Sasol Syferfontein FAUNA AND FLORA REPORT

SASOL MINING PTY (LTD)

MARCH 2014

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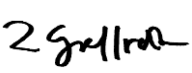
Rudi Greffrath (Cert. Sci. Nat.)	Report Writer		20/03/2014
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EXECUTIVE SUMMARY

Introduction

Digby Wells Environmental (Digby Wells) was tasked to perform a Fauna and Flora Study for the proposed Syferfontein project by Sasol Mining (Pty) Ltd (Sasol Mining).

Sasol is planning to develop an underground coal mine on the farm Syferfontein near Kinross in the Mpumalanga Province of South Africa. The proposed project will exploit the number 4 lower coal seam in the Syferfontein Block IV coal reserves using underground methods. This report details the results of two seasonal field surveys and the potential concerns identified during these investigations are highlighted and discussed.

Methodology

A literature review and desktop study were completed in order to determine the expected species composition or baseline conditions of the study area before field work was conducted. Vegetation was then sampled with stratified random sampling and the use of the Braun Blanquet assessment in order to define vegetation communities which were then mapped. In addition, a species list was compiled listing all species recorded in the field survey with particular emphasis on dominant species, alien invasive species and Species of Special Concern (SSC).

Sensitivity of the study site was determined based on available information on both National and Provincial level. In addition to the field survey, an assessment of the biodiversity value was also undertaken.

Study area

The project area is located in the Grassland Biome of South Africa. The study area is situated within an area vegetated by the Moist Sandy Highveld Grassland vegetation type according to Low & Rebelo (1998) with the most recent vegetation classification, classifying it as Eastern Highveld Grassland (Mucina & Rutherford 2006). The vegetation type is considered to be Endangered nationally with none conserved and 55% altered, primarily by cultivation (Mucina & Rutherford 2006).

The study site can be divided into three main sections: Transformed, Degraded and Natural land. The study area includes agricultural fields consisting of maize and soya beans, buildings including farm houses and worker accommodation, alien invasive tree areas and roads. The study site is currently being used predominantly for commercial farming.

A total of 121 plant species were recorded on the study site. Of these, eight are regarded as SSC, five are Mpumalanga Protected plants therefore provincially protected with no plants on the national list of Protected Trees. Sixteen invasive species were recorded from Schedules 1, 2 and 3 of Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA). Ten mammal species were recorded from the site, on species protected. 147 bird species were recorded, two of which are protected, seven reptiles and no amphibians were recorded.

Sensitivity

Wetlands constitute High Sensitivity areas due to their role as process areas within the ecosystem. In addition, high sensitivity is given to areas occurring within a Threatened Ecosystem, and those areas that were pristine or close to pristine with low or no anthropogenic impacts. Areas occurring within Highly Significant areas according to the C-Plan (unless heavily degraded) is also assigned a High Sensitivity.

Areas of medium sensitivity include those natural areas with some anthropogenic change or degradation, with high numbers of species of special concern and moderate rocky slopes.

Low sensitivity was assigned to areas completely transformed or heavily degraded, on relatively flat ground. The study area was found to be in different states of sensitivity, with the riparian and grassland areas designated as high and medium high respectively and alien trees being low sensitivity.

To conclude, the project are covers environments and habitat types that have been earmarked for conservation, and which during this survey have been proved to have biodiversity value. As the development of this mine is exclusively underground, the impact assessment showed the impact on the environment to be medium-low, and no mitigation is possible. This project may go ahead, if mitigation measures are adhered to strictly.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLANS

1 INTRODUCTION

South Africa is an exceptionally diverse country, one of the most biologically diverse in the world. This is largely due to the species diversity and endemism of the vegetation. The major natural systems of the country have been classified in terms of the biome concept, based on dominant plant life forms, correlated with climatic variations. Biomes found in South Africa include Desert, Fynbos, Succulent Karoo, Nama Karoo, Grassland, Savanna, Albany thicket, Forest and Wetland vegetation (DEAT, 2005).

The faunal component of the Grassland biome is usually related directly to the vegetation types, which are related to the soil types. Nutrient rich and nutrient poor soils produce different vegetation types, which support selective grazers and browsers. The grasslands of Mpumalanga are mainly divided into farms, which limits faunal movement and reduces the function of the ecosystem. Farms are commonly used for cultivation and livestock. As most of these farms are not managed for maintaining ecosystem function but rather for maximum agricultural production, it is likely that the majority of the area is an unnatural ecosystem.

In many areas, especially in terrestrial ecosystems, it is not the direct use of biological resources that is threatening their sustainability, but rather indirect pressures such as changing land use and associated clearing of natural vegetation and habitat fragmentation. The Mpumalanga Province is rich in biodiversity; this is commonly attributed to its bio-geographical location and diverse topography.

The National Biodiversity Implementation Plan sets out the strategic objectives, outcomes and activities identified during the National Biodiversity Strategy and Action Plan (NBSAP) process. It identifies the leading agents and key partners for implementing the activities (DEAT, 2005). The plan consists of a goal and five strategic objectives (Table 1-1).

Table 1-1: Goal and strategic objectives of the National Biodiversity Implementation Plan

GOAL	**Conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future.**
OBJECTIVE 1	Policy framework for biodiversity management.
OBJECTIVE 2	Institutional framework for biodiversity management.
OBJECTIVE 3	Integrated management of terrestrial and aquatic ecosystems.
OBJECTIVE 4	Sustainable use of biological resources.
OBJECTIVE 5	A network of conservation areas to conserve representative samples.

Under Strategic Objective 3, the various industries impacting on biodiversity are encouraged to develop and implement changes in operations procedures to minimise negative impacts on biodiversity and create sustainable practices. Industries mentioned include those related to agricultural, mining, forestry, fishing and property development. Under mining industries it states that relationships already exists between mining industry and biodiversity sectors and

that these relationships should be further developed, this is also true for Independent Power Producers (IPPs). Funds set aside for rehabilitation should be utilised to mitigate negative impacts on biodiversity and important biodiversity areas should be set aside and managed. The overall statement drives home that biodiversity is the responsibility of the industry and that practices should be carried out in a way that is responsible, sustainable and preserves biodiversity of the area. It also states that rehabilitation efforts should consider biodiversity.

The focus of this study is for the above mentioned strategic objectives to be the backbone of this investigation and subsequently to inform environmental management decisions on site. In order for this to be accomplished, the primary objective of this investigation is to characterise the flora and fauna present and to investigate the potential impacts of the proposed project on the vegetation and animal life in the study area. Thereafter to suggest management measures that will mitigate the effects that construction and operation will have on the area, thereby striving for the attainment of the National Biodiversity Strategy goal. This report details field work findings of the Syferfontein study area, as well as an in depth description of the study area and expected impacts.

1.1 Project Description

Sasol Mining (Pty) Ltd (Sasol Mining) is the holder of various mining rights in respect of collieries supplying coal to its Secunda Operations. To ensure that the Secunda Complex remains operational for the next forty years and beyond, Sasol Mining has devised a strategy to expand or replace the current collieries. As part of this strategy, Sasol Mining plans to expand its Sasol Syferfontein Colliery by applying for a Mining Right in terms of the Minerals and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002) (MPRDA) to mine the number 4 lower coal seam in the Syferfontein Block IV coal reserves. A Mining Right Application (MRA) has not been lodged with the Regional Manager, Mpumalanga Region, of the Department of Mineral Resources (DMR) at this point in time.

The proposed Project area is located approximately 16km north-west from the town of Secunda and approximately 3km west from the town of Kinross, within South Africa's Mpumalanga Province. Sasol Mining plans to mine the above mentioned areas using the underground board and pillar mining method as the means of primary development. In addition to this, Sasol Mining utilises a special method for higher extraction, known as the Nevid Mining Method. This method ensures that there will be minimal disturbances above ground; at the surface. The Syferfontein Block IV reserves will be accessed by means of an adit in the highwall of the existing Syferfontein Colliery as a brownfields Project. No mine infrastructure is currently planned for the Syferfontein Block IV underground area. The proposed Project will be served by existing infrastructure located on the Tweedraai mining area.

1.2 Study Area

The study area is situated within the Grassland Biome of South Africa (Rutherford & Westfall, 1986, Mucina & Rutherford 2006). The Grassland Biome is found on the high central plateau of South Africa, and the inland areas of Kwazulu-Natal and the Eastern

Cape. The topography is mainly flat and rolling, but includes the escarpment itself. The altitude where this biome occurs varies from near sea level to 2 850 m above sea level. The vegetation type consists of a simple, single-layered herbaceous community of mainly tussocked grasses, herbs and forbs. High rainfall on the cold, frosty, Mpumalanga highveld, together with sandy soils, controls the distribution of this vegetation type.

Grasslands are dominated by a single layer of grasses (Rutherford & Westfall, 1986). The amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localized habitats. Geophytes are often abundant. Frost, fire and grazing maintain the grass dominance and prevent the establishment of trees (Rutherford & Westfall, 1986).

The study area is situated within the Moist Sandy Highveld Grassland and the according to Low & Rebelo (1998) with the most recent vegetation classification, classifying it as Eastern Highveld Grassland and Soweto Highveld Grassland vegetation types (Mucina & Rutherford 2006). Both these vegetation types are considered to be endangered nationally with none conserved and some altered, primarily by cultivation (Figure 1-1).

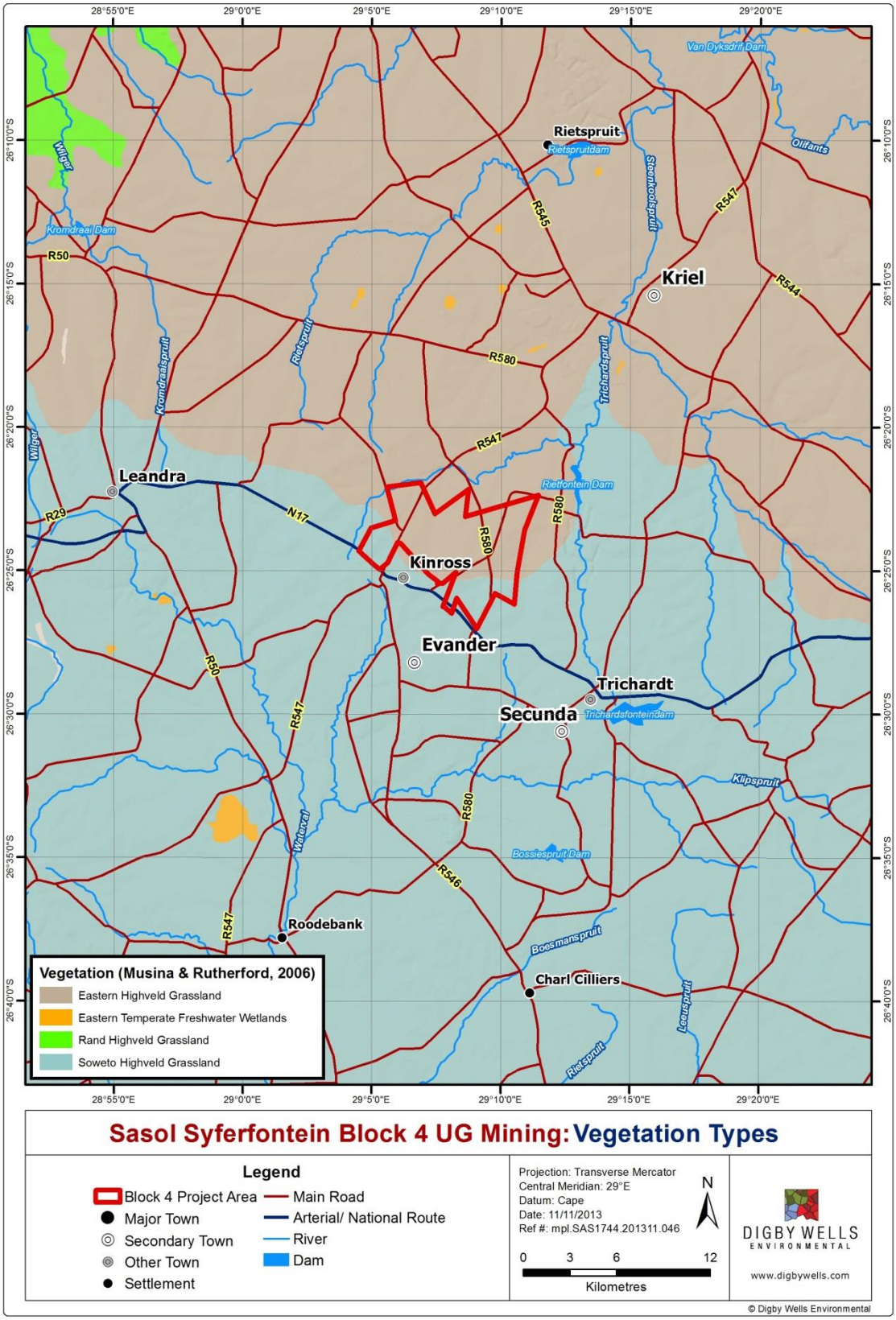

Figure 1-1: Mucina and Rutherford (2006) vegetation types.

As discussed earlier the conservation status of this vegetation type is very poor, with large parts that are either currently cultivated or have been previously ploughed, and the remaining untransformed vegetation that occurs as patchy remnants are often heavily grazed.

Moist Sandy Highveld Grassland is dominated by the grasses *Eragrostis plana, Eragrostis curvula, Heteropogon contortus, Trachypogon spicatus* and *Themeda triandra*. Acocks (1988) describes the same area as Bankenveld and considers it to be a sour vegetation type in which forbs play an important part. This variation occurs on flattish sandy country in which the dominant species include *Tristachya leucothrix, Eragrostis racemosa, Heteropogon contortus, Trachypogon spicatus, Digitaria tricholaenoides, Themeda triandra* and others. *Tristachya biseriata* may be abundant on ridges.

The mine lease area, or area of interest, is situated in an endangered ecosystem (Figure 3-8). This means that the ecosystem has undergone degradation of ecological structure, function or composition as a result of human intervention, although it is not critically endangered.

This vegetation unit occurs in Mpumalanga, Gauteng (and to a very small extent also in neighbouring Free State and North-West) Provinces (Figure 3-2). It lies in a broad band roughly delimited by the N17 road between Ermelo and Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south. It extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State. The altitude ranges from 1 420 – 1 760 m.
It occurs on gently to moderately undulating landscape on the Highveld plateau supporting short to medium high, dense, tufted grassland dominated almost entirely by *Themeda triandra* (Rooi grass) and accompanied by a variety of other grasses such as *Elionuris muticus* (Wire grass), *Eragrostis racemosa* (Small heart grass), *Heteropogon contortus* (Spear grass) and *Tristachya leucothrix* (Trident grass).

Only small scattered wetlands, narrow streams and occasional ridges or rocky outcrops interrupt the continuous grassland cover. The geology of the Soweto Integration consists mainly of shale, sandstone or mudstone of the Madzarinwe formation (Karoo supergroup).

Conservation status: Currently considered endangered, only a handful of patches are statutorily conserved (Waldrift, Krugersdorp, Leeuwkuil, Suikerbosrand, and Rolfe's Pan Nature Reserves) or privately conserved (Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves, Heidelberg Natural Heritage Site). Almost half of the area already transformed by cultivation, urban sprawl, mining and building of road infrastructure. Some areas have been flooded by dams (Grootdraai, Leeukuil, Trichardtsfontein, Vaal and Willem Brummer dams). Erosion is generally very low (93%).

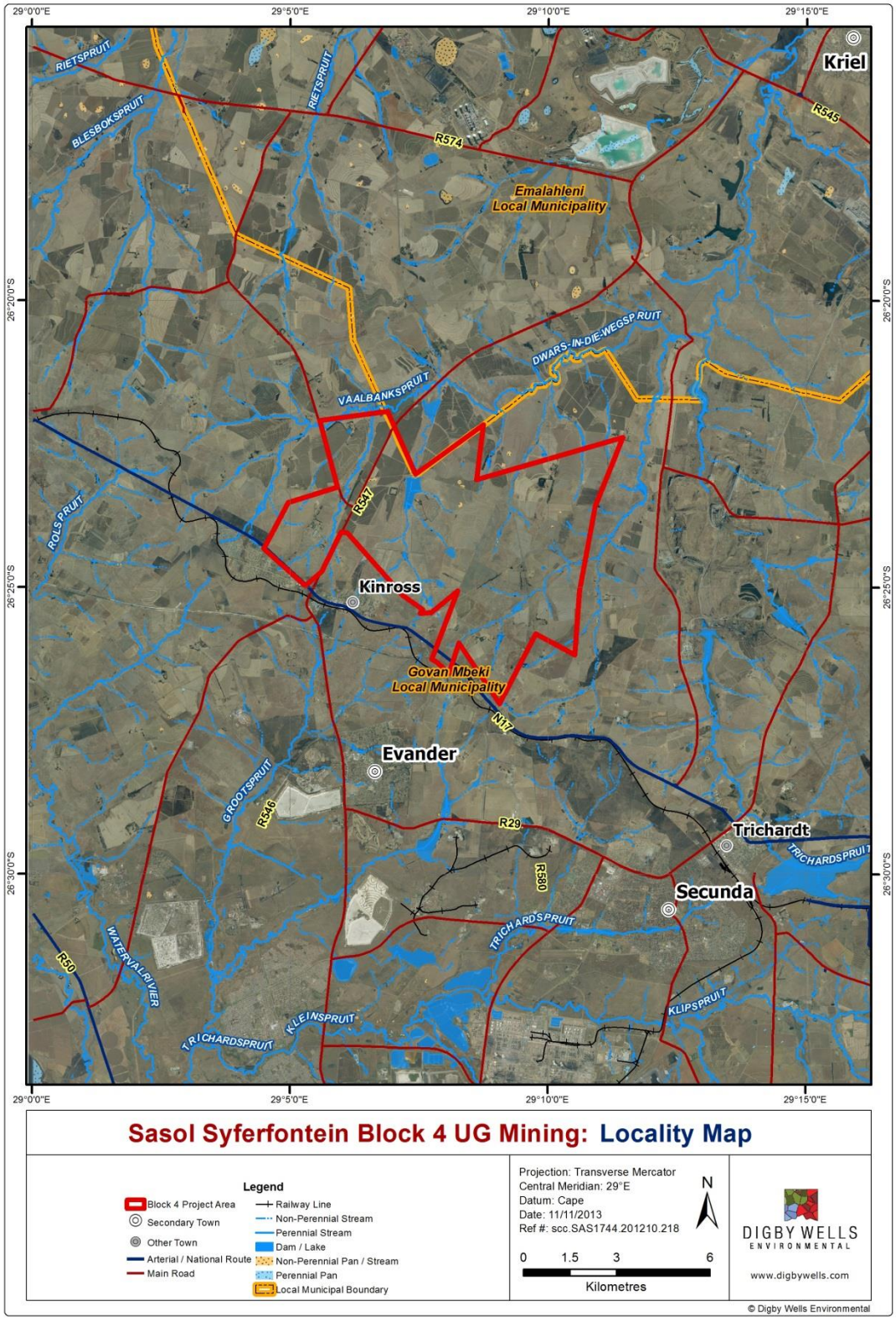

Figure 1-2: **Locality map of the study area.**

1.3 Terms of Reference

A terrestrial biodiversity assessment report will be compiled and will include the findings of the vegetation survey and fauna survey as detailed in the methodology section below. Potential impacts on terrestrial biodiversity will be identified and the significance of these impacts assessed in order to determine suitable mitigation measures that can be included in a Biodiversity Management Plan for the colliery.

1.4 Expertise of the Specialist

Rudi Greffrath, a senior fauna and flora specialist achieved a Bachelor of technology degree in Biodiversity Conservation at the Nelson Mandela Metropolitan University; and is an environmental consultant specialising in both terrestrial ecology and environmental management. He is SACNASP affiliated in Ecological Science, Reg no. 200245/13. Experience includes ecology field work such as flora and fauna surveys, biodiversity assessments, Biodiversity Action Plans, species relocation and environmental rehabilitation. Furthermore, experience has been acquired in environmental Rehabilitation Monitoring, Rehabilitation Action Plans, Environmental Impact Assessment (EIA) and Environmental Management Plans (EMP). Project experience includes various countries such as Botswana, Sierra Leone, Mali, Mozambique, Ghana, Democratic Republic of the Congo, Namibia and throughout South Africa including the Mpumalanga, Limpopo, Gauteng, North West, Kwazulu Natal, Free State, Northern Southern and Western Cape.

A curriculum vita is included in Appendix A.

1.5 Aims and Objectives

This specialist study serves to undertake a basic ecological assessment of the local flora and fauna communities associated with the Syferfontein study area in order to determine the current state of these components. Information generated from this survey has been used to address the impacts that the construction and operational activities will have on this environment. In order to achieve this aim the following objectives were considered:

- To delineate the various vegetation/habitat types and describe their sensitivity, present within the study area;
- To determine if any flora and fauna species or assemblages will be directly impacted upon by the proposed mining activities and its associated infrastructure, this includes flora and fauna communities present, the state of these communities, identification of possible red data species according to the International Union for the Conservation of Nature (IUCN), National and Provincial criteria; and
- To undertake an assessment of the impacts associated with various activities on the health of the flora and fauna species or assemblages; and to recommend measures that should be included in the EMP to prevent or limit impacts to flora and fauna species or assemblages.

2 METHODOLOGY

2.1 Literature review and desktop study

A desktop study was undertaken, aiming to identify:

- Potential species in the site area according to the South African National Biodiversity Institute (SANBI);
- Potential Red Data species and their current status;
- Expected vegetation type and community structure, (Low & Rebelo, and Mucina & Rutherford 2006); and
- Current Biodiversity and Ecosystem Status.

2.2 Vegetation analysis

2.2.1 Sample plots

As the sampling of the entire study area is not possible, representative samples of the vegetation were assessed. The vegetation was classified according to available aerial imagery as well as through an initial site inspection. The number of sample sites visited was determined by the time available for the study as well as the accessibility of each of the sample sites. Then, areas of each vegetation type classified before going to site were sampled randomly. This methodology allows for more efficient sampling than overall random sampling.

There is a method for determining the number of plots required for a statistically accurate sample for each vegetation type. However, time limitations did not allow for such complete sampling. The result is the sampling of as many plots as possible in each predetermined vegetation type. At each sample site, a plot size of 100m^2 was sampled. Each plot was described with topographical and environmental data recorded. In each plot; the species were identified in the field as far as possible. Plants that could not be identified in the field through the use of field guides, such as Pooley (1988) and Van Outshoorn (1999) were collected and photographed. These were identified later through the use of ispot (www.ispot.org.za). The Braun Blanquet method was used for the listing of species and their associated cover. The Braun Blanquet method is the standard for phytosociological studies (plant description and mapping) in South Africa and is an internationally recognised method of surveying.

2.2.2 Vegetation communities

Vegetation communities were defined using the data gathered from each sample plot. The presence of each of the different species in relation to environmental data defined several different vegetation types. Each of these vegetation types exhibits some diagnostic species.

2.2.3 Vegetation mapping

Vegetation was mapped using the information gathered from the sample plots and resultant vegetation communities, as well as aerial imagery.

2.3 Flora

Through the sample plots, several aspects of the flora were identified. These included the Species list, list of Species of Special Concern, and the list of alien and invasive species.

2.3.1 Species list

The species list is compiled mainly from the data gathered from the sample plots. All species occurring in each of the sample plots were identified as far as possible, either during the site visit or afterwards from photographs. In addition, species seen within the study area, but not occurring within specific sample plots were also recorded. This allowed for the production of a species list representative of the entire study area.

2.3.2 Species of Special Concern

From the overall species list, a list of SSC can be drawn up. In order to be fully comprehensive, this list includes plants on each of the following lists:

- South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;
- National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and
- Mpumalanga Protected Plants.

An initial list of SCC expected to be found within the study area comprises Possible Species of Special Concern (PSSC). If any of these (and any additional species on the above lists) are recorded on site, they are ascribed the status Confirmed Species of Special Concern (CSSC). It is likely that many of the PSSC do occur on site, but were not recorded in this site visit.

The South African red data list uses the same criteria as that defined by the IUCN. According to the IUCN all species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (IUCN, 2010). The categories are described in Table 2-1 below.

Table 2-1: Red Data Categories (IUCN, 2010)

Category		Description
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.
Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at risk category.

Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.

The online IUCN data base was referenced in order to identify Red Data species and their various threat status categorizations.

2.3.3 Alien invasive species

Alien invasive species are recorded from each of the sample plots, as well as through opportunistic sightings throughout the study area. Alien invasive species are those that are classified by the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA) or NEMBA as alien weeds or invasive plants. Each of the categories defined by these Acts has associated legislated control measures.

2.4 Fauna

Pertinent notes were made during the survey and desktop studies were also conducted for mammals, birds, reptiles and frogs. All fauna species encountered on site were identified and recorded. The following methods were used during the survey:

2.4.1 Mammals

Visual sightings and ecological indications were used to identify the mammal inhabitants of the study area; this includes scats, tracks and habitat such as burrows and dens. Scat found was collected (if required), photographed with a scale along with any tracks found and identified. For identification purposes the following field guides were used, Mammals of Southern Africa (Smithers, 1983), The Mammals of the Southern African Sub-region (Skinner & Chimimba, 2005), Red Data Book of the Mammals of South Africa (Friedman & Daly 2004) and The Kingdon field guide to African Mammals (Kingdon, 1997). The following was recorded:

- All mammals encountered, noted or captured during the survey;
- Animals listed in previous studies and observed by people residing in the study area;
- A list of the most prominent mammal species; and
- A list of threatened or protected species encountered during the survey.

Small mammal trapping was also applied by using Sherman traps. Sherman traps are collapsible traps (23 cm x 9 cm x 7.5 cm) which were baited and laid along transects. Areas where clear small mammal activity could be seen such as the presence of burrows were also used as sites for trapping. The traps were checked in the morning as small mammals are predominantly active at night. Captured animals were photographed, identified and released. Species of conservation concern and listed by the IUCN or by the South African Environmental legislation and Mpumalanga provincial as protected and endemic within the study area, took priority and the Red Data status identified and recorded.

2.4.2 Birds

The principal ornithological field survey technique used was transect surveys. Transect surveys were planned based on representative sites of different avifauna habitat, such as dams, open areas and road reserves by simply following available roads and paths that transect over these habitat types. Transect procedures involve slow attentive walks along transects during which any bird seen or heard is identified and recorded; this was completed during diurnal and nocturnal surveys. Species observed during the vegetation surveys were also recorded.

The following was recorded:

- All birds encountered or noted during the survey;
- All birds observed by observed by people residing in the study area; and
- A list of rare and endangered species encountered.

Visual identification of birds was used to confirm bird calls where possible. Bird species were confirmed using Sinclair *et al* (1997) and Robert's birds (2009).

2.4.3 Reptiles and amphibians

Herpetofauna include reptile and amphibian species. Direct/opportunistic observation was completed along trails or paths within the project area. Any herpetofauna species seen or heard along such paths or trails within the project area were identified and recorded. Another method used was refuge examinations using visual scanning of terrains to record smaller herpetofaunal species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, under rocks, in leaf litter, rodent burrows, ponds, old termite mounds, etc. Amphibians and reptiles observed by people residing in the study area were also recorded. Branch (2001), Du Preez and Caruthers (2009) and Carruthers (2009) was used to confirm identification where necessary.

2.4.4 Red Data faunal assessment

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

- Habitat requirements (HR) – Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated.
- Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats).
- Habitat linkage (HL) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species habitat within the study area.

Probability of occurrence is presented in four categories, namely:

- Low (will not occur);
- Medium (could possibly occur);
- High (most likely could occur); or
- Recorded (does occur on site).

The IUCN Red Data categories are used for the status identification of mammals, birds, reptiles and amphibians globally.

2.5 Sensitivity assessment

Following the field survey and vegetation classification, vegetation sensitivity analysis was quantified by subjectively assessing two factors, namely ecological function and conservation importance. These were defined as follows:

2.5.1.1 Ecological function

- High ecological function: Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystem integrity (e.g. pristine grasslands, pristine wetlands and pristine ridges).
- Medium ecological function: Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to sensitive/pristine ecosystem.
- Low ecological function: Degraded and highly disturbed systems with little or no ecological function.

2.5.1.2 Conservation importance

- High conservation importance: Ecosystems with high species richness which usually provide suitable habitat for a number of threatened species. Usually termed ‘no-go’ areas and unsuitable for development, and should be conserved.
- Medium conservation importance: Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be accommodated, provided the current species diversity is conserved.
- Low conservation importance: Areas with little or no conservation potential and usually species poor (most species are usually exotic).

Ecological health is an indication of carrying capacity of an ecosystem and therefore its ability to perform ecological services. In order to adequately gauge the ecological health of the study site it was important to give a qualitative definition of the ‘perceived biodiversity value’ of the land. This is done at a broad level, to simply categorise the total area of land owned based on potential biodiversity value. Biodiversity Value is understood as being a combination of the conservation status and the functional status of the area.

Functional Status refers to an indication of the services provided by an area and includes both ecological and human related services. Functional Status depends on the degree to which the area or system still provides a noticeable service (Figure 2-1).

Conservation Status depends on:

- The amount of the area or system remaining (the extent);
- The diversity in terms of 1. Proportional species composition of the area of system, and 2. The presence of ecosystems/habitat and species which are endemic, threatened, vulnerable or have particularly high religious/cultural value; and
- The degree to which the area or system reflects/represents its original state.

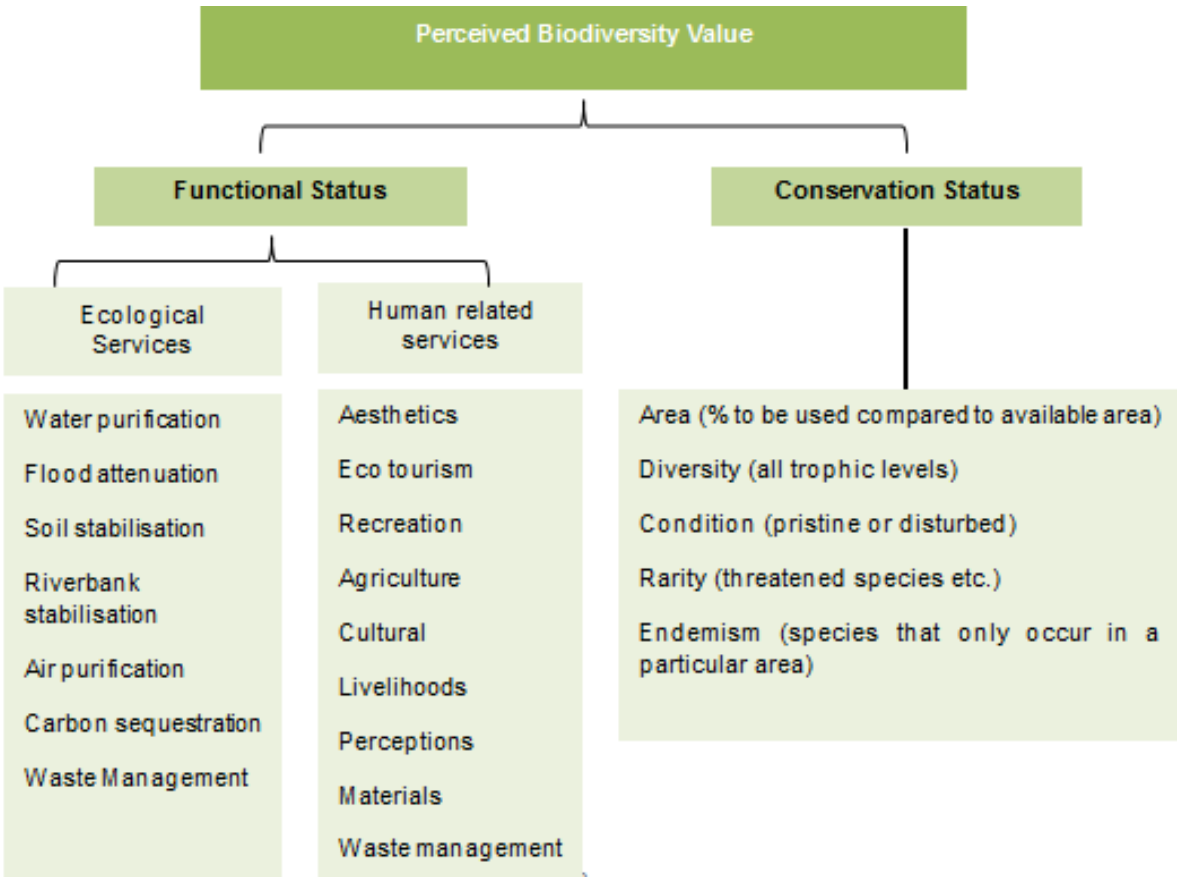

Figure 2-1: Perceived Biodiversity Value (Coombes, 2004)

The final decision on the biodiversity value of an area depends on the combination of the functional and conservation status (Coombes, 2004). In assessing the biodiversity value of the area various literature and data is referenced such as:

- International Union of the Conservation of Nature ,
- The Mpumalanga Biodiversity Conservation Plan (or C-Plan),
- The National Protected Areas Expansion Strategy,
- The National Vegetation Map (Mucina and Rutherford, 2006),
- The National List of Ecosystems that are Threatened and in need of Protection, and
- The National Spatial Biodiversity Assessment.

In addition, the data gathered from the field assessment allows for more fine-scale and accurate view of the vegetation in the study area. This data is pivotal for the determination of sensitivity of the area. Based on this approach the total land surface within the project area is categorised into the following biodiversity classes as listed in Table 2-2 below.

Table 2-2: Score table describing the Biodiversity value scores

Score	Biodiversity Value	Percentage Score
1	Very High Biodiversity Value	0 - 25%
2	High Biodiversity Value	25-50%
3	Moderate Biodiversity Value	50 – 75%
4	Low Biodiversity Value	75 – 100%

3 RESULTS AND DISCUSSION

3.1 Vegetation

Due to current and historic land use, the study site contains three main sections: Natural, Transformed and Degraded land. The study area includes a great deal of farmland, with associated houses and buildings. The higher lying areas of the study area are covered by maize fields, with large areas transformed by alien plants. The remaining land area is used for cattle grazing and, as such, is degraded from its natural state. Areas under cultivation (maize, potatoes and planted grazing), buildings and alien stands fall into the transformed category. Degraded land includes those grassland areas that are currently being used as grazing land, mainly for cattle, as well as wetlands which are used for grazing. Domestic livestock can have high impacts on natural vegetation, resulting in decreases to species richness and diversity. Transformed areas contain few or no indigenous species, whereas degraded areas comprise mainly indigenous species with some invasive species in disturbed areas.

Natural areas contain mostly natural indigenous elements and are seen as sensitive areas. Historically these areas would not have been misused, they are wetlands, ridges and undisturbed primary grassland, of which very little is left. As degraded areas contain some indigenous elements, it is important to provide a brief description of these areas. Most degraded sites are areas that may have been cleared a little in the past, or have been heavily overgrazed, resulting in the majority of this vegetation type comprising grass species with scattered shrubs. The remaining indigenous species tend to be those that are not favoured by grazing livestock and are noted for their presence in overgrazed areas (such as *Serphium plumosum*, known as bankrupt bush). Degraded areas are thus a grassland habitat with some wetland species in the low lying areas, with high numbers of plants indicating over grazing and few geophyte species. Common species include *Eragrostis gummiflua, Digitaria eriantha* and *Eragrostis curvula*. It is important to note that despite the somewhat disturbed nature of the site, the wetland and grassland areas form important habitat for species such as the grass owl and form process areas that are vital to the functioning of the ecosystem. There are two main vegetation types forming the degraded areas, these are grassland and wetland, which are described in Table 3-1 below. For a vegetation map see Figure 3-1.

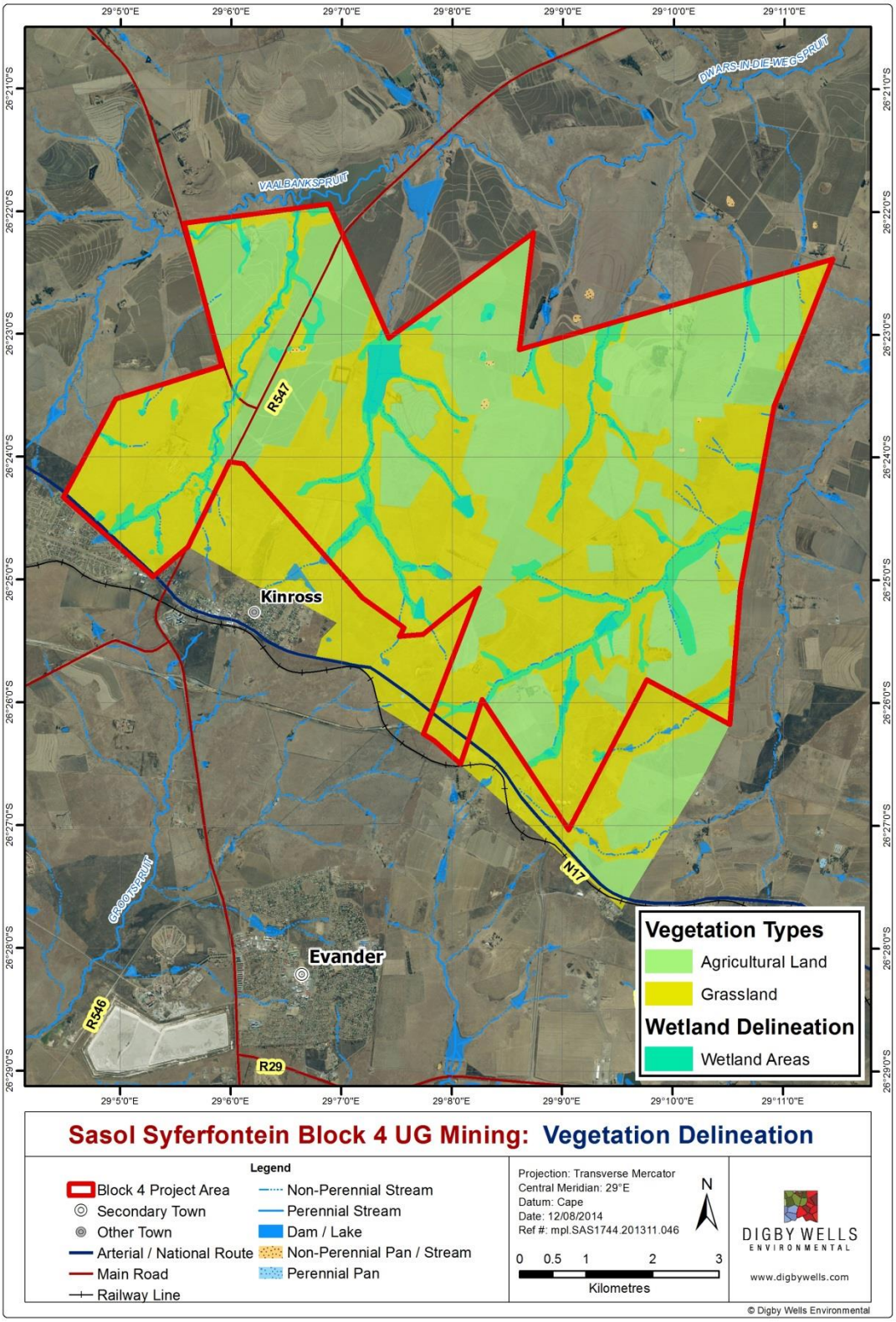

Figure 3-1: Dominant vegetation types encountered at Syferfontein

Table 3-1: Vegetation types found in the Syferfontein study area.

Vegetation type	Description	Dominant and Notable Species
Grassland	Grassland occurs on the edges of wetlands in areas used currently for grazing. They tend to be quite degraded throughout the area with low species diversity and richness and many species commonly associated with overgrazing. Despite this they contain some two provincially protected species and it is suspected that more may be found. The Syferfontein grasslands also form important faunal habitat with grass owls a notable occurrence.	*Eragrostis curvula* *Themeda triandra* *Digitaria eriantha* *Serphium plumosum* *Gladiolus crassifolius* *Wahlenbergia krebsii* *Selago densiflora* *Asclepias gibba* var. *gibba*
Wetland	Wetlands occur throughout the study site with several seeps and drainage lines. Many of these have been dammed to provide drinking water for cattle. Typical wetland species occur, with some species restricted to the wetter areas on the banks of the wetlands. These are process areas and thus form important zones within the study area.	*Persicaria serrulata* *Ledebouria ovatifolia* *Trifolium sp.* *Imperata cylindrica* *Cyperus congestus* *Cyperus fastigiatus* *Cyperus esculentis*

3.2 Flora

3.2.1 Species list

A total of 121 species were recorded from the study site. It is likely that a more in-depth study may record many more species. Some of the most common species include *Themeda triandra, Eragrostis gummiflua* and *Digitaria eriantha* which occurred in most sample plots. Poaceae (the grass family) is well represented with 36 species, accompanied by eleven reeds and sedges. Much of the site comprises problem species (these are discussed in depth is section 3.2.3 below), especially *Seriphium plumosum* (bankrupt bush). This species is common in overgrazed areas, as it is unpalatable and becomes the dominant species when palatable grass species are grazed, which allows for the invasion of bankrupt bush.

There are limited numbers of geophyte species including *Boophone disticha* and *Ledebouria* species. There should be higher numbers of such species but livestock grazing has resulted in their removal in large areas.

Some species occurring in the area are presented in Figure 3-2 below. The complete species list is included in Appendix B.

Figure 3-2: Common species of the study area. A: *Imperata cylindrical*, a grass occurring in wet areas, B: *Ledebouria ovatifolia*, C: *Eragrostis gummiflua* and D: *Eragrostis curvula* both common grass species.

3.2.2 Species of Special Concern

SCC (now listed as Confirmed Species of Special Concern) recorded from the study site are presented in Table 3-2 below. They are also shown in Figure 3-3.

Table 3-2: Species of Special Concern recorded from the study area

Species	**Common Name**	**Ecological status**	**Growth form**
Aloe ecklonis	Grass aloe	MPB Protected	Aloe
Aloe maculata	Soap aloe	MPB Protected	Aloe
Crinium bulbispermum	Orange River Lilly	MBP protected	Herb
Eucomis autumnalis	Common Pineapple Flower	Schedule 11: Protected Plants; TSP Declining	Herb
Gladiolus crassifolius	Thick-leaved Gladiolus	MPB Protected	Shrub
Habenaria epipactidea	Ghost Orchid	MPB Protected	Orchid
Satyrium longicauda	-	Schedule 11: Protected Plants	Orchid
Watsonia spp.	-	Schedule 11: Protected Plants	Herb

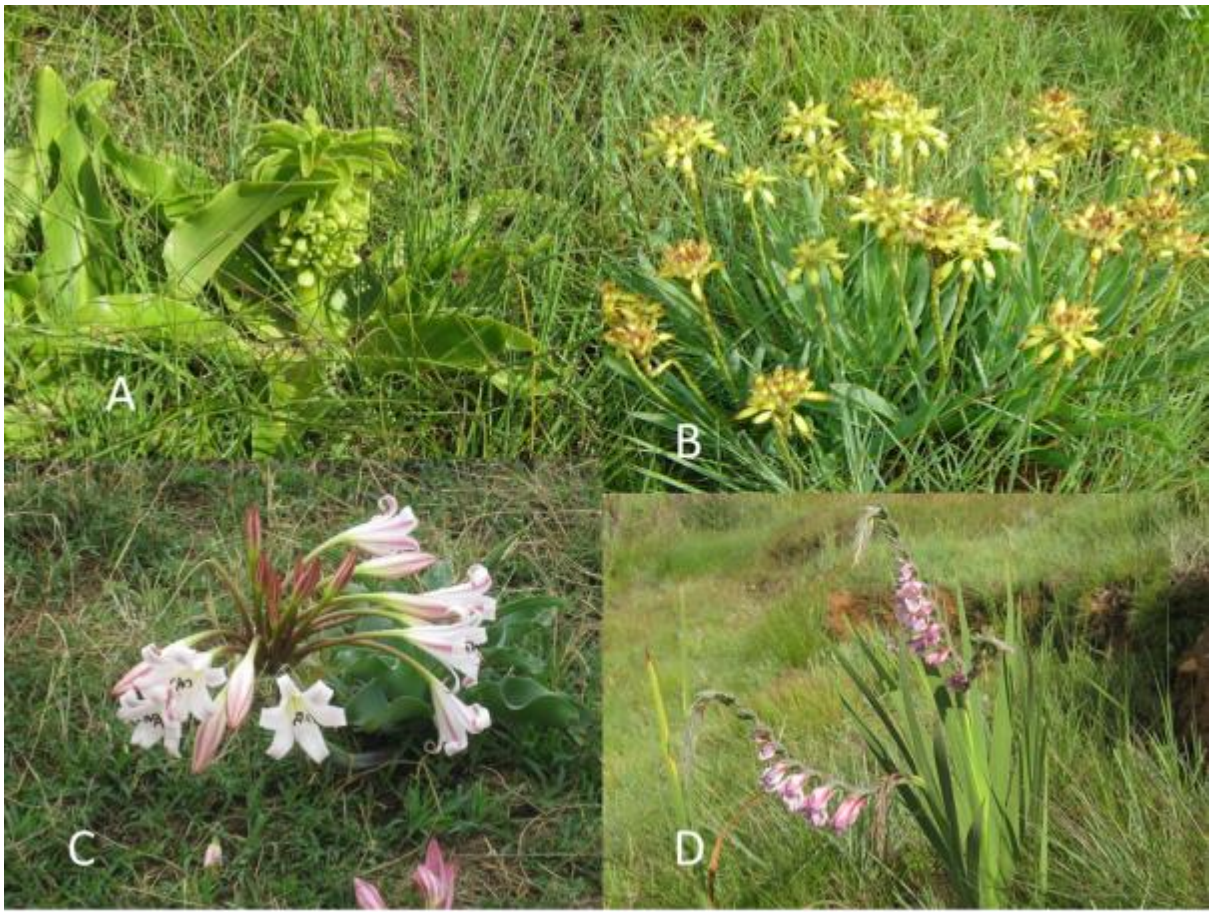

Figure 3-3: A: *Eucomis autumnalis,* B: *Aloe ecklonis,* C: *Crinium macowanii,* D: *Gladiolus crassifolius*, all grassland species listed as Protected in the Mpumalanga Conservation Act (Act 10 0f 1998).

3.2.3 Alien vegetation and problem plants

Sixteen alien invasive or weed species were recorded from site. These usually occurred in the transformed areas along roadsides and in disturbed areas such as the edges of fields. Some species occurred in natural vegetation where there was some disturbance. Some of the aliens recorded from site are presented in Figure 3-4, the entire list is given in Table 3-3 below.

Table 3-3: List of all Alien Invasive species recorded from the Syferfontein project site.

Species	**Common Name**	**Ecological status**	**Growth form**
Acacia mearnsii	Black Wattle	Alien Invasive**	Tree
Bidens formosa	Cosmos	Alien Invasive	Herb
Bidens pilosa	Common Black-jack	Alien Invasive	Herb
Cirsium vulgare	Scotch Thistle	Alien Invasive*	Herb
Cyperus rotundus subs. Rotundus	Purple Nutsedge	Weed	Sedge

Datura ferox	Large thorn apple	Alien Invasive*	Herb
Eucalyptus camaldulensis	Red river gum	Alien Invasive**	Tree
Ipomoea purpurea	Morning glory	Alien Invasive***	Sedge
Opuntia ficus-indica	Sweet prickly pear	Alien Invasive*	Succulent
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive	Herb
Pinus pinaster	Cluster pine	Alien Invasive**	Tree
Salix babylonica	Weeping willow	Alien Invasive**	Tree
Solanum sisymbrifolium	Wild Tomato	Alien Invasive*	Shrublet
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb
Verbena bonariensis	Tall Verbena	Alien invasive	Shrub
Xanthium spinosum	Spiny cocklebur	Alien Invasive*	Succulent

Species from the CARA Schedule 1*, 2** and 3*** are found in the study site. There are different laws associated with each of these species:

Category 1: Declared weeds

These plants have no economic importance, and are harmful to the environment (Bromilow, 2010). They are prohibited and are required to be controlled or eradicated by law. There are four species recorded from the Syferfontein study area; *Cirsum vulgare, Datura ferox, Opuntia ficus-indica* and *Xanthium spinosum*.

Category 2: Declared Invader Plants

These plants have a commercial or utility value but can become invasive, they are only allowed in designated areas under controlled conditions (Bromilow 2010). There are three category two plants recorded from the Syferfontein study area; *Eucalyptus camaldulensis, Pinus pinaster* and *Salix bablylonica*.

Category 3: Mostly Ornamental Plants

These are garden plants that become invasive, no further planting, and no trade in these plants is allowed (Bromilow, 2010). Existing plants may remain provided they do not occur in wetlands, watercourses or within a flood line, and their spread must be controlled (Bromilow, 2010). There is one Category Three alien in the Syferfontein study area; namely *Ipomoea purpurea*.

Problem plants are those that are not necessarily listed as alien species, but may be on the draft list of invasive species to be enacted by CARA and/or NEMBA. They may be indigenous species that reduce the biodiversity of natural vegetation and reduce the function of natural vegetation. Figure 3-4 shows some of these problem plants.

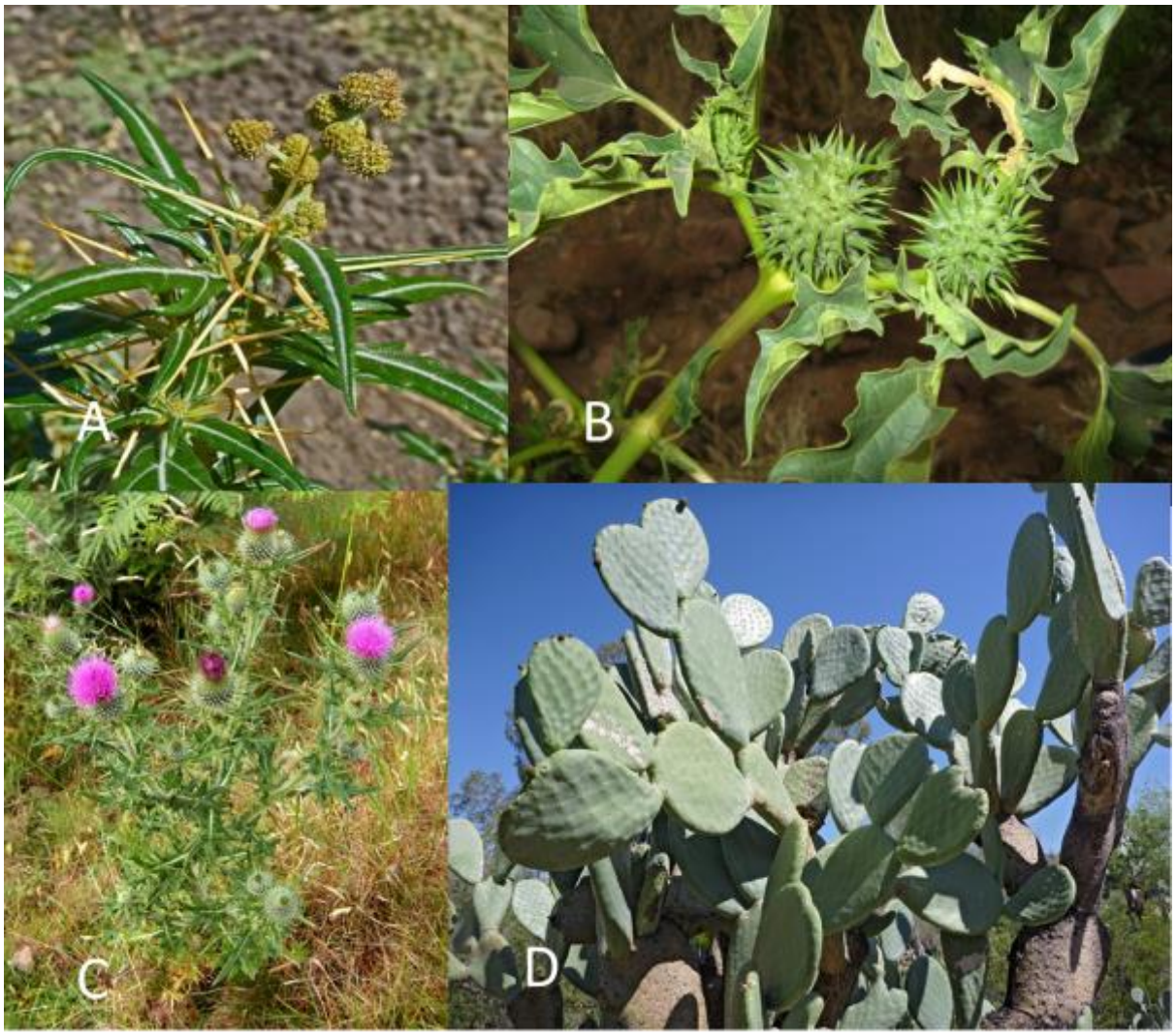

Figure 3-4: Category 1 Alien invasive and problem species recorded from the Syferfontein site. A: *Xanthium spinosum*, B: *Datura ferox,* C: *Cirsium vulgare*, D: *Opuntia ficus-indica*

3.3 Fauna

3.3.1 Mammals

Actual sightings, spoor, calls, dung and nesting sites were used to establish the presence of animals on the proposed project site. The evidence of dung and spoor suggests that mammals were present in the area although very few were recorded during the surveys. The observations of local land owners were used to supplement the findings of the mammal survey. Table 3-4 lists protected mammals that were observed in the Syferfontein project area. The mammals recorded were found within a variety of the vegetation communities present. One species was found to be of concern; Serval (*Felis serval*) being a Red Data species protected under IUCN, described as Near Threatened.

Table 3-4: Mammal species observed on the project area.

Scientific Name	Common Name	Red Data Status	Observation Method
Atilax paludinosus	Water mongoose	Least concern	Signs
Canis mesomelas	Black backed jackal	Least concern	Locals
Cryptomys hottentotus	Common Molerat	Least concern	Locals
Cynictis penicillata	Yellow mongoose	Least concern	Seen
Felis serval	Serval	**Near Threatened**	Signs/Locals
Hystrix africaeaustralis	Porcupine	Least concern	Signs/Locals
Otomys angoniensis	Angoni Vlei Rat	Least concern	Signs/Locals
Poecilogale albinucha	Striped Weasel	No Results	Seen
Sylvicapra grimmia	Common duiker	Least concern	Locals
Tatera brantsi	Highveld Gerbil	Least concern	Seen

3.3.2 Birds

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species. A total of 147 bird species were identified as occurring in the area of interest (Appendix B). Most of these birds were observed in the vicinity of less disturbed areas. Many were also identified close to the wetland areas in the project area, with birds regularly seen feeding on dried maize kernels on the edges of maize fields. Officially protected bird species recorded are listed in Table 3-5, a full list can be seen in Appendix B.

Table 3-5: Protected bird species

Scientific name	Common name	IUCN and Protected Status
Sagittarius serpentarius	Secretary bird	VU
Tyto capensis	Grass Owl	LC/Provincially protected

3.3.3 Reptiles and Amphibians

According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. The presence of suitable habitat within the study area should provide a number of different species of amphibians, none, however, were recoded. This may indicate a severely

degraded wetland system or simply the result of a poor sampling period for amphibians specifically. The sampling period was poor for amphibians as it was noted as a particularly high flow season resulting in fewer habitats for frogs and tadpoles.

A number of reptile species occur on site. Most of these species are easily spotted and have been encountered in residential buildings or gardens. Reptile species identified in the project area are listed in Table 3-6.

Table 3-6: Herpetofauna species identified on the project area.

Scientific name	English name	IUCN Status
Bitis arietans	Pufadder	LC
Causus rhombeatus	Nightadder	LC
Hemachatus haemachatus	Rinkhals	LC
Lamphrophis aurora	Aurora house snake	LC
Psammophylax rhombeatus	Skaapsteker	LC
Rhinotyphlops schlegelii	Schlegel's beaked blind snake	LC

3.3.4 Species of Special Concern

A number of the Species identified during the field survey are listed as Red Data (IUCN, 2012) and are nationally or provincially protected. The presence of these species indicates that despite the degraded nature of much of the habitat in the area, habitat still exists for the presence of a number of important species. These are listed in Table 3-7 below.

Table 3-7: Species of Special Concern

Species	National Red Data	Endemic	Provincially protected
Mammals			
Felis serval (Serval)	NT	X	X
Birds			
Sagittarius serpentarius	VU		
Tyto capensis	LC		X

3.4 Sensitivity and Conservation Planning Tools

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects, and will form an important part of the sensitivity analysis. Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed, and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based in much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

3.4.1 Mpumalanga C-plan

The Mpumalanga C-Plan (2013) encompasses the Syferfontein Project site, the C-Plan calculates areas required to meet biodiversity targets, and calculates irreplaceability value, defined as “the likelihood of a particular parcel being needed to meet biodiversity targets”. There are 6 categories defined by the C-Plan; these are outlined in Table 3-8 below.

Table 3-8: Mpumalanga C-Plan Categories

Category	Explanation
Protected areas	Already managed for biodiversity protection
Irreplaceable	100% Irreplaceable – no other options available to meet targets
Highly Significant	50 – 99% Irreplaceable – very limited options available to meet targets.
Important & Necessary	Lower irreplaceability value, less than 50% but still required to meet targets.
Least Concern	Areas of natural habitat that could be used to meet some targets but not needed now, as long as other areas are not lost.
No Natural Habitat Remaining	Virtually all natural habitat has been irreversibly lost as a result of cultivation, timber plantations, mining, urban development.

The Syferfontein area project site comprises of a large area of CBA Irreplaceable and CBA Necessary, with some areas of Modified where predominantly cultivation and agriculture dominate (Figure 3-5). Large Natural areas also still exist.

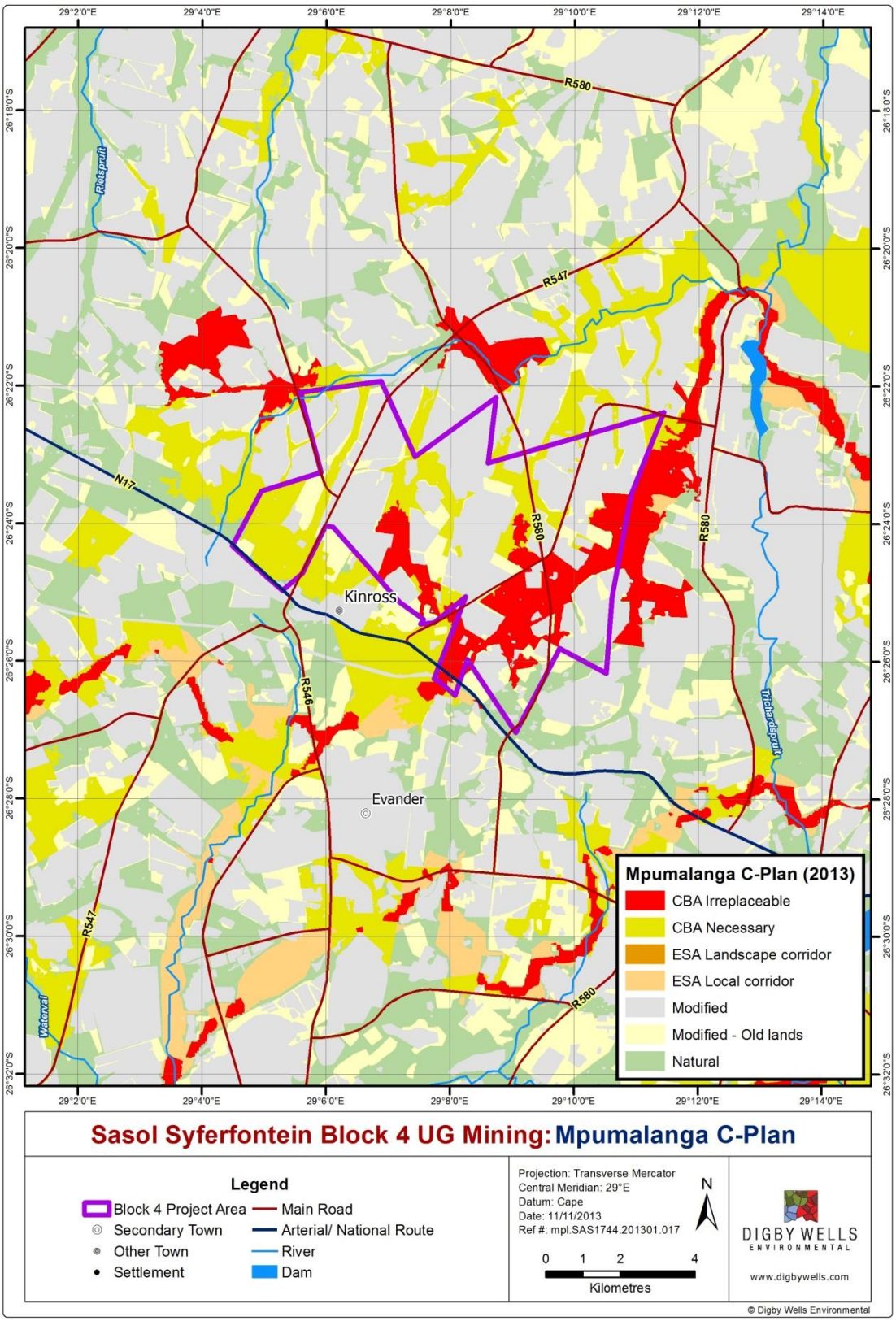

Figure 3-5: Mpumalanga C-Plan

3.4.2 Protected areas

Officially protected areas, either Provincially or Nationally that occur close to a project site could have consequences as far as impacts on these areas are concerned. For the Syferfontein site however, there are no protected areas in proximity to the study area (Figure 3-6).

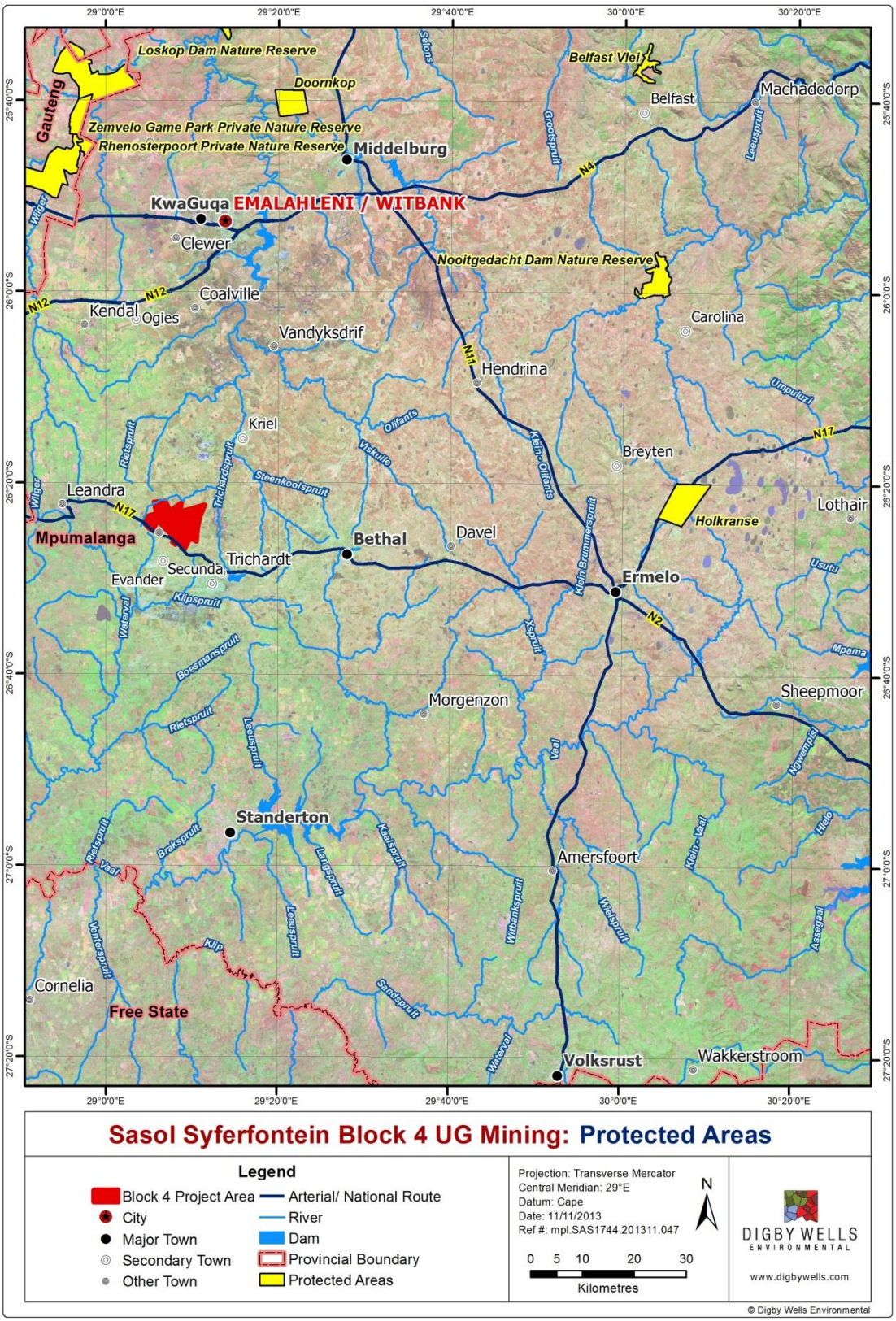

Figure 3-6: Protected area in relation to the study site

3.4.3 Important Bird Areas

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only million hectares of the total land surface covered by our IBA's legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013).

These areas are identified by BirdLife International. These sites are small enough to be entirely conserved and differ in their character, habitat or ornithological importance from the surrounding habitat. Often IBAs form part of a country's existing protected area network, and so are protected under national legislation. There is no formal National IBA Conservation Strategy for this area within South Africa (Birdlife, 2013). The Syferfontein area does not fall within, or are close to any IBA's. The Amersfoort-bethal-carolina district IBA is about 40km from the site (Figure 3-7).

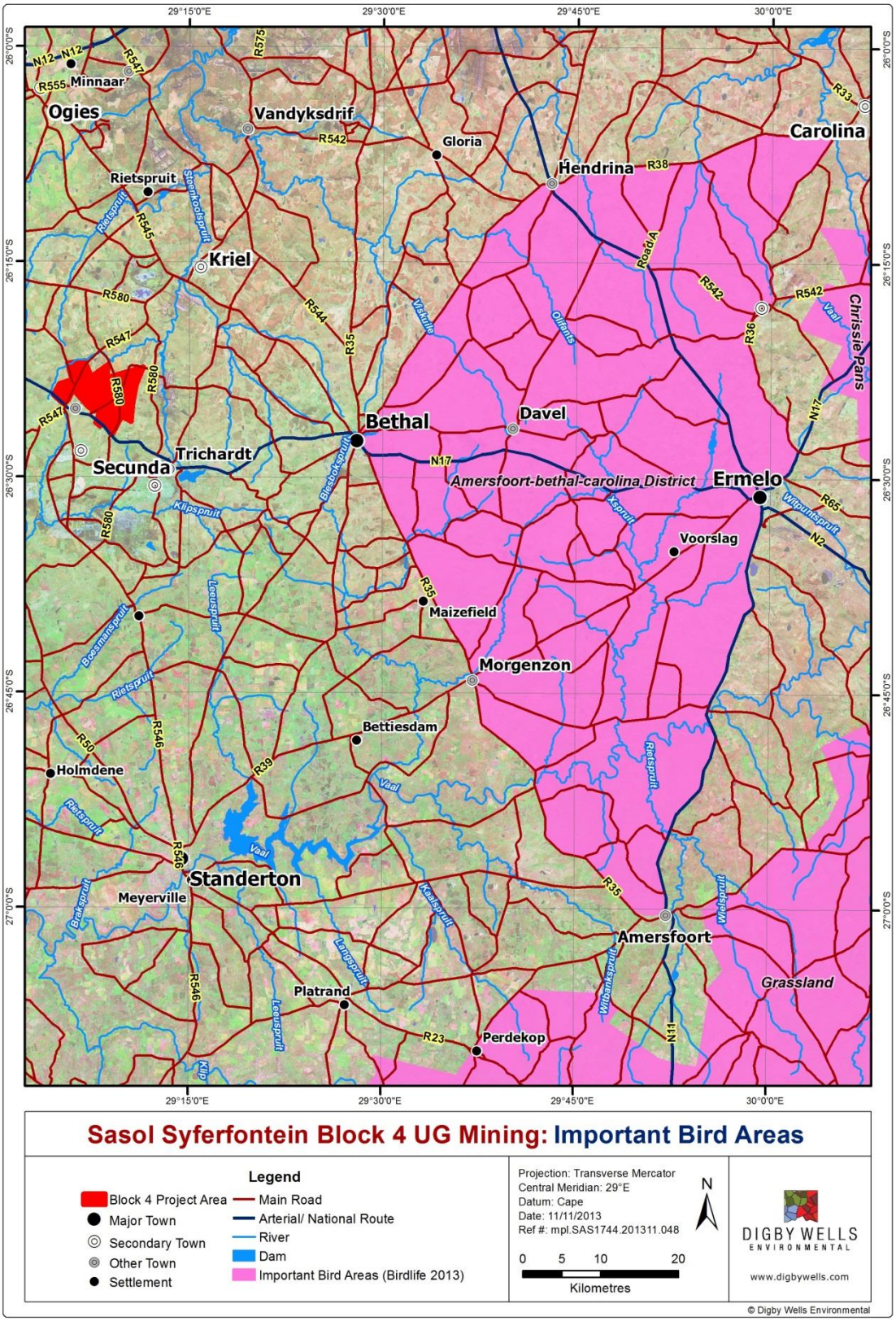

Figure 3-7: IBA's in relation to the Syferfontein study area.

3.4.4 Nationally Threatened Ecosystems

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable;
- The approach must be target driven and systematic, especially for threatened ecosystems;
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a number of criteria are developed and an ecosystem is listed based on its highest ranking criterion; and
- The identification of ecosystems to be listed must be based on scientifically credible, practical and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments:

- The South African Vegetation Map (Mucina and Rutherford 2006);
- National forest types recognised by the Department of Water Affairs and Forestry (DWAF);
- Priority areas identified in a provincial systematic biodiversity plan; and
- High irreplaceability forest patches or clusters identified by DWAF.

The criteria for identifying threatened terrestrial ecosystems include six criteria overall, two of which are dormant due to lack of data (criteria B and E). The criteria are presented in Table 3-9 below.

Table 3-9: Criteria for the listing of National Threatened Ecosystems

Criterion	Details
A1	Irreversible loss of natural habitat
A2	Ecosystem degradation and loss of integrity
B	Rate of loss of natural habitat
C	Limited extent and imminent threat
D1	Threatened plant species associations
D2	Threatened animal species associations
E	Fragmentation
F	Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan

These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. The study area occurs within two threatened ecosystems below, the Eastern Highveld Grassland and the Soweto Highveld Grassland (Figure 3-8).

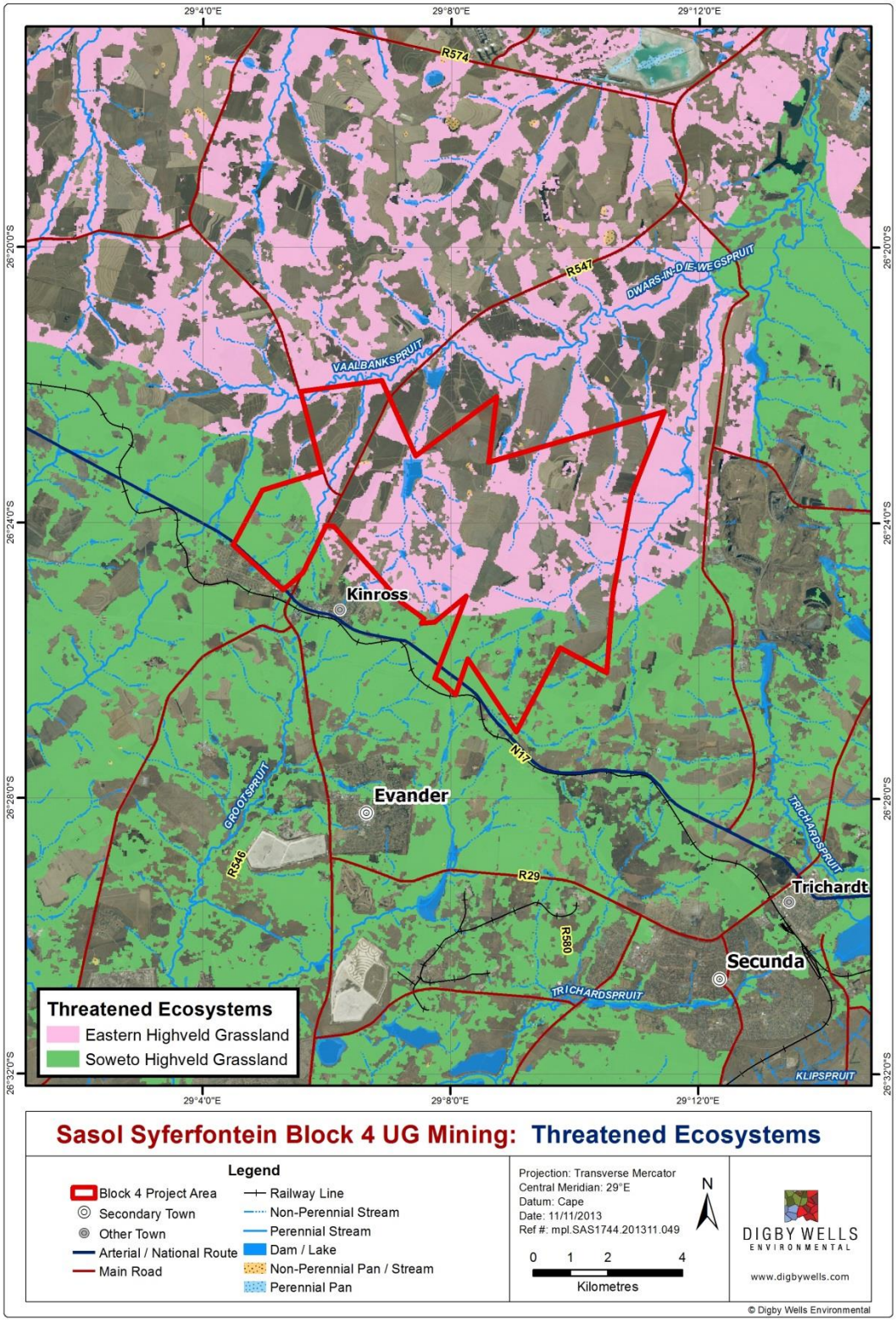

Figure 3-8: Threatened ecosystems and their location with respect to the proposed development.

3.4.5 National Protected Areas Expansion Strategy (NPAES)

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. There are no areas earmarked for conservation within 50km of the proposed development (Figure 3-9).

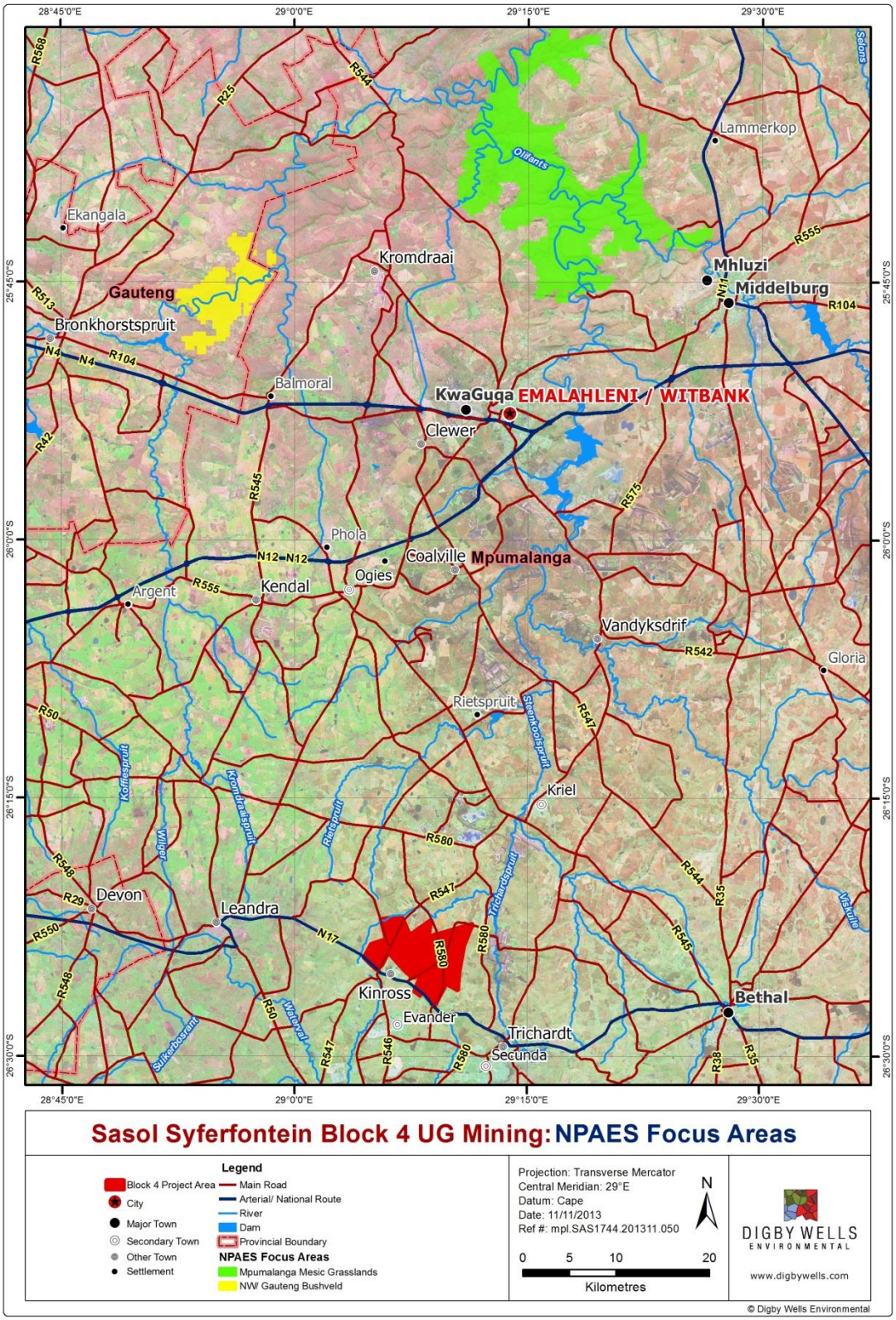

Figure 3-9: National Protected Area Expansion Strategy Focus Areas and their location with respect to the proposed development.

3.4.6 Sensitivity

From the information that was interrogated for this report it is evident that the study area does form part of the MTPA conservation strategy. According to the C-Plan the area consists of Irreplaceable, Necessary and Natural landscapes, which means the possibility of encountering additional protected flora, and or landscapes in the study area does exist. The study area does not occur close to any protected areas or important bird areas. It does however fall within two nationally protected vegetation types. Finally, the study area does not form part of the NPAES. As far as protected species are concerned, broad scale data was available for the mammal determination and there are protected species that can occur on site, as listed in this report. For the Avifauna component, there are 23 species that can occur on site, even though the area does not fall within an IBA, actual species recorded are listed in this report. One protected reptile species can be expected, although none was encountered, one protected amphibian species can be expected and one protected Invertebrate species, neither was however encountered. Overall it appears that there is a reasonably chance to encounter additional protected species in the remaining natural areas on site.

4 IMPACT ASSESSMENT

The following tables (Table 4-1 and Table 4-2) describe the Impact Rating Methodology which was applied for the proposed Project area and proposed activities.

Table 4-1: Impact Assessment Categories: Severity, Spatial Scale, Duration and Probability Rating.

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the	Almost certain/Highly probable It is most likely that the impact will occur.

Rating	Severity	Spatial scale	Duration	Probability
			impact.	
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of

Rating	Severity	Spatial scale	Duration	Probability
				design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 4-2: Significance Categories.

Significance

Probability / Likelihood	Consequence (severity + scale + duration)								
	1	3	5	7	9	11	15	18	21
1	1	3	5	7	9	11	15	18	21
2	2	6	10	14	18	22	30	36	42
3	3	9	15	21	27	33	45	54	63
4	4	12	20	28	36	44	60	72	84
5	5	15	25	35	45	55	75	90	105
6	6	18	30	42	54	66	90	108	126
7	7	21	35	49	63	77	105	126	147

Significance	
High (Major)	**108- 147**
Medium-High (Moderate)	**73 - 107**

Medium-Low (Minor)	**36 - 72**
Low (Negligible)	**0 - 35**

Table 4-3: Activities table

Activity No.	Activity	Timeframe
Construction Phase		
1	Construction of underground structures - incline	201? – Jan 20??
2	Transportation of materials & workers on site	201? – Jan 20??
3	Temporary storage of lubricants and fuels.	201? – Jan 20??
Operational Phase		
4	Underground board and pillar mining method.	Life of the mine (approximately 30 years with the potential to extent this period)
7	Storage, handling and treatment of hazardous products (fuel, explosives, and oil) and management of waste.	Life of the mine (approximately 30 years with the potential to extent this period)
Decommissioning phase		
8	Decommissioning of underground mine.	After the life of mine
Post-closure Phase		
11	Post-closure and water and subsidence monitoring	After the life of mine

4.1 Construction Phase

4.1.1 Impact: Construction of underground structures

Criteria	Details / Discussion
Description of impact	During the construction of the underground structures, there is a possibility that subsidence could occur.
Mitigation required	No Mitigation is possible for surface subsidence.

Criteria	Details / Discussion				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	Moderate (3)	Very Serious(5)	Very Serious (5)	Probable (4)	Medium-low (52)
Post-Mitigation	N/A				

4.2 Operational Phase

4.2.1 Impact: Underground board and pillar mining method

Criteria	Details / Discussion				
Description of impact	During the operational phase the board and pillar mining method could cause subsidence.				
Mitigation required	No Mitigation is possible for surface subsidence.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	Moderate (3)	Very Serious(5)	Very Serious (5)	Probable (4)	Medium-low (52)
Post-Mitigation	N/A				

4.3 Decommissioning Phase

4.3.1 Impact

Criteria	Details / Discussion				
Description of impact	During the decommissioning phase, there is a possibility that subsidence could occur.				
Mitigation required	No Mitigation is possible for surface subsidence.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	Moderate (3)	Very Serious(5)	Very Serious (5)	Probable (4)	Medium-low (52)
Post-Mitigation	N/A				

4.4 Post-Closure

4.4.1 Impact

Criteria	**Details / Discussion**				
Description of impact	During the post closure phase, there is a possibility that subsidence could occur.				
Mitigation required	No Mitigation is possible for surface subsidence.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	Moderate (3)	Very Serious(5)	Very Serious (5)	Probable (4)	Medium-low (52)
Post-Mitigation	N/A				

5 CUMULATIVE IMPACTS

When determining the impacts of a development such as this, one needs to consider cumulative impacts. Cumulative impacts take into account impacts of current land use and land use change in the broader area. Ideally, all development should take place within a predefined Strategic Environmental Assessment which defines no-go and conservation areas as well as allowing for development such as housing, roads, agriculture and mining. In the absence of such a strategic plan, one can look at the surrounding activity and land use and determine to a certain extent, the overall impacts in the region with the addition of the proposed mine.

There are currently several mines surrounding the Syferfontein study site, most of these are coal mines (Figure 5-1). This has a high cumulative impact on the general area as a whole. The construction of yet another mine in the area can be seen to have serious impacts on ecosystem function. Even though the proposed Syferfontein mine is underground, and not open-cast, it will add to the general environmental degradation caused by the numerous mines in the area in conjunction with other land uses (agriculture, residential development and cattle farming).

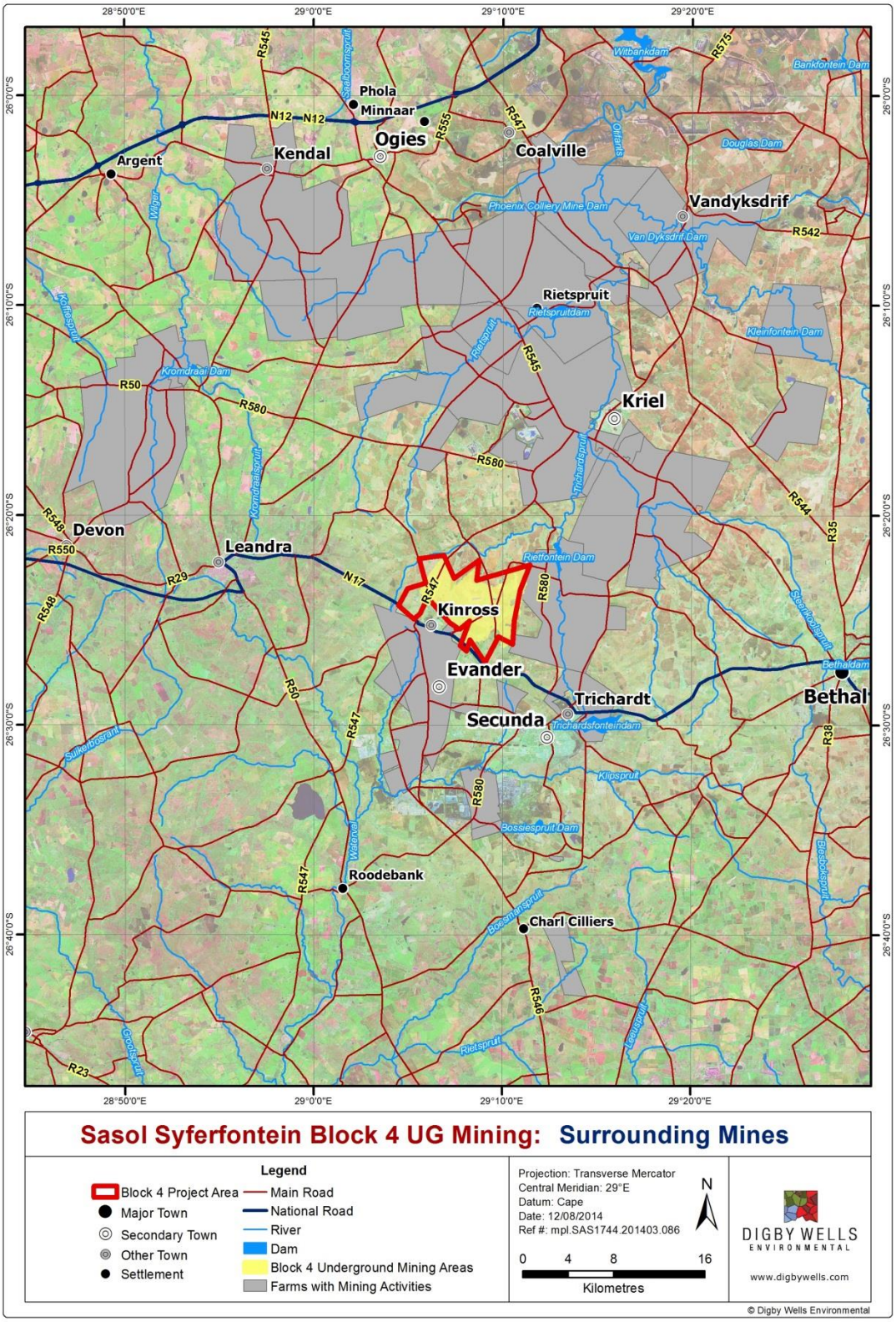

Figure 5-1: Map of the Syferfontein mine area and nearby existing and proposed mines.

The opportunity exists for the proposed Syferfontein mine to contribute quite substantially to the conservation in the region. Conservation of as much of the natural land in the area, and the creation of corridors linking other natural areas would aid in conservation of ecosystems, flora and fauna. If this is achieved (permanently, not just over the life of the mine), then the mine itself will have a net positive impact. The proposed mine would have essentially provided their own offsets, especially if the wetland areas and associated grassland is restored and managed as a conservation and corridor area

6 SUMMARY OF SIGNIFICANT IMPACTS

As this is an underground operation and no surface infrastructure will be located in the area of interest, the only possible significant impact would be surface subsidence, the likelihood of this can however only be determined with the appropriate geotechnical information.

7 MITIGATION MEASURES AND MANAGEMENT PLAN

Broad mitigation and management actions are described initially and then activity specific actions are described in this section**Error! Reference source not found.**.

Although the mine shaft and associated infrastructure occurs in a different area than the project site, the opportunity to conserve much of the high sensitivity areas within the project site as corridor areas should not be overlooked. If this is done, and the area actively conserved throughout the life of mine and after closure, the overall ecological impact of the mine may be positive.

7.1 Avoid sensitive habitat (high sensitivity)

- Avoidance of the wetland areas and associated grasslands is strongly recommended. Any future infrastructure must adhere to this. These areas must be monitored for surface subsidence.

7.2 Rescue and relocation of flora and fauna

7.2.1 Flora

- Flora SSC should be avoided in any future development, such as roads. If this is not possible, the rescue of as many species as possible should occur. These species should be relocated to a nursery area.
- Cattle should be excluded from these areas (or managed correctly within them) and the invasive and problem plant species controlled. Restoration should also occur to restore grass owl habitat as well as naturally occurring species of special concern.

7.2.2 Fauna

- Faunal SSC are not expected to be affected by the underground mining activities, as no impacts on habitat will occur the faunal species associated with the habitat types will not be adversely affected.
- Fauna will be positively impacted should the recommended corridor areas be implemented.

Biodiversity and Land Management Plan (BLMP)

A biodiversity and land management plan is recommended for the Syferfontein project area in order to effectively manage existing biodiversity. It is recommended that a competent person be placed to manage and monitor the state of the surrounding wetlands and grassland. The competent person will be responsible for implementing and monitoring the ecosystem health as well as managing the rehabilitation operations, where needed.

7.3 Monitoring programme

A monitoring programme, which assesses the ecological state of the terrestrial ecological resources, is recommended. On site monitoring must take place to identify negative trends in the ecosystem, adaptive management will then be applied to correct these negative trends; bush encroachment and alien invasive plant species should be considered.

8 MONITORING PROGRAMME

The on-site effects that the underground mine have on the flora of the area, such as possible surface subsidence can be quantified with continuous monitoring of natural areas on the project site. Such a monitoring program must concentrate on the red data species management and alien invasive species management. A monitoring program will include seasonal assessments to identify areas where management will have to be applied. An alien invasive management program must also be developed, that will be utilised. Furthermore the management of the red data species will have to take place. Follow up surveys of the identified alien invasive problem areas will have to be conducted in order to adapt management plans to suit specific areas. Seasonal monitoring of the effects of the study area on flora and fauna in the general area must be conducted, this can be accomplished through information sharing with local land owners and surveys conducted on the surrounding farms. The major management measure to be employed with regards to the Red data species will be the set aside biodiversity corridor areas.

A monitoring program needs to evaluate the management actions on each of these components. The method of monitoring is the Braun Blanquet method, which is a specialised method designed specifically for vegetation survey/monitoring purposes.

- Monitoring must take place annually;
- Monitoring must be completed by qualified specialists;
- Adaptive management must applied;
- Monitoring during the wet season is essential; and
- Findings must be compared to previous years.

9 RECOMMENDATIONS AND KNOWLEDGE GAPS

During the field assessment the identified grassland was seen as having a positive impact on the biodiversity in the area. This was primarily because of the diversity of plant and to a

lesser extent animal species that were encountered here. It is recommended that a management plan be implemented which will firstly monitor fauna and flora present in the area, and secondly devise management measures to enhance the status of the habitat present. Any destruction of the natural areas such as Grassland, rocky outcrops and wetland habitat types should be avoided. Land users such as farmers must be managed in such a way that biodiversity is enhanced, this can be accomplished through declaring sensitive habitats no go areas where grazing and planting of crops are prohibited.

Monitoring of fauna and flora will indicate the effectiveness of any management measures employed. With the presence of riparian habitat, which is present in the study area, affording amphibians the opportunity to colonise a portion of the area, further studies in this regard is suggested. To summarise:

- Biodiversity Land Management Plan;
- Fauna and flora monitoring plan;
- Alien invasive management plan.

The opportunity to maintain or increase the ecological functioning of this area exists, thereby indirectly supporting the population of animal species possibly reliant on this area for services. By preserving any remaining grassland, rocky outcrops and wetland habitat types and removing the threats, the ecological functioning of the areas will be positively affected thereby increasing the suite of ecological services offered to animals, making the area an attractive option for animals to re-colonize

10 CONCLUSION

The area of study was found to be under pressure from surrounding land use, most notably, agriculture including maize and cattle farming. Despite these threats, it was found that the area of study provided an ecological service to the plant and animal species encountered during the field survey and possibly to the plant and animal species that were identified during the desktop survey.

The area is either transformed or degraded but wetlands and associated grasslands form important process and habitat areas. Grasslands also support SSC. These areas are of conservation importance and the opportunity exists for Sasol to conserve some biodiversity corridors maintaining ecosystem functionality and potentially having an overall positive impact on biodiversity.

It is the opinion of the specialist that mining should go ahead with the following conditions:

- Any surface infrastructure, such as roads and fences, should be relocated to an area of low sensitivity, and
- The project area including all the wetland systems and the associated grasslands should be set aside as a biodiversity corridor and managed as a conservation area throughout the life of mine and beyond. Cattle should be excluded from these areas and invasive and problem plants actively controlled. Restoration of these areas should also be undertaken.

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Appendix A: Curriculum Vitae

Mr. Rudolph Greffrath

Senior Fauna and Flora Specialist

Biophysical Department

Digby Wells Environmental

Education

- 2005: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).
- 2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

Professional Registration

- South African Council for Natural Scientific Professions (Membership No. 200245/13).
- IAIA, International Association for Impact assessments;
- Botanical Society of South Africa.

Employment

- 2006 – Present: Digby Wells Environmental, Johannesburg, South Africa.
- 2002 - 2003: Shamwari Game Reserve, Eastern Cape, South Africa.
- 2001: Kop-Kop Geotechnical instrumentation specialists, Johannesburg, South Africa.

Experience

Rudi's current role is that of a fauna and flora specialist, in this capacity he is responsible for planning and conducting fauna and flora surveys/studies that are either completed in support of environmental authorisations or are focused specialist studies which meet local and international standards. In addition to this, Rudi is responsible for compiling Biodiversity Land Management Programs where different specialist studies are collated into a working document for clients in order to aid in pre or post mining management. He is also involved in rehabilitation studies which entail the planning, implementation and monitoring of vegetative rehabilitation in designated areas on mines. Rudi also fulfils the role of project manager for selected projects; here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multi-disciplinary team of specialists.

Rudi is also involved in the acquisition of permits for mines, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys,

thereafter he manages the process involving relevant provincial and National authorities in order to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudi includes the following:

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);
- Environmental pre-feasibility studies for gold tailings reclamation and iron ore mining projects;
- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;
- Impact assessments based on the terrestrial environment;
- Biodiversity and Land Management Programs;
- Protected plant species management strategies planning and implementation;
- Monitoring of rehabilitation success through vegetation establishment;
- Rehabilitation planning;
- Environmental auditing of rehabilitated areas;
- Project management of ecological specialist studies;
- Planning and design of Rehabilitation off-set strategies.

Training

- Measurements of Biodiversity at the University of the Free State, led by Prof. M. T. Seaman. September 2008.
- Bird Identification course led by Ettiene Maraise November 2009.
- Introduction to VEGRAI and Eco-classification led by Dr. James Mackenzie December 2009.
- Dangerous snake handling and snake bite treatment with Mike Perry 2011.
- Rehabilitation of Mine impacted areas, with Fritz van Oudshoorn, Dr Wayne Truter and Gustav le Roux 2011.

Projects

The following project list is indicative of Rudi's experience, providing insight into the various projects, roles and locations he has worked in.

Project	Location	Client	Main project features	Positions held	Activities performed
Mmamabula Energy Project (MEP).	Botswana	CIC energy	Construction of a railway, opencast mine, wellfield, conveyors, addits,	Ecologist	Fauna and Flora surveys for the project features, including impact assessments,

			housing.		management plans. Alien eradication plans.
Tongan Biodiversity Land Management Plan	Ivory Coast	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the BLMP, compilation of BLMP. Alien eradication plans.
Kibali Gold mine	DRC Congo	Randgold	Gold mine infrastructure	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Nzoro Hydroelectric station	DRC Congo	Randgold	Hydroelectric plant	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Loulo Biodiversity Land Management Plan	Mali	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the project features, compilation of BLMP.
Koidu Diamond Mine	Sierra Leone	Koidu Resources	Construction of new open pit	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plan.
Resource Generation	South Africa	Temo Coal	Coal mine/Railway Line	Ecologist	Fauna and Flora surveys, Protected plant species management plans, Permitting and Rehabilitation design.
Impunzi Rehabilitation monitoring	South Africa	Glencore	Monitoring of rehabilitation success and suggested	Flora specialist, Project	Vegetation surveys, rehabilitation monitoring. Alien

			management measures	manager	eradication plan.

Publications

Biodiversity Action Plans for faunal habitat maintenance and expansion in mining. Poster presented at the 48th Annual Grassland Society of Southern Africa (GSSA) conference.

Appendix B: Birds

Scientific name	Common name	Habitat	IUCN Status
Acridotheres tristis	Indian myna	suburbia	LC
Actitis hypoleucos	Common sandpiper	wetlands, rivers	LC
Alcedo cristata	Malachite Kingfisher	Lakes, streams	LC
Alopochen aegyptiaca	Egyptian goose	Riparian	LC
Amadina erythrocephala	Red headed finch	broadleaved woodland savanna	LC
Amadina fasciata	Cut throat finch	Dry thornveld	LC
Amandava subflava	Orange breasted waxbill	Grassland, weed grasses	LC
Anas smithii	Cape shoveller	Riparian	LC
Anas sparsa	African black duck	Riparian	LC
Anas undulata	Yellow-billed duck	Riparian	LC
Anhinga rufa	African Darter	Riparian	LC
Anthus cinnamomeus	African Pipit	Open grassland	NA
Anthus vaalensis	Buffy Pipit	short grassed hillsides	LC
Apalis thoracica	Bar throated Apalis	Scrub	LC
Apus caffer	White-Rumped Swift	Aerial over open country	LC
Ardea cinerea	Grey Heron	Riparian	LC
Ardea melanocephala	Black Headed Heron	Riparian	LC
Ardea purpurea	Purple Heron	Riparian	LC
Asio capensis	Marsh Owl	Marshes, damp grassland	LC
Bostrychia hagedash	Hadeda ibis	diverse	LC
Botaurus stellaris	Great Bittern	Riparian	LC
Bubo africanus	Spotted Eagle-Owl	Diverse, woodland, savanna, suburbia	LC
Bubulcis ibis	Cattle egret		NA
Burhinus capensis	Spotted thick knee	Grassland and Savanna	LC
Buteo rufofuscus	Jackal buzzard	grasslands	LC
Buteo trizonatus	Steppe buzzard	open grassland	NA

Calandrella cinerea	Red-Capped Lark	Open country with short grass cover	LC
Calidris minuta	Little stint	wetlands	LC
Caprimulgus europaeus	European Nightjar	Woodland, savannah	LC
Caprimulgus rufigena	Rufous cheecked Nightjar	Dry thornveld, Woodland	LC
Charadrius tricollaris	Three banded plover	waterbodies	LC
Chrysococcyx caprius	Diderick Cuckoo	Savanna, grassveld	LC
Ciconia ciconia	White stork	Grasslands, vlei's cultivated lands	LC
Cisticola juncidis	Zitting Cisticola	Thick grass	LC
Cisticola tinniens	Levaillant's cisticola	Reedbeds, rivers, dams	LC
Colius striatus	Speckled Mousebird	Thick bush, fruiting trees	LC
Columba guinea	Speckled (rock) Pigeon	rocky terrain	LC
Coracias naevia	Purple Roller	open broadleaved woodland	NA
Corvus albus	Pied Crow	Cosmopolitan	LC
Corvus capensis	Cape Crow	upland grassland	LC
Cossypha caffra	Cape Robin Chat	bushveld	LC
Coturnix coturnix	Common quail	grasslands fields	LC
Creatophora cinerea	Wattled starling	Grassland, Open woodland	LC
Crex crex	Corn crake	vlei margins, wooded areas	LC
Cuculus canorus	Common Cuckoo	Woodland, Savannah	LC
Cuculus solitarius	Red-Chested Cuckoo	Mature woodland	LC
Delichon urbicum	Common House Martin	Dry thornveld, Woodland	LC
Dendrocygna bicolor	Fluvous Whistling-duck	Riparian	LC
Dendrocygna viduata	White-faced whistling-duck	Riparian	LC
Egretta ardesiaca	Black heron	Riparian	LC
Egretta garzetta	Little Egret	Riparian	LC

Egretta/Ardea intermedia	Yellow billed Egret	Riparian	Unknown
Elanus caeruleus	Black shouldered kite	open areas, agricultural areas	LC
Emberzia flaviventris	Golden breasted bunting	Mixed woodland	LC
Eremopterix leucotis	Chestnut Backed Sparrowlark	road verges, cultivated land	LC
Euplectes albonotatus	White winged widowbird	Grass savanna	LC
Euplectes axillaris	Fantailed widowbird	Reedbeds, rivers, dams	LC
Euplectes orix	Southern Red bishop	Grassland, savanna	LC
Euplectes progne	Long tailed widowbird	Open grassland	LC
Eupodotis afraoides	Northern black korhaan	open grassland, scrub	LC
Falco biarmicus	Lanner falcon	open grassland	LC
Falco naumanni	Lesser kestrel	open grassland, agricultural areas	LC
Falco rupicolis	Rock kestral	rocky terrain	NA
Falco rupicoloides	Greater kestral	dry areas, open savannah, grasslands	LC
Fulica cristata	Red knobbed koot	Riparian	LC
Gallinago nigripennis	African snipe	marshes, wetlands	LC
Gallinula angulata	Lesser moorhen	Riparian	LC
Gallinula chloropus	Common moorhen	Riparian	LC
Haliaeetus vocifer	African Fish-eagle	Riparian	LC
Himantopus himantopus	Black winged stilt	vleis, flooded ground	LC
Hirundo albigularis	White throated Swallow	Associated with water	LC
Hirundo cucullata	Greater striped swallow	Grassland, vleis	LC
Hirundo fuligula	Rock Martin	rocky terrain	LC
Hirundo rustica	Barn Swallow	Cosmopolitan	LC
Ixobrychus minutus	Little Bittern	Riparian	LC
Jynx ruficollis	Red throated wryneck	Grassland open savanna	LC

Lamprotornis nitens	Cape glossy starling	Mixed woodland	LC
Lanius collaris	Common Fiscal Shrike	Many habitats	LC
Lanius minor	Lesser grey shrike	Mixed dry thornveld	LC
Lybius torquatus	Black collard Barbet	Woodland Savanna	LC
Macronyx capensis	Cape (Orangethroated) Longclaw	Upland grassland	LC
Megaceryle maxima	Giant Kingfisher	Wooded streams, dams	LC
Merops hirundineus	Swallow-Tailed Bee-eater	Scrub	LC
Merops pusillus	Little Bee-eater	Savanna, woodland	LC
Mirafra africana	Rufous-Naped Lark	Open grassland	LC
Mirafra fasciolata	Eastern clapper Lark	Grassland, open savanna	LC
Motacilla aguimp	African pied Wagtail	Along rivers	LC
Motacilla capensis	Cape Wagtail	Near freshwater	LC
Muscicapa striata	Spotted flycatcher	Wooded habitats	LC
Myrmecocichla formicivora	Anteating Chat	Grassland	LC
Nectarinia famosa	Malachite sunbird	Hills	LC
Numida meleagris	Helmeted guineafowl	grassland agricultural areas	LC
Oena capensis	Namaqua Dove	Prefers dryer regions	LC
Ortygospiza atricollis	African quailfinch	Open grassland	LC
Oxyura maccoa	Maccoa duck	Riparian	LC
Passer diffusus	Southern grey headed sparrow	Woodland	LC
Passer domesticus	House sparrow	Gardens	LC
Passer melanurus	Cape sparrow	Grassland, fields	LC
Phalacrocorax africanus	Reed Cormorant	Riparian	LC
Phalacrocorax lucidus	White breasted Cormorant	Riparian	NA
Phoeniculus purpureus	Red Billed Woodhoopoe	woodland thornveld	LC
Phylloscopus trochilus	Willow warbler	broadleaved woodland savanna	LC

Platalea alba	African spoonbil	pans, lakes, dams	LC
Plectropterus gambensis	Spur winged goose	riparian	LC
Plocepasser mahali	White-browed sparrow weaver	River courses, dry thornveld	LC
Ploceus velatus	Southern Masked weaver	Savanna, grassveld	LC
Polyboroides typus	Gymnogene (Harrier hawk)	open broadleaved woodland	LC
Prinia flavicans	Black Chested Prinia	Scrub	LC
Psophocichla litsitsirupa	Groundscraper Thrush	open broadleaved woodland	LC
Pternistis swansonii	Swainson's francolin	agricultural lands	NA
Pycnonotus nigricans	Red eyed Bulbul	Riverine Bush	LC
Pycnonotus tricolor	Dark Capped Bulbul	thornveld to forest	NA
Quelea quelea	Red billled Quelea	Savanna, croplands	LC
Riparia paludicola	Brown Throated Martin	Freshwater lakes, rivers	LC
Sagittarius serpentarius	Secretary bird	open bushland and savannah	**VU**
Sarkidiornis melanotos	Knob billed duck	Riparian	LC
Saxicola torquatus	Common Stonechat	Upland grassland, wetland	LC
Scleroptila levaillantii	Red winged francolin	grassland	NA
Scleroptila levaillantoides	Orange river francolin	open grassland	NA
Scopus umbretta	Hamerkop	pans, lakes, dams	LC
Serinus mozambicus	Yellow fronted canary	Mixed woodland	LC
Sigelus silens	Fiscal flycatcher	Bush, shrub	LC
Spizocorys conirostris	Pink-Billed Lark	upland grassland	LC
Spreo bicolor	Pied starling	Grassland	LC
Stenostira scita	Fairy Flycatcher	Thornveld	LC
Streptopelia capicola	Ring-necked dove	Wide range of habitats	LC
Streptopelia semitorquata	Red-Eyed Dove	Wide range of habitats	LC

Streptopelia senegalensis	Laughing Dove	Wide range of habitats	NA
Tadorna cana	South Afican shelduck	Riparian	LC
Telophorus zeylonus	Bokmakierie	Shrub	LC
Thallassornis leuconotus	White backed duck	Riparian	NA
Threskiornis aethiopicus	African Sacred ibis	grasslands, vleis	LC
Trachyphonus vaillantii	Crested Barbet	Woodland Savanna	LC
Tricholaema leucomelas	Acacia Pied Barbet	Woodland Savanna	LC
Tringa glareola	Wood sandpiper	wetlands	LC
Tringa nebularia	Common greenshank	wetlands	LC
Tringa stagnatilis	Marsh sandpiper	large inland waterbodies	LC
Turdus olivaceus	Olive Thrush	forest shrub	LC
Tyto alba	Barn Owl	Diverse, desert to moist savanna	LC
Tyto capensis	Grass Owl	Marshes, Grasslands	LC/**Provincially protected**
Upupa africana	African Hoopoe	open broadleaved woodland	NA
Urocolius indicus	Red-Faced Mousebird	Thornveld, broadleaved woodland	LC
Vanellus armatus	Blacksmith plover	damp wetland margins	LC
Vanellus coronatus	Crowned lapwing	short grassland	LC
Vanellus senegallus	Wattled lapwing	Damp grasslands, vleis	LC
Vidua macroura	Pintailed whydah	Savanna, grassveld	LC
Zosterops capensis	Cape White-eye	Woodland, Savannah	NA