-made impacts are causing population declines in 'pristine' habitats such as national parks and remote rainforests. Reductions in atmospheric ozone levels are allowing increased UV-radiation, pollutants are accumulating in natural systems and bacterial and virus distribution is accelerating across the globe (Carruthers 2001). Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently, frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. The Giant Bullfrog (*Pyxicephalus adspersus*) has been chosen as a flagship species for the grassland ecoregion (Cook in le Roux 2002)

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in Limpopo Province can be classified as explosive breeders. Explosive breeding frogs utilise palustrine, lacustrine (dams) or endoheic systems such as ephemeral pans and depressions for their short duration reproductive cycles. A few species utilise riverine systems; especially permanent rivers, mountain streams and floodplains. There are also terrestrial breeders such as *Breviceps*.

As the survey was undertaken during daylight hours during the late summer months (March 2019), only a few species of frogs were recorded. Ideally, a herpetological survey should be undertaken throughout the duration of the wet season (November-March). It is only

during this period accurate frog lists can be compiled. During this survey; fieldwork was augmented with species lists compiled from personal records (Blouberg NP; data from the South African Frog Atlas Project (SAFAP) and published data, and the list provided in Table below is therefore regarded as likely to be fairly comprehensive.

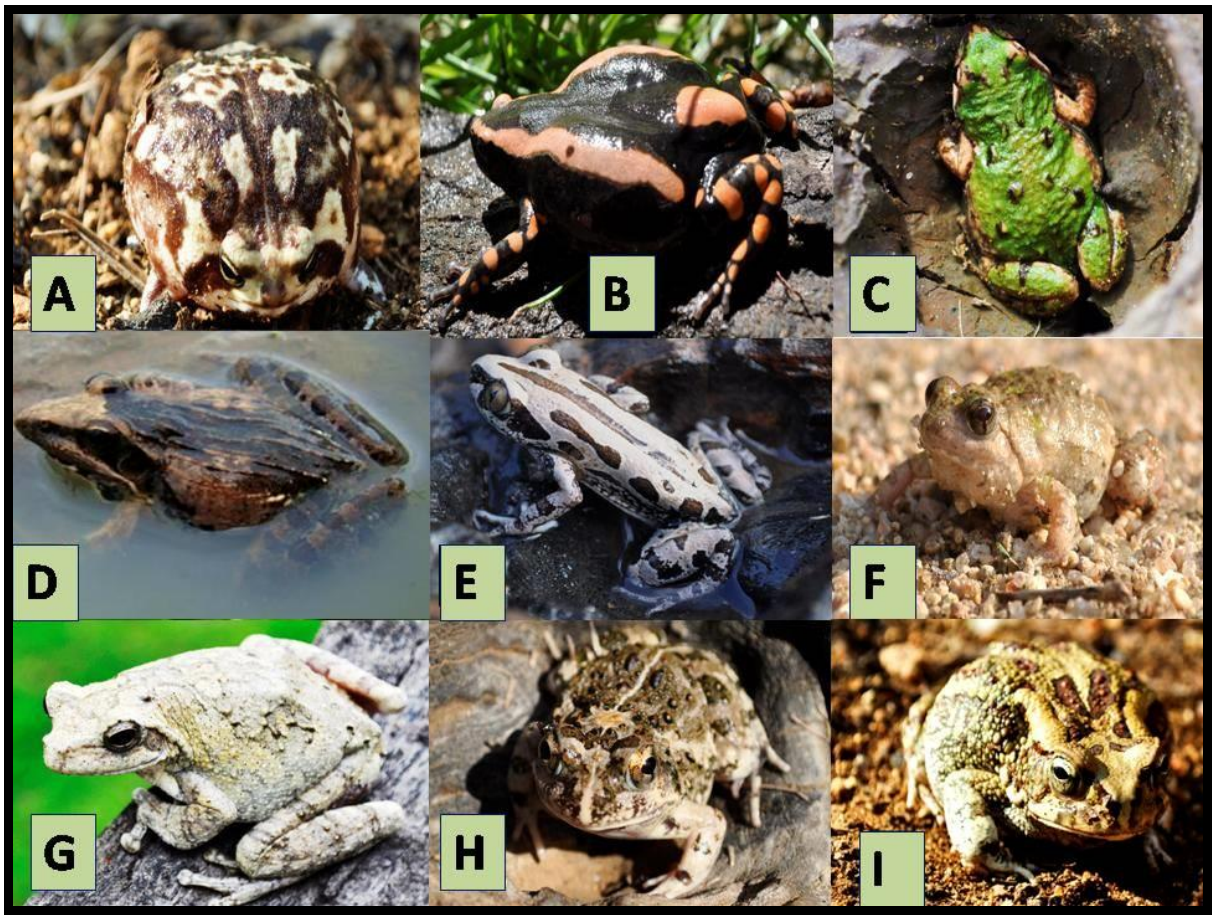

Figure 3. **A conglomerate of photographs of the frog species likely to occur or in suitable habitat surrounding the proposed site. The majority of frog species will be restricted to the Mogalakwena River and flood-bench. A:** Bushveld Rain Frog (*Breviceps adspersus*); **B**: Banded rubber Frog (*Phrynomantis bifasciatus*) **C:** Common Caco (*Cacosternum boettgeri*); **D:** Plain Grass Frog (*Ptychadena anchietae*); **E:** Bubbling Kassina (*Kassina senegalensis*); **F:** Snoring Puddle Frog (*Phrynobatrachus natalensis*); **G:** Southern Foam Nest Frog (*Chiromantis xerampelina*); **H:** Tremelo Sand Frog (*Tomopterna cryptotis*); **I:** Olive Toad (*Sclerophrys garmani*)

The majority of the site comprises degraded Limpopo Sweet Bushveld. The understory layer has been heavily overgrazed with thicket formation adjacent to the poorly defined non-perennial or intermittent drainage lines. The sandier sections of the site provide suitable habitat for Bushveld Rain Frogs (*Breviceps adspersus*) whilst certain areas are situated on a rocky substrate which prevents burrowing activities. Three frog species were recorded during the brief site visitation namely a single Olive Toad *(Sclerophrys garmani*) under a

small log within the seasonal flood-bench above the active channel of the Mogalakwena River. An old Southern Foam Nest Frog (*Chiromantis xerampelina*) nest was observed on an overhanging *Senegalia ataxacantha* branch as well as flushing a Plain Grass Frog (*Ptychadena anchietae*) from the margins of a seasonal pool within the Mogalakwena River. No evidence of any natural wetlands such as valley bottom wetlands or seasonal pans/depressions were observed on the site.

Figure 4. The seasonal pools within the Mogalakwena River suitable breeding habitat for Tremelo Sand Frogs (*Tomopterna cryptotis*), Snoring Puddle Frogs (*Phrynobatrachus natalensis*), Banded Rubber Frogs (*Phrynomantis bifasciatus*), Common Caco (*Cacosternum boettgeri*), Tremelo Sand Frogs (*Tomopterna cryptotis*), Common Platanna (*Xenopus laevis laevis*) and Guttural Toads (*Sclerophrys gutturalis*).

Reptiles

Comprehensive reptile species lists are impossible to determine without extensive fieldwork over a number of months or even years. No pitfall or funnel trapping was conducted due to time constraints and the survey was based primarily on visual encounters. This method entails active searching in suitable habitat components such as searching in the different vegetation communities, turning over objects such as logs and loosely embedded rocks, searching in crevices in rocks and bark and replacing all surface objects after examining the ground beneath. Logs, termite mounds and other substrates are not torn apart to minimize disturbance to important habitat elements in the sample unit. Observers note only presence

of individuals or sign and identify the detection to the most specific taxonomic level possible. Specimens are only captured when necessary to confirm identification especially of difficult to distinguish species. Because of human presence in the area (livestock grazing, pathways,) coupled with habitat destruction and disturbances (wood harvesting), alterations to the original reptilian fauna are expected to have already occurred within and adjacent to the graphite mining areas.

Figure 5. Several juvenile Bushveld Lizards (*Heliobolus lugubris*) were observed mimicking the 'Oogpister" or predacious ground beetle (Anthia sp.). within the overgrazed open woodlands on the site.

The degraded *Senegalia nigrescens-Terminalia prunoides* sweet Bushveld with scattered logs and rocks offers suitable habitat for Cape Gecko (*Pachydactylus capensis)*, Transvaal Thick-toed Gecko (*Pachydactylus affinis*), Eastern ground Agama (*Agama aculeata distanti*), Variable Skink (*Trachylepis varia*), Striped Skink (*Trachylepis striata*), Speckled Rock Skink (*Trachylepis punctatissima*), Rainbow Skink (*Trachylepis margaritifer*), Cape Skink (*Trachylepis capensis*), Yellow-throated Plated Lizard (*Gerrhosaurus flavigularis*), Spotted Sand Lizard (*Pedioplanis lineoocellata lineoocellata*), Spotted Sandveld Lizard (*Nucras intertexta*), Common Rough Scaled or Savanna Lizard (*Meroles squamulosus*). The sand soils, rocky outcrops on the site and logs provide suitable habitat for the fossorial Sundevall's Writhing Skink (*Mochlus sundevallii sundevallii*).

The adjacent rocky hill to the south of the mining site as well as low-lying rocky extrusions provide suitable habitat for rupicolous (living on or amongst rocks) reptile species including several species of snakes, skinks and geckos such as Turner's Gecko (*Pachydactylus turneri*). Snake species likely to occur include Bibron's Blind Snake (*Afrotyphlops bibronii*), Boomslang (*Dispholidus typus*), Spotted Bush-Snake (*Philothamnus semivariegatus*), Puff Adder (*Bitis arietans arietans*), Horned adder (*Bitis caudalis*), Southern African Python (*Python natalensis*), Western Yellow-bellied Sand Snake (*Psammophis subtaeniatus*) Striped Grass Snake (*Psammophylax tritaeniatus*), Mole Snake (*Pseudaspis cana*), Black Mamba (*Dendroaspis polylepis*), Snouted Cobra (*Naja annulifera*), Mozambique Spitting Cobra (*Naja mossambica*), Common House Snake (*Boaedon capensis*), Rhombic Egg-Eater (*Dasypeltis scabra*) and Rhombic Night Adder (*Causus rhombeatus*).

The closed woodland riparian zone including the flood-bench of the Mogalakwena River provides suitable habitat for arboreal reptile species including Southern Tree Agama (*Acanthocercus atricollis*), Common Dwarf Gecko (*Lygodactylus capensis capensis*), Flap-necked Chameleon (*Chamaeleo dilepis dilepis*), Spotted Bush Snake (*Philothamnus semivariegatus*), Boomslang (*Dispholidus typus typus*). The termite mounds within the closed riparian woodland as well as seasonal pools provides suitable habitat for the "protected' Southern African Python (*Python natalensis*), Nile Monitor (*Varanus niloticus*) as well as White-throated or Southern Rock Monitor (*Varanus albigularis*). The pools within the Mogalakwena River provide suitable habitat for Cape or Marsh Terrapin (*Pelomedusa subrufa*).

Mammals

The mammal survey was based primarily from a desktop screening perspective and a single day site visitation (8 hours) assessing the habitat availability during daylight hours. No small mammal trapping or camera trapping was conducted during the site visitation. Fieldwork was augmented with previous surveys in similar habitats within the Blouberg-Alldays area as well as published data. The proposed mining area was initially traversed on foot to ascertain the presence of available refuges, spoors or droppings within the degraded open woodland on the site as well as within the river bed of the Mogalakwena River. For medium and large mammals, visual encounters of the actual animal as well as spoor or tracks, scat, foraging marks were noted and used for species identification.

Larger carnivores likely to occur in the area especially within the adjacent private conservation areas include Leopard (*Panthera pardus*), Brown Hyaena (*Parahyaena brunnea*), Caracal (*Caracal caracal*), Serval (*Leptailurus serval*), Honey Badger (*Poecilogale albinucha*), and Blacked-backed Jackal (*Canis mesomelas*). Antelope species likely to be recorded from the study area include Kudu (*Tragelaphus strepsiceros*), Bushbuck (*Tragelaphus scriptus*), Impala (*Aepyceros melampus*), Reedbuck (*Redunca arundinum*), Grey Rhebok (*Pelea capreolus*), Klipspringer (*Oreotragus oreotragus*), Steenbok (*Raphicerus campestris)* and Bush Duiker (*Sylvicapra grimmia*). The population sizes will depend on the current levels of hunting and poaching within the site and adjacent neighbouring properties.

Mammal species recorded within the Mogalakwena River and riparian zone included Kudu (*Tragelaphus strepsiceros*), Bushbuck (*Tragelaphus scriptus*), Steenbok (*Raphicerus campestris)* and Common Duiker (*Sylvicapra grimmia*). A Scrub hare (*Lepus saxatilis*) was flushed from a small *Senegalia erubescens*. The quills of a Cape Porcupine (*Hystrix africaeaustralis*) were observed within the closed riparian woodland. Abandoned Warthog (*Phacochoerus aethiopicus*) burrows were observed within the site as well as digging activities within the active channel of the Mogalakwena River. The majority of the larger mammals will use the site on a transient basis and due to high levels of anthropogenic disturbances associated with the livestock grazing and hunting are not resident.

The rocky hill to the south of the proposed mining area and low-lying rocky extrusions or outcrops provide suitable habitat for several rupicolous mammal species such as Namaqua Rock Mouse (*Aethomys namaquensis*), Spiny Mouse (*Acomys spinosissimus*), Eastern Rock Elephant Shrew (*Elephantulus myurus*) and Chacma Baboon (*Papio ursinus*). Rodent species likely to occur within the open woodlands on the site include Tree Squirrel (*Paraxerus cepapi*), Springhare (*Pedetes capensis*), Bushveld Gerbil (*Tatera leucogaster*), Acacia Rat (*Thallomys paedulcus*), Black-tailed Rat (*Thallomys nigricauda*), Southern Multimammate Mouse (*Mastomys coucha*), Striped mouse (*Rhabdomys pumilio*), Namaqua Rock Mouse (*Micaelamys namaquensis*), Woodland Dormouse (*Graphiurus murinus*), Red Veld Rat (*Aethomys chrysophilus*). Bat species recorded from the area include Egyptian Free-tailed Bat (*Tadarida aegyptiaca*), Rusty Pipistrelle (*Pipistrellus rusticus*), Cape serotine bat (*Eptisecus capensis*), Schreiber's Long-fingered Bat (*Miniopterus schreibersii*), Yellow House Bat (*Scotophilus dinganii*), Common Slit-faced Bat (*Nycteris thebaica*). No bat surveys were undertaken during the faunal habitat assessment.

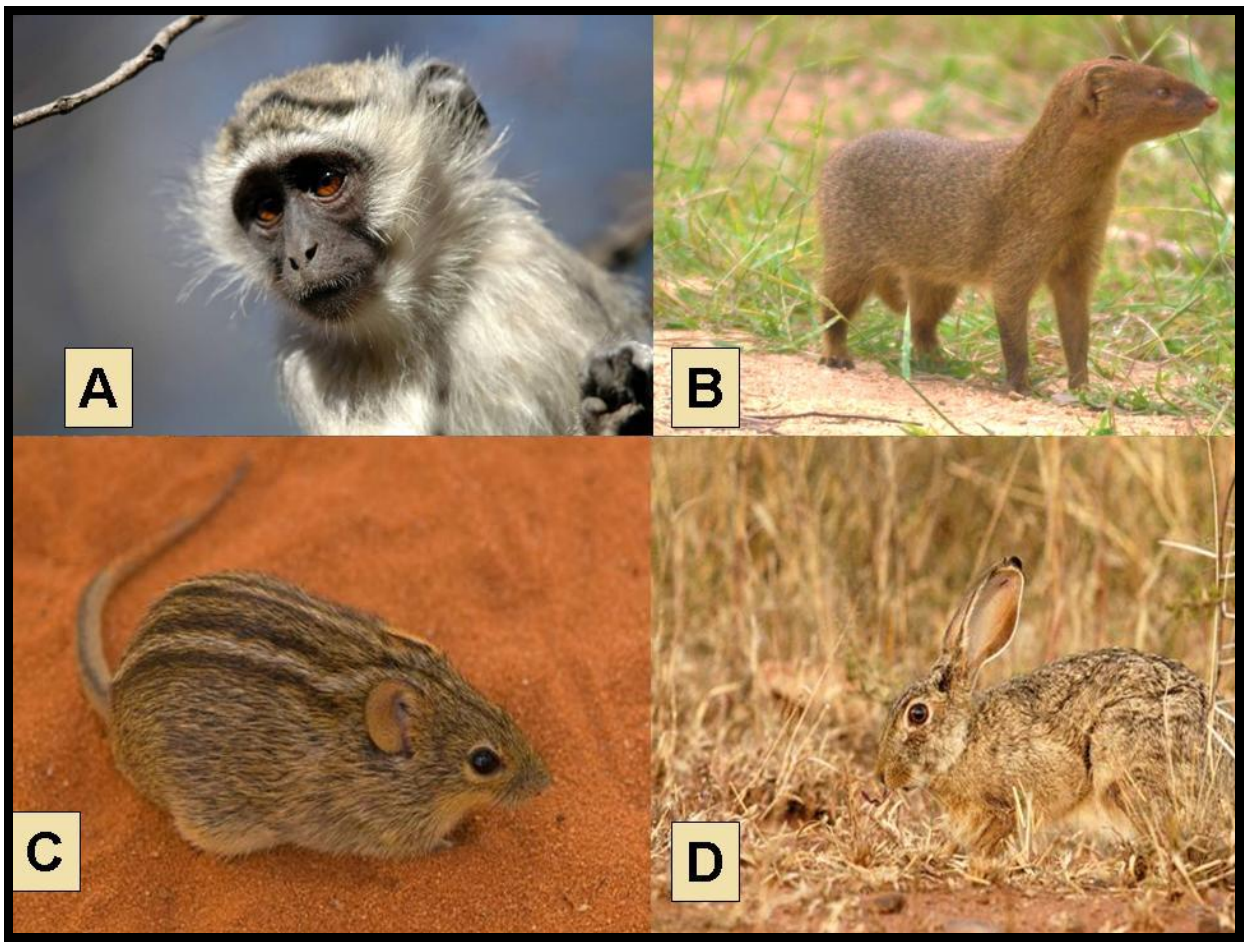

Figure 6. **A collage of photographs* of smaller mammal species likely to occur on the site.** **A:** Vervet Monkeys (*Cercopithecus pygerythrus*) were observed foraging within a Ficus sur in the riparian zone of the Mogalakwena River; **B:** Slender Mongoose (*Cynictis pencillata*) was recorded from riparian zone of the Mogalakwena River. **C:** Suitable habitat for Striped Mouse (*Rhabdomys pumilio*) occurs within the site. **D:** Scrub Hares (*Lepus saxatilis*) was flushed from a small *Senegalia erubescens*.

Avifauna

The savanna biome is identified here as having a grassy under storey and a distinct woody upper story of trees and tall shrubs. Tree cover can range from sparse to almost closed canopy (along some non-perennial drainage lines in the study area as well as riparian zone of Crocodile River). The woodland comprises predominantly broadleaved, winter deciduous woodland. Soil types are varied but are generally nutrient poor. The savanna biome contains a large variety of species (it is the most species-rich community in southern Africa) but is generally less important from a Red Data bird perspective, as very few bird species are restricted to this biome.

* photographs courtesy of Prof. G.D. Engelbrecht

The savanna biome, and specifically short open woodland as well as thickets of *Senegalia erubescens, Senegalia mellifera* and *Dichrostachys cinerea*, is particularly well represented in the study area. The degraded short open woodland tends to have fewer species than the adjacent tall moist closed woodland or riparian zone of the Mogalakwena River. Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of vegetation types above, it is even more important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors such as vegetation type, topography and current land use.

Figure 7. A single White-backed Vulture (*Gyps africanus*) was observed roosting within an Anna Tree *Faidherbia albida* on the edge of the closed woodland riparian zone of the Mogalakwena River

The savanna biome is particularly rich in large raptors, and forms the stronghold of Red Data species such as White-backed Vulture, Cape Vulture, Martial Eagle and Tawny Eagle. These large raptors may occasionally utilise the study area for foraging arrays. A single White-backed Vulture was observed roosting within an Anna Tree *Faidherbia albida* on the edge of the closed woodland riparian zone of the Mogalakwena River. Recent records of Cape Vulture and Whitebacked Vulture from the 2245_2845 pentad during the current South African Bird Atlas Project (SABAP2). Apart from Red Data species, the study area provides habitat for several non-Red Data raptor species, such as Wahlberg's Eagle, African Hawk Eagle, Steppe Eagle, Brown Snake Eagle, Black-chested Snake Eagle and a multitude of medium-sized raptors for example the migratory Steppe Buzzard, Gabar

Goshawk, Dark Chanting Goshawk, Southern pale Goshawk African Goshawk, African Harrier Hawk (Gymnogene),. The smaller raptors observed included a Little Sparrowhawk foraging within the closed woodland riparian zone. The degraded short open woodland offers suitable habitat for the migratory European Roller which is listed as 'Near-threatened'.

The Mogalakwena River and closed wooded riparian zone (flood-bench) are important habitats for remaining birds in the area. The Mogalakwena River and closed wooded riparian zone offer suitable habitat for African Fish Eagle and stork species such as African Openbill, Marabou Stork, Black Stork and Yellowbilled Stork and a variety of other waterbirds. The riparian habitat along the Mogalakwena River provides refuge for shy and skulking species such as the African Finfoot and possibly Whitebacked Night Heron. The eroded macro-channel banks of the Mogalakwena River could provide favourable nesting, foraging and dispersal habitat for the Half-Collared Kingfisher. No large raptor nests were discovered on the site although several large indigenous trees (*Combretum erythrophyllum, Faidherbia albida)* were observed within the riparian zone of the Mogalakwena River. Several trees with suitable holes for cavity nesting species were located within the open woodland as well as along the riparian zone of the Mogalakwena River. Bird species utilising tree cavities for roosting and nesting include owls, starlings, barbets, oxpeckers, woodpeckers and hoopoes. The majority of bird species observed on the site were recorded from the closed woodland vegetation unit situated along the edge of the flood-bench and macrochannel embankments of Mogalakwena River. Lower species diversity was observed in the degraded open woodlands.

DISCUSSION

VEGETATION

Vegetation type

The vegetation of the study is a classified as belonging to the **Limpopo Sweet Bushveld vegetation type (SVcb 19).**

Limpopo Sweet Bushveld occurs on undulating terrain and comprises short to medium-tall open woodland. Many areas are traversed by drainage lines and tributaries. Bush densification is evident in large areas with the woody species *Senegalia erubescens, Senegalia mellifera* and *Dichrostachys cinerea* dominant in these areas. The vegetation is characterised by the dominance of the tall trees *Vachellia robusta, Senegalia burkei,* medium-sized shrubs *Senegalia erubescens, Vachellia nilotica, Boscia albitrunca, Combretum apiculatum, Terminalia sericea, Dichrostachys cinerea, Rhigozum obovatum, Cadaba aphylla* and *Commiphora pyracanthoides.* The herbaceous layer is characterised by the dominance of the grasses *Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Panicum coloratum,* and the forbs *Hermbstaedtia odorata, Indigofera daleoides, Commelina benghalensis* and *Harpagophytum procumbens.*

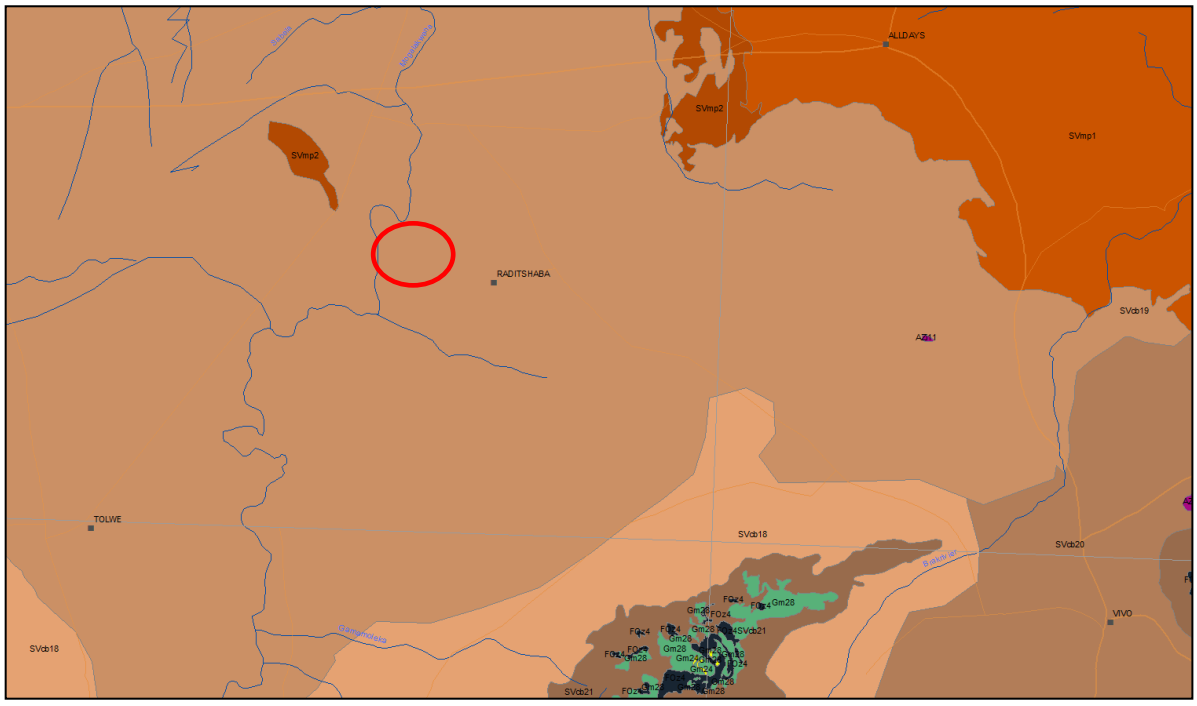

Figure 8. Approximate location (red circle) of the study area within the Limpopo Sweet Bushveld vegetation type (Source: Mucina & Rutherford, 2006).

This vegetation type is regarded as being least threatened. Although only 1% of the target of 19% is statutorily conserved in smaller nature reserves, the area is mostly used for game farming and cattle grazing purposes with an estimated 5% transformed by cultivation.

Vegetation units

Vegetation unit 1 (low-lying woodland) is found toward the northern part of the study area with a section in the south-eastern part also. The soil is characteristically red and moderately deep with few rocks present except for a few medium-sized rocks in some areas covering less than 5% of the study area. The herbaceous layer is degraded mainly due to past and current overgrazing by domestic animals (cattle, goats and donkeys). The woody layer is well-developed with a variety of woody species that ranges in height between 0.5-10m. Due to the overgrazing the grasses are sparse with only a few small tufts present in some areas. As a result, the forbs are mostly pioneer species that can withstand trampling and harsh environmental conditions. Various small drainage channels that has been created by surface runoff and bare soil conditions, are found throughout this vegetation unit (see photo right). The vegetation of the drainage channels does not differ from that of the surrounding vegetation due to them being narrow and only channelling water during high rainfall events. In some sections deeper channels that have become eroded are present, but still with the same vegetation and structure. The woody layer shows signs of densification in some area that can be attributed to the overgrazing and degraded herbaceous layer. The area has a moderate species richness though the herbaceous layer is dominated by pioneer forb species. From a plant ecological and ecosystem functioning point of view this unit has a **low-medium conservation value and ecosystem functioning.** The low-lying woodlands have a **medium conservation value** from a faunal

perspective as the vegetation unit does not provide critical habitat for any threatened faunal species and is not restricted to the site and occurs throughout the study area.

The **Rocky woodland (vegetation unit 2)** is the largest unit of the study area and is located in the southern and eastern section of the site. The soil is shallow leached and loamy in some areas. The vegetation consists of dense shrub and tree species that grow on shallow rocky soil. The area is covered with medium-sized rocks covering up to 45% of the area, while in some sections the soil is gravelly. The area is traversed by a number of small drainage channels with a few deeper and more eroded channels present especially closer to the river area. The vegetation along the small drainage channels does not differ from that of the rest of the unit, while the vegetation around the deeper and more eroded channels are more dense with a few tall woody species but similar in composition to that of the rest of the unit. This area has also been overgrazed by past and current land-use practices resulting in a degraded herbaceous layer. This has resulted in the indigenous invader shrub *Dichrostachys cinerea* forming very dense thickets of uniform height in some areas. These areas have very little grasses or forbs as a result of the shading effect of the dense thickets. This vegetation unit is characterised by the dominance of *Acacia* species (now *Vachellia* and *Senegalia*) in the woody layer, while the grasses *Enneapogon scoparius* and *Schmidtia pappophoroides* are prominent in small patches where small openings in the woody layer are present. This vegetation unit has a moderate species richness with various pioneer forbs. From a plant ecological and ecosystem functioning point of view this unit has a **medium conservation value and ecosystem functioning.** The rocky woodlands have a **medium conservation value** from a faunal perspective as the vegetation unit does not provide critical habitat for any threatened faunal species and is not restricted to the site and occurs throughout the study area.

The **Riverine area (vegetation unit 3)** forms the western boundary of the study area. The area is typical of seasonal river systems (Mogalakwena River) where large amounts of water during high rainfall events causes erosion and destruction of the herbaceous layer of the embankment. That together with the dense woody layer all contribute towards a degraded herbaceous layer consisting of pioneer weedy species mostly. During the survey the riverbed was dry with smaller sections where small water pools still existed and where streambank erosion is high. The area is also used for grazing by domestic animals and a few donkeys and cattle were observed grazing the few remaining grasses in the riverbed. The woody layer is well-developed and comprises tall indigenous trees with a high canopy cover of between 85-100%. The herbaceous layer is degraded consisting of pioneer species mostly together with the declared category 1 alien invasive weed *Ricinus communis* that forms dense stands in various localities. From a plant ecological point of view this unit has a medium conservation value, however, together with its ecosystem functioning, this unit is regarded as having a **high conservation value.** The Mogalakwena River and riparian zone are considered as **high sensitivity** from a faunal perspective as they offer suitable habitat for threatened faunal species as well as potential dispersal corridors for remaining faunal species. A suitable buffer zone needs to be implemented between the edge of the riparian zone and the proposed mining activities. A minimum of 500m is proposed as this will ensure that adequate open woodland as well as potential dispersal/foraging habitat remains adjacent to the Mogalakwena River.

Red data species

Lists of red data species are normally acquired via various resources and if no specific recording was made/confirmed on the site, lists obtained from Quarter Degree Grids (QDSG) are used as a broad guideline. At this broad scale the list will include species that may not be found on the proposed site since no suitable habitat exists, while species not listed could be present also. These lists therefore provide broad guidelines only but are useful tools to assess the habitat suitability of the site for these species.

The study site was scanned for the presence of or suitable habitat for any red data plant with specific emphasis on the species as listed in the table below. No red data species were found to be present in the study area (Table 2).

Table 2. Red data species previously recorded in the quarter degree grid of the study area (Raimondo *et al.* 2009).

Genus	National Status	Habitat	Recorded in study area
Vachellia erioloba	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops	Not found
Ansellia africana	Declining	In hot dry mixed deciduous woodlands at medium to low altitudes near rivers	No suitable habitat
Boophone disticha	Declining	Dry grassland and rocky areas	Not found
Bowiea volubilis	Vulnerable	Along mountain ranges and in thickly vegetated river valleys. Often grows under bush clumps and in boulder scree.	No suitable habitat
Brachycorythis conica	Vulnerable	Short grasslands, hillsides, on sandy gravel overlying dolomite, sometimes also on quartzites.	No suitable habitat
Callilepis leptophylla	Declining	Grassland or open woodland, often on rocky outcrops	No suitable habitat
Dioscorea sylvatica	Vulnerable	Wooded places with fair to reasonably good rainfall	No suitable habitat
Elaeodendron transvaalense	NT	Savanna or bushveld, from open woodland to thickets, often grows on termite mounds	No suitable habitat
Siphonochilus aethiopicus	CR	all open or closed woodland, wooded grassland or bushveld	No suitable habitat

Topography, drainage

The study area slopes towards the west where a seasonal river is present. The site is flat to undulating with various small informal and in some cases eroded but narrow drainage channels that resulted from overgrazing with the resultant removal of the herbaceous layer that bind the soil.

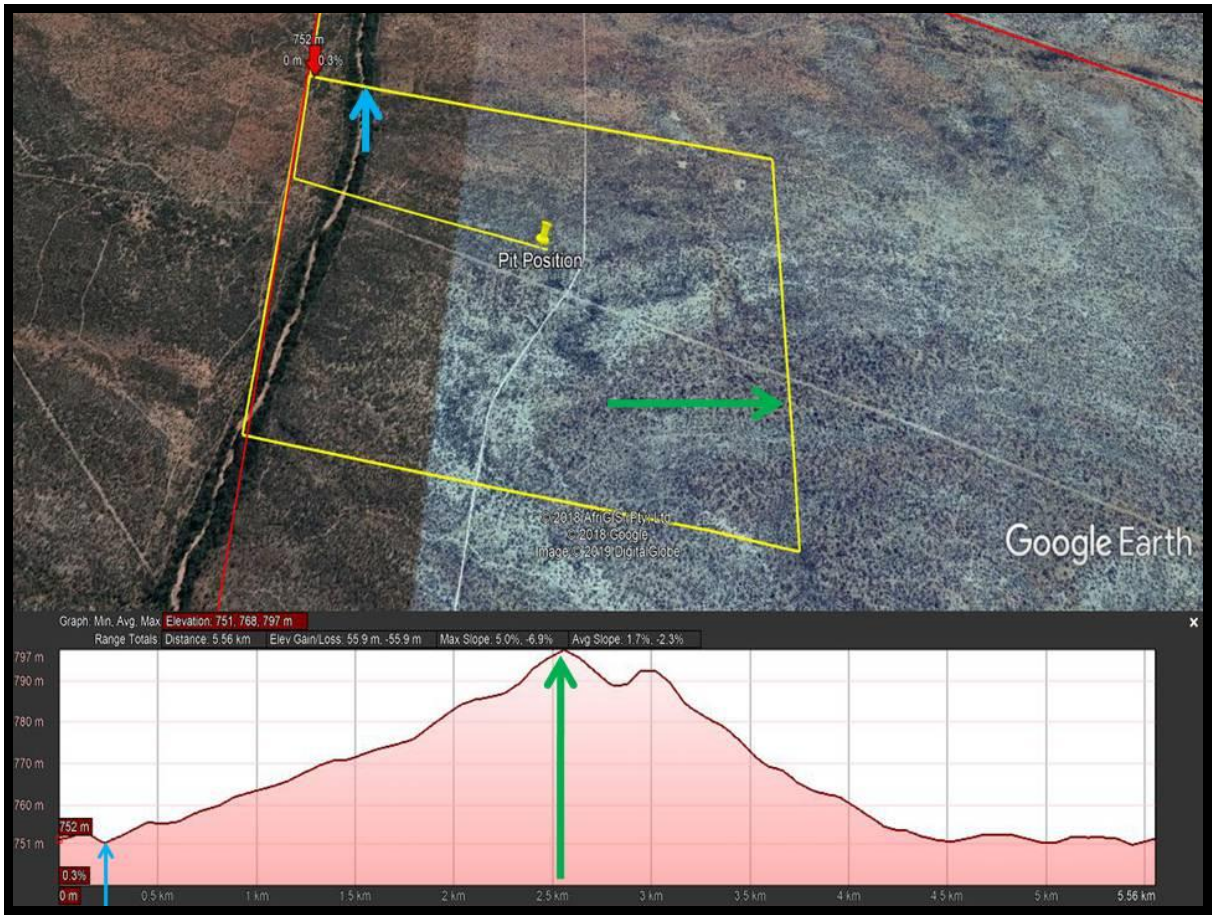

Figure 9. An elevation profile for the proposed study area. The site has a gentle sloping topography with an average slope of 1.7%. The highest point is on the south-eastern boundary (797 m) and the lowest (751 m) within the active channel of the Mogalakwena River of the north-eastern boundary.

Ecosystem classification

The proposed mining area was also assessed in terms of their provincial classification according to the Limpopo Conservation Plan 2 (LCPv2) (Desmet *et al.,* 2013). The area is classified as a Critical Biodiversity Area (CBA) (Figure 10):

Figure 10. Ecosystem classification according to Limpopo Conservation Plan 2 indicating the study area to be located in CBA area.

Alien plant species

A total of four different declared alien invasive species, the forb woody *Crotalaria agatiflora* (vegetation unit 3), the forbs *Ricinus communis* and *Xanthium strumarium* (vegetation unit 3) and the succulent *Opuntia stricta* (vegetation unit 1) were found to be present as single individuals in the study area.

Opuntia stricta is a succulent species with metamorphic stems resembling leaves, while the leaves have been reduced to form thorns. The plant originates from the Caribbean region and is an upright or spreading fleshy shrub usually growing 50-100cm tal. The plant is known to invade rocky slopes and river banks as well as degraded areas in grasslands and woodlands. The plant forms dense impenetrable thickets and prevents access to areas while it also displaces indigenous species and causes injuries to people, livestock and wild animals. Pastoralists have made claims that animals that digested the plane has died as a result thereof.

Crotalaria agatiflora is an evergreen shrub that is native to tropical East Africa. The plant invades watercourses and displaces indigenous vegetation. It spreads via a large number

of seeds that are washed by the water to other areas. It also invades grassland and savanna areas within southern Africa.

Ricinus communis is an annual shrub with a soft woody stem. It originates from Tropical Africa and grows extremely fast in degraded areas, especially watercourses, where it displaces natural vegetation and produces a large number of seeds that are dispersed by the water.

Xanthium strumarium is a monoecious forb also known as the common cocklebur belonging to the Asteraceae family. It is thought to originate from North America and is known to grow in disturbed areas and alongside riverine areas. The seeds are borne in a spine bur and easily disperses via water, but also by becoming entangled in the hair of mammals that then disperses the seeds.

Opuntia and is a declared category 1 weed (CARA) and category 1b plant (NEMBA), *Crotalaria agatiflora* a category 1b (NEMBA) and *Ricinus communis* and *Xanthium strumarium* are category 2 weeds (NEMBA). *Ricinus communis* is also a host plant for the polyphagous Indian Shot-borer beetle which has detrimental impacts on certain indigenous as well as exotic softwood tree species. All category 1 plants must be removed and eradicated by the landowner by law, while category 2 plants need to be contained within one's property. **It is therefore important that these plants are removed from the different vegetation units and that a programme is implemented on a long-term basis to control the spread of these plants.**

Medicinal plants

Two medicinal plants were found within the study area within vegetation unit 3 during the surveys. They are the tree *Ziziphus mucronata* and the weed *Gomphocarpus fruticosus.* None of these species are threatened, while *Gomphocarpus fruticosus* is a pioneer weed that grows in degraded areas.

Protected trees

In terms of the National Forests Act 1998 (Act No 84 of 1998) certain tree species can be identified and declared as protected. The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell,

donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. The protected *Boscia albitrunca* (Shepherds Tree) was observed in vegetation units 1 and 2 and removal of these protected tree species will require permits.

FAUNA

Amphibians

Figure 11. The protected Giant Bullfrog (*Pyxicephalus adspersus*) has been recorded in the Polokwane-Seshego area by the consultant. Remaining populations are threatened due to extensive habitat transformation and degradation within the area. Large numbers are killed annually after heavy summer downpours migrating towards suitable breeding habitats on the adjacent major road networks. No suitable habitat for Giant Bullfrogs on the site

Figure 12. The protected African Bullfrog (*Pyxicephalus edulis*) has been recorded by the consultant from the adjacent Blouberg Nature Reserve as well as within seasonal pans towards Makhado. No suitable habitat within proposed mining site for African Bullfrogs

Threatened species

One threatened species occurs within Limpopo Province namely the Northern Forest Rain Frog (*Breviceps sylvestris*) which is currently classified as lower-risk "Near-threatened'. *Breviceps sylvestris sylvestris* is restricted to the afromontana and north-eastern mountain grasslands of Limpopo within the Magoebaskloof-Legalameetse area. The subspecies *Breviceps sylvestris taeniatus* occurs on the slopes of the Blouberg and Soutpansberg. No suitable habitat for Northern Forest Rain Frogs on the site.

The Giant Bullfrog (*Pyxicephalus adspersus*) and African Bullfrog (*Pyxicephalus edulis*) are protected frog species. No suitable breeding habitat occurs on the site or in the immediate surrounding area for both Giant and African Bullfrogs. African Bullfrogs have been recorded in the Vivo and Blouberg area to the south of the site.

Reptiles

Threatened species

Continual destruction of suitable habitats has resulted in the disappearance of numerous reptile species on the site. No snake species was recorded during the brief field survey.

No threatened reptile species have been recorded within the 2228 DC QDGC or are likely to occur on the site. The site offers suitable habitat for the 'protected' South African Python (*Python natalensis*) especially within the Mogalakwena River and riparian zone. Several termite mounds were observed which offer suitable breeding sites for pythons.

***Avifauna* (birds)**

Several bird species of conservation and bio-diversity importance occur, or possibly could occur occasionally on the site. The major causal factors for population declines include habitat loss, transformation and degradation through destruction of riverine and wetland\marsh habitat; agricultural and livestock modification; poisoning (persecuted directly and indirectly); shooting (especially raptors); invasion of alien vegetation and human made structures (lines, pylons, drownings in reservoirs, road fatalities etc.). One threatened bird species was recorded during the brief survey namely an Endangered White-backed Vulture (*Gyps africanus*).

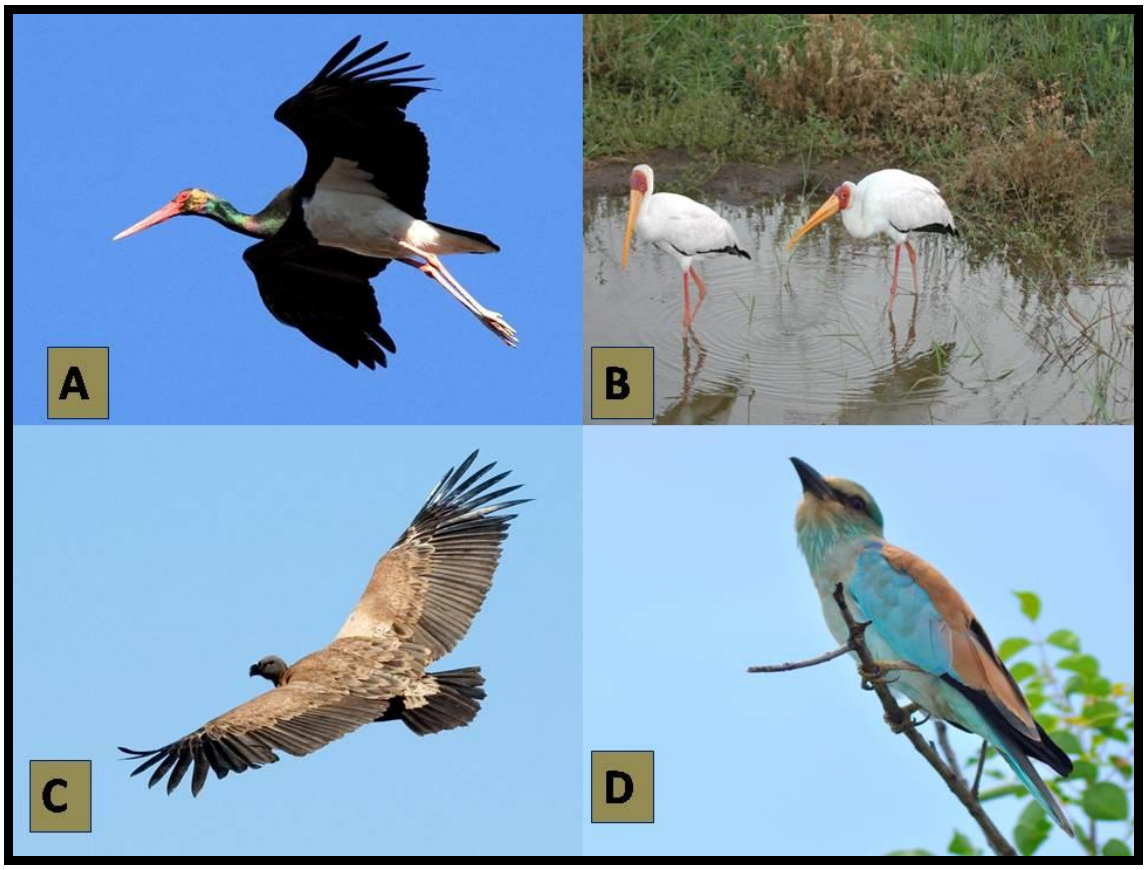

Figure 13. A collage of photographs of threatened bird species recorded from the 2245_2845 pentad during the current SABAP2. **A:** Black Stork (*Ciconia nigra*) Vulnerable; **B:** Yellow-billed Stork (*Mycteria ibis*) Endangered; C: White-baked Vulture (*Gyps africanus*) Endangered and **D:** European Roller (*Coracias garrulus*) Near-threatened.

Table 3. List of threatened and near-threatened bird species that have been recorded from the 2245_2845 pentad and that could occur near the proposed graphite mining site.

Common Name	Scientific Name	Conservation Status (Taylor 2015)	Likelihood of Occurrence
White-Backed Night Heron	*Gorsachius leuconotus*	Vulnerable	Suitable habitat within the riparian zone of the Mogalakwena River
Yellow-billed Stork	*Mycteria ibis*	Endangered	Suitable habitat for occasional foraging arrays within the Mogalakwena River
Black Stork	*Ciconia nigra*	Vulnerable	Suitable habitat for occasional foraging arrays within the Mogalakwena River
Secretarybird	*Sagittarius serpentarius*	Vulnerable	Marginally suitable habitat on the site. Has not been recorded during SABAP2.
Cape Vulture	*Gyps coprotheres*	Endangered	Suitable habitat for occasional foraging arrays.
White-Backed Vulture	*Gyps africanus*	Endangered	**Confirmed present.** Suitable habitat for occasional foraging arrays as well as potential nesting sites within large riparian trees along the Mogalakwena River.
Tawny Eagle	*Aquila rapax*	Endangered	Suitable habitat for occasional foraging arrays. Has not been recorded during SABAP2.
Martial Eagle	*Polemaetus bellicosus*	Endangered	Suitable habitat for occasional foraging arrays. Has not been recorded during SABAP2.
African Crowned Eagle	*Stephanoaetus coronatus*	Vulnerable	Suitable habitat for occasional foraging arrays within the Mogalakwena River. Has not been recorded during SABAP2.
Lanner Falcon	*Falco biarmicus*	Vulnerable	Suitable foraging and exploratory habitat. Has not been recorded during SABAP2.
Red-footed Falcon	*Falco vespertinus*	Near-threatened	Non-breeding migrant. Suitable habitat within the open woodland on the site. Has not been recorded during SABAP2.
Kori Bustard	*Ardeotis kori*	Near-Threatened	Marginally suitable habitat on the site. Has not been recorded during SABAP2.
European Roller	*Coracias garrulus*	Near-threatened	Non-breeding migrant. Suitable habitat within the open woodland on the site.

The proposed mining area does not comprise of critical habitat for any threatened bird species. The most suitable habitat for remaining threatened bird species is the tall closed woodland riparian zone along the Mogalakwena River as well as seasonal pools. The degraded open woodland comprises marginally suitable habitat for occasional foraging arrays as well as exploratory movements of certain threatened bird species. More

comprehensive avifaunal surveys conducted over extended periods will be required in order to ascertain the current status of threatened bird species on the site.

Mammals

Figure 14. Temminck's Ground Pangolin foraging during the day (photograph courtesy of Prof. G.D. Engelbrecht).

Threatened species

No evidence of any threatened mammal species was recorded during the brief single day site visitation (8 hours) of the site. This can be expected due to the short-duration of the field work as well as secretive nature of the threatened mammal species, including Leopards and Temminck's Ground Pangolin. The majority of threatened mammal species occurring in the area are extremely difficult to observe even during intensive field surveys conducted for extended periods. It is highly unlikely that the proposed mining area within the degraded open woodlands constitutes significant habitat for any of the above-mentioned threatened mammal species. More intensive surveys (using camera traps) are required in order to ascertain the current conservation status of threatened mammal species on the site.

Table 4. Red Data List mammal species with confirmed records from the 2228 DD QDGC and for which suitable habitat is present, and which may therefore occur within the study area.

TAXONOMIC INFORMATION				RED LISTING INFORMATION				TOPS 2007
Order	Family	Scientific name	Common name	Regional listing	Regional Listing criteria	Current global listing	Global listing criteria	
Carnivora	Felidae	*Panthera pardus*	Leopard	Vulnerable	C1	Vulnerable	A2cd	Vulnerable
Pholidota	Manidae	*Smutsia temminckii*	Temminck's Ground Pangolin	Vulnerable	A4cd	Vulnerable	A4d	Vulnerable

SENSITIVE ENVIRONMENTS/HABITATS ON AND SURROUNDING THE SITE

The degraded short open woodland and rocky woodland vegetation units (1 & 2) offer suitable habitat for several animal species and is considered as having **medium sensitivity**. Mining activities should be restricted to the degraded woodlands. The fencing off of the area as well as removal of bush-encroached areas adjacent to the mining site could potentially result in a positive impact for the area.

Rivers are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment (O'Keefe, 1986). Any impact on the non-perennial drainage line on the western boundary of the site is therefore also likely to impact on upstream and downstream areas. Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Streamside riparian areas support a wealth of biological diversity (e.g., Naiman *et al.*1993) and are ecologically important regardless of their role as corridors. Areas preserved along streams include a diversity of habitats and maintain the integrity of aquatic ecosystems by providing shade, nutrients, and structure while reducing sedimentation and pollution (Gregory et al. 1991). Conservation and restoration of these habitats are, therefore, important to maintaining the biological diversity of ecosystems that include riparian habitats.

Riparian zones may act as potential refugia for certain fauna and could allow for possible re-colonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-

colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007). The riparian vegetation provides vital refuge, foraging and migratory passages for species migrating to and away from the rivers. The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams).

Riparian areas have one or both of the following characteristics:

- distinctly different vegetative species than adjacent areas; and
- species similar to adjacent areas but exhibiting more rigorous or robust growth form.

The riparian vegetation is dependent on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more mesic species (water-loving) being located closest to the river channel, often with their roots in the water, and the less water-loving terrestrial species further away from the river.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- enhancing water quality in the river by the interception and breakdown of pollutants;
- interception and deposition of nutrients and sediments;
- stabilisation of riverbanks and macro-channel floor;
- flood attenuation;
- provision of habitat and migration routes for fauna and flora;
- provision of fuels, building materials and medicines for communities (if done on a sustainable basis); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).

The tall closed woodland riparian areas along the Mogalakwena (vegetation unit 3) must be considered a ‘no-go’ area for the mining development and are considered as High sensitivity and conservation potential. An appropriate buffer zone should be implemented. No further vegetation removal must occur except for the removal of invasive plant and tree species. Water abstraction from the non-perennial river could potentially result in further

habitat modification and degradation and should not be permitted without appropriate approval from authorities (DWS).

POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE ASSOCIATED FLORA

The following assessment of impacts was done and was guided by the requirements of the NEMA EIA Regulations (2014) and is presented in the tables below:

Loss of habitat

It is expected that most of the plant species of units 1, & 2 (low ecological sensitivity) will be damaged or destroyed by the proposed mining development on the property. Since these areas are degraded and not regarded as being near-pristine it is thought that the loss of species would not be significant in terms of overall habitat and biodiversity. If properly mitigated the proposed development should have a **medium-term negative impact** on the total ecosystem. Any development in unit 3 (high ecological sensitivity) could potentially negatively affect the plant and animal biodiversity and especially the water channelling function of the system. Development of this vegetation unit could have a **long-term negative effect** on the ecosystem.

HIGH CONSERVATION UNIT: 3

Activity	Potential impact	Environmental significance									Reversibility	Cumulative impact	Irreplaceble loss	Mitigation measures
		Nature	Extent	Duration	Magnitude	Probability	Rating before mitigation		Rating after mitigation					
Environmental Component: Vegetation, Fauna														
Clearing of vegetation for construction	Loss of plant species	–	2	4	6	2	24	**Low**	12	**Negligible**	Irreversible	Low	Low	See potential impacts and recommended mitigation measures in report
	Loss of rare/medicinal species	–	1	4	2	2	14	**Neglible**	7	**Negligible**	Irreversible	Low	Low	
	Loss of animal species	–	3	3	6	2	24	**Low**	12	**Negligible**	Irreversible	Low	Low	
	Loss of biodiversity	–	3	4	6	2	26	**Low**	13	**Negligible**	Irreversible	Low	Low	
	Increased soil erosion	–	3	4	8	2	30	**Low**	15	**Negligible**	Reversible	Low	Low	
	Alteration of ecosystem functioning	–	3	5	8	4	64	**High**	26	**Low**	Irreversible	Low	Low	
	Alien plant invasion	+	3	4	8	1	15	**Neglible**	15	**Negligible**	Reversible	Low	Low	

MEDIUM-LOW CONSERVATION UNIT: 1 & 2

Activity	Potential impact	Environmental significance									Reversibility	Cumulative impact	Irreplaceble loss	Mitigation measures
		Nature	Extent	Duration	Magnitude	Probability	Rating before mitigation		Rating after mitigation					
Environmental Component: Vegetation, Fauna														
Clearing of vegetation for construction	Loss of plant species	–	3	3	6	4	48	**Moderate**	8	**Negligible**	Irreversible	Low	Low	See potential impacts and recommended mitigation measures in report
	Loss of rare/medicinal species	–	1	1	2	1	4	**Low**	4	**Negligible**	Irreversible	Low	Low	
	Loss of animal species	–	2	3	6	4	44	**Moderate**	4	**Negligible**	Irreversible	Low	Low	
	Loss of biodiversity	–	3	3	6	4	48	**Moderate**	10	**Negligible**	Reversible	Low	Low	
	Increased soil erosion	–	2	3	6	1	11	**Neglible**	8	**Negligible**	Reversible	Low	Low	
	Alien plant invasion	+	1	4	8	1	13	**Neglible**	4	**Negligible**	Reversible	Low	Low	

Mitigation and recommendations

No development within unit 3 (Riverine area) is recommended. During the **CONSTRUCTION (mining)** phase the following is recommended: Any bulbous or succulent plant species encountered should be removed and temporarily planted in a suitable container and replanted in the area after mining has been completed. No unnecessary removal of plants must take place.

Where vegetation needs to be "opened" to gain access it is recommended that the herbaceous species are cut short rather than removing them. That will ensure that they regrow during the growing season and also protect the soil against erosion. If possible "soil saver blankets" could be placed over the vegetation to prevent erosion and unnecessary trampling. These blankets must be removed after mining has ceased.

The removal of indigenous woody species should be avoided as far as possible, except in the proposed mining areas where all vegetation will be destroyed. These species have an extensive root system binding the soil and take long to establish. The topsoil should be stored adjacent to the mining area and must be used to restore the area after mining has ceased. All temporary stockpile areas, litter and dumped material and rubble must be removed during and on completion of mining activities. Vegetation clearance should be restricted to the mining areas allowing remaining animals opportunity to move away from the disturbance. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site. No hunting with firearms (shotguns, air rifles or pellet guns) or catapults should be permitted on the property as well as neighbouring areas.

A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen to rehabilitate areas that became degraded due to mining activities.

Alien vegetation

Alien species poses a huge threat to the natural environment due to their competitive nature that leads to the displacement of natural indigenous species (plants and animals), and also due to their excessive use of soil water.

Mitigation and recommendations

All alien vegetation should be eradicated within the study site and invasive species as listed in this report should be given the highest priority. The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term

effects and the effectiveness of the agent. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications. Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983) and National Environmental Management: Biodiversity Act (10/2004) (NEMBA). These acts define weeds as alien plants, with no known useful economic purpose that should be eradicated. Where herbicides are used to clear vegetation, selective and biodegradable herbicides registered for the specific species should be applied to individual plants only. General spraying and the use of non-selective herbicides (e.g. Roundup, Mamba etc.) should be prohibited at all times.

Environmental Control Officer (ECO)

A properly qualified ECO should be appointed to monitor all activities and to report any actions that could or potentially could have a negative effect on the environment. The ECO should also keep records of all actions related to the environmental management plan that should be available on site for inspection. It is also recommended that photographic records are kept before, during and after construction of the various activities.

Waste Management

Adequate waste management measures must be implemented preventing possible illegal dumping and littering of adjacent sensitive areas.

- Adequate toilet facilities must be provided for all staff to prevent pollution of the environment.
- The excavation and use of rubbish pits is forbidden.
- Burning of waste is forbidden.
- A fenced area must be allocated for waste sorting and disposal.
- Individual skips for different types of waste (e.g. 'household' type refuse, building rubble, etc.) should be provided.

Stormwater Management and pollution of water system

All stormwater and runoff generated by the mining activities must be appropriately managed.

- The stormwater drainage network system must be kept separate from the wastewater (water containing waste) system.
- The storm water system must be designed such that no large amount of water is released at one point only.

- The release of water must be designed such that the force of the water is reduced to prevent unnecessary erosion.

Prior to construction commencement

- It is vitally important that storm water management is properly managed on site both during and after mining.
- After mining has ceased, the site should be contoured to ensure free flow of runoff and to prevent ponding of water.
- Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion.

Erosion and Surface runoff

Most development and/or mining activities are characterised by large areas of sealed surfaces such as roads, footpaths, houses etc. As a result, water infiltration is considerably reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Mining and construction activities associated with development can lead to massive short-term erosion unless adequate measures are implemented to control surface run-off. Sheet erosion occurs when run-off surface water carries away successive thin layers of soil over large patches of bare earth. This type of erosion is most severe on sloping soils, which are weakly structured with low infiltration, which promotes rapid run-off. It occurs on the site where vegetation has been destroyed. Continual erosion in sheet-eroded slopes is a common cause of gully erosion. Gully erosion results from increased flow along a drainage area, especially where protective vegetation has been removed and soils are readily transported. A gully has steep, bare sides and is often narrow and deep. Once formed, a gully usually spreads upstream through continual slumping of soil at the gully head. Gully erosion can be associated with salting as the saline sub-soils are readily eroded.

Mitigation and recommendations

Vegetation plays a critical role in the hydrological cycle by influencing both the quantity and quality of surface run-off. It influences the quantity of run-off by intercepting rainfall, promoting infiltration and thus decreasing run-off. Vegetation can influence water quality in two ways: by binding soils thus protecting the surface layer, and by intercepting surface run-off thus preventing erosion. When the speed of the run-off is reduced, suspended particles can settle out and dissolve substances, such as nutrients, can be assimilated by

plants. The vegetation has a filtering effect. The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season in order to prevent erosion. The dry months are also the period when the majority of plant and animal species are either dormant or finished with their propagation/breeding activities. Soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from any drainage area. The careful position of soil piles, and runoff control, during all phases of the mining development, and planting of some vegetative cover after mining activities have ceased (indigenous groundcover, grasses etc.) will limit the extent of erosion occurring on the site. Sufficient measures must be implemented to prevent the possible contamination of the surface water and groundwater.

If bare soil areas result due to the proposed mining, sand bags should be packed along the contour lines to prevent any soil washing onto the lower-lying areas of the site.

Loss of Faunal Habitats

Alteration of the vegetation of the proposed site will directly, and indirectly, impact on the smaller sedentary species (insects, arachnids, reptiles, amphibians and mammals) adapted to their ground dwelling habitats. Larger, more agile species (birds and mammals) will try and re-locate in suitable habitats away from the construction activities and since it is a nature reserve they should not be affected negatively in the long-term.

Mitigation and recommendations

Any animals encountered in the areas could be relocated away from the development site. During the mining phase, workers must be limited to mining areas only and access to natural undeveloped areas must be strictly regulated, preventing uncontrolled hunting, poaching and gathering of firewood and medicinal plants. Increased pressure on the environment could result in major environmental degradation if environmentally sensitive practices are not followed and maintained. During the mining activities; wherever possible, work should be restricted to one area at a time. This will give smaller birds, mammals, reptiles and amphibians an opportunity to move into undisturbed areas close to their natural habitat.

The Site Manager and ECO must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. All animals unearthed or disturbed should ideally be released in appropriate habitat away from the development. Mining activities should be limited to the daylight hours preventing disturbances to the nocturnal activities of

certain species and nearby human populations. This will also minimise disturbances to sensitive and secretive species.

CONCLUSION & RECOMMENDATIONS

Any development will have a negative effect on the natural ecosystem in particular the vegetation thereof. The vegetation of the areas where the proposed mining will take place will be destroyed. The purpose of any ecological assessment is to determine areas of high sensitivity and to provide guidelines to ensure that the proposed development is ecologically sensitive and to prevent unnecessary destruction of natural ecosystems.

The vegetation of the study area (Limpopo Sweet Bushveld vegetation type - SVcb 19) is not regarded as a threatened ecosystem on a National basis, though the study area is regarded as a Critical Biodiversity Area on Provincial level. According to the Limpopo Conservation Plan 2 (LCPv2) (Desmond *et al.,* 2013) the purpose of the plan is to develop the spatial component of the bioregional plan that facilitate biodiversity conservation and also inform natural resource management plans, land-use planning, environmental impact assessments and authorisations. Since the plan and associated maps are done on a relatively coarse scale it is important to note that it does not replace site assessments for Environmental Impact Assessment purposes and still requires specialist interpretation and assessment (Desmond *et al.,* 2013). It is furthermore important to note that the classification of an ecosystem within a specific category is based on various aspects including, birds, vegetation, herpetological data, rivers, wetlands, birds, conservation areas etc.

The vegetation of vegetation units 1 and 2 are degraded mostly due to grazing practices. This has caused the degradation of the herbaceous layer and provided (and still provides) the woody species the opportunity to germinate and increase in density. This has resulted in the woody layer becoming densified thereby preventing the establishment of the grasses. This has also resulted in the low to moderate erosion along the informal drainage channels since there is no more grasses and forbs to bind the soil. The proposed mining area is also small in relation the larger surrounding area. Although these units are classified as belonging to a CBA area on a Provincial level (and Least Threatened on a national Level), the site surveys indicate these units to be somewhat degraded with a moderate-low species richness and diversity. Thus from an ecosystem functioning point of view these units are regarded as having a **medium ecological sensitivity** (Figure 15).

The riverine area (vegetation unit 3) is typical of river systems with a well-developed woody layer and degraded herbaceous layer. The area has a low species richness, but due to its water channelling and storing function as well a potential biological or dispersal corridor, it is regarded as having a **high ecological sensitivity** (Figure 15).

The protected tree *Boscia albitrunca* is present in vegetation units 1 & 2. This tree is usually found in the drier parts of the country such as the study area. The tree is regarded as a medium-sized tree that can grow up to 7m tall. It plays an important role in the ecosystem by providing food, shelter and shade to various animal and bird species. The tree also provides habitat for different herbaceous species to grow underneath its canopy. Humans use the roots of the tree to make porridge, while it is also used as a substitute for coffee in some areas. It is therefore important that these trees are not unnecessarily removed from the ecosystem. If single individuals of these species have to be removed, a permit from the Department of Agriculture, Fisheries and Forestry (Forestry Branch) and Nature Conservation will have to be obtained for this purpose.

Only two medicinal plants were found within the study area. None of these species are threatened, while one is a pioneer weed that grows in degraded areas and disturbed riverbanks. No or red data plant species were identified in the study area. The alien plant species identified should be eradicated from the property.

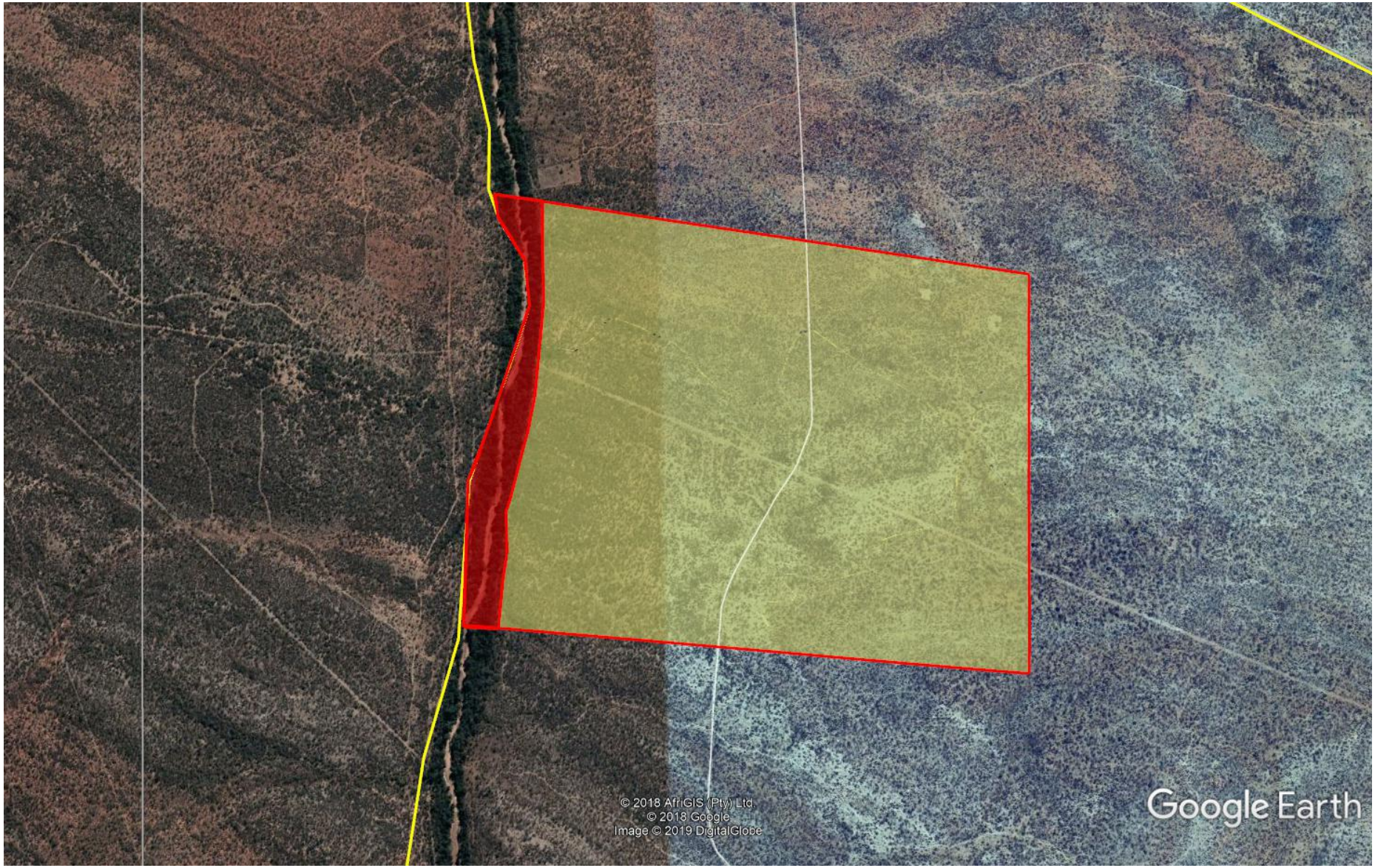

Figure 15. Ecological sensitivity map of the different vegetation units (Yellow = Medium; Red = High)

.

REFERENCES

ACT No 7. 2003. Limpopo Environmental Management Act. Act No 7 of 2003.

ACOCKS, J.P.H. 1988. Veld Types of South Africa. 3rd edn. *Mem. Bot. Surv. S. Afr*. 57: 1–146.

ALEXANDER, G. & MARAIS, J. (2007). *A Guide to the Reptiles of Southern Africa*. Struik Publishers, Cape Town.

BRANCH, W.R. (1988). *Field Guide to the Snakes and other Reptiles of Southern Africa*. Struik Publishers, Cape Town.

BREDENKAMP, G.J. & BROWN, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. Urban Greenfile Nov-Dec 2001: 38-39.

BREDENKAMP G.J & BROWN, L.R. 2003. A reappraisal of Acocks' Bankenveld: origin and diversity of vegetation types. South African Journal of Botany 69(1): 7-26.

BROMILOW, C. 2001. *Problem plants of South Africa*. Briza Publications, Pretoria.

BURNETT, M.R., AUGUST, P.V., BROWN, J.H. & KILLINGBECK, K.T. (1998). The influence of geomorphological heterogeneity on biodiversity. A patch-scale perspective. *Conservation Biology*, 12, 363-370.

CARRUTHERS, V.C. 1990. *The Magaliesberg*. Southern Book Publishers, Johannesburg.

CHIEF DIRECTORATE SURVEYS & MAPPING. 2006. 1:50 000 Topographic Map South Africa: 2528DD Balmoral. Government Printer, Pretoria.

CHILD MF, ROXBURGH L, DO LINH SAN E, RAIMONDO D, DAVIES-MOSTERT HT, EDITORS. 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

CONSERVATION OF AGRICULTURAL RESOURCES ACT, 1983 (Act No. 43 of 1983).

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. 2007. National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

ECOAFRICA. 2015. Limpopo Environmental Outlook Report. Limpopo Economic Development, Environment and Tourism.

ENVIRONMENTAL CONSERVATION ACT, 1989 (Act No. 73 of 1989).

ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2010 (Gazette No 33306 – Regulation 543).

DESMET, P, HOLNESS, S. & SKOWNO, A. 2013. Limpopo Conservation Plan v.2: Technical Report. Limpopo Department of Economic Development, Environment & Tourism

DU PREEZ, L & CARRUTHERS, V.C. 2009. *A complete guide to the Frogs of Southern Africa*. Struik Publishers, Cape Town.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. 2007. National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

ECOAFRICA. 2015. Limpopo Environmental Outlook Report. Limpopo Economic Development, Environment and Tourism.

Eisenberg, A. 2010. *Warning to Birds: All-Glass Buildings Ahead*. New York Times. Aug. 28, 2010.

ENVIRONMENTAL CONSERVATION ACT, 1989 (Act No. 73 of 1989).

ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2010 (Gazette No 33306 – Regulation 543).

FREITAG, S. & VAN JAARSVELD, A.S. 1995. Towards conserving regional mammalian species diversity: a case study and data critique. *S. Afr. J. Zool.* 30(3): 136-144.

GOLDING J (ED). 2002. Southern African Plant Red Data Lists. Southern African Botanical Diversity Network Report No. 14, Pretoria.

JACOBSEN, N.H.G. (1989). A reptile survey of the Transvaal. Unpublished Ph.D. thesis, University of Natal, Durban.

KENT, M. & COKER, P. 1992. Vegetation description and analysis. Belhaven Press, London.

KLEM, D.& P. G. SAENGER. 2013. Evaluating the Effectiveness of Select Visual Signals to Prevent Bird-window Collisions. The Wilson Journal of Ornithology 125(2):406-411.

KNOBEL, J. & Bredenkamp, G. 2005. The magnificent natural heritage of South Africa. Roggebaai, Sunbird Publishers.

LOW, A.E. & REBELO, A.G. (eds). 1998. Vegetation of South Africa, Lesotho and Swaziland. A companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

MCKINNELY, M. L. 1999. High rates of extinction and threat in poorly studied taxa. *Conservation Biology* 13: 1273-1281.

MUCINA, L AND RUTHERFORD, M.C. (eds) 2006. The *vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. SANBI, Pretoria.

NATIONAL ENVIRONMENT MANAGEMENT ACT, 1998 (Act No. 107 of 1998).

NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT, 2004 (Act No. 10 0f 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT, 2004 (Act No. 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

NATIONAL FORESTS ACT, 2006 (Act No. 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062, Cape Town, 8 Sept 2006.

NORTH WEST DEPARTMENT OF AGRICULTURE, CONSERVATION, ENVIRONMENT AND RURAL DEVELOPMENT. (2009). North West Provincial Biodiversity Conservation Assessment Technical Report, Version 1.2., March 2009. North West Department of Agriculture, Conservation, Environment and Rural Development, Mmbatho

NATURAL SCIENTIFIC PROFESSIONS ACT, 2003 (Act No. 27 of 2003).

PRIMACK, R.B. (1995). *A Primer of Conservation Biology*. Sinauer Associates, U.S.A. 277 pages.

SANBI. 2013. Grasslands Ecosystem Guidelines: landscape interpretation for planners and managers. Compiled by Cadman, M. de Villiers, C., Lechmere-Oertel, R. and D. McCulloch. South African National Biodiversity Institute, Pretoria. 139 pages.

SCHMIDT, E., LOTTER, M. & MCCLELLAND, W. 2002. Trees and shrubs of Mpumalanga and Kruger National Park. Jacana, Johannesburg.

SAMWAYS, M.J. (1994). *Insect Conservation Biology*. Chapman & Hall. SAMWAYS, M. & HATTON, M. (2000). *Palmnut Post*, Vol 3, No 2, 9-11. SIEGFIED, W.R. (1989). *Preservation of species in southern African nature reserves*. In: Huntley, B.J. (Ed). *Biotic Diversity in Southern Africa*, 186-201. Cape Town: Oxford University Press.

SKINNER, J.D. and CHIMIMBA, C.T. (2005). The Mammals of the Southern African Subregion 3rd ed. Cambridge University Press.

SKINNER, J.D. and SMITHERS, R.H.N. (1990). The Mammals of the Southern African Subregion. University of Pretoria, Pretoria.

SMITHERS, R.H.N. (1986). South African Red Data Book-Terrestrial Mammals. South African National Scientific Programmes Report No.125: 1-214.

TAYLOR MR, PEACOCK F, WANLESS RM (EDS) 2015. The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

VAN OUDTSHOORN, F. 1999. Guide to grasses of southern Africa. Briza Publications, Pretoria.

VAN SCHALKWYK, M. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species.

VAN WYK, A. E. & MALAN, S.J. 1998. *Field guide to the wild flowers of the Highveld*. Struik Publishers (Pty) Ltd, Cape Town.

VAN ROOY, J. (2000). Introduction to bryology in southern Africa. 8. Moss diversity and endemism. *PlantLife*, 23, 31-32.

WHITTINGTON-JONES. C. (2003) *Gauteng biodiversity gap analysis project: ornithology and herpetology layer.* Unpublished report.