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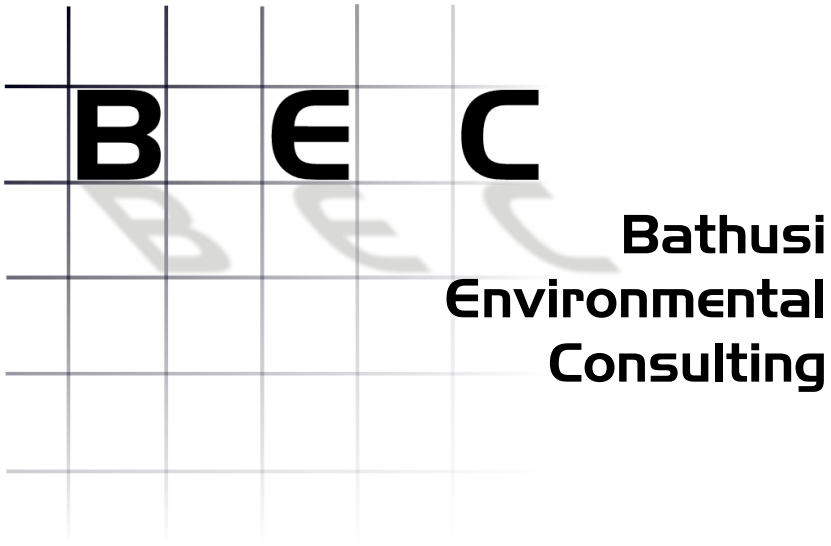
Strategic Terrestrial Biodiversity Impact Assessment for the proposed Stooping of Underground Works at Matla Colliery, Mpumalanga Province

including:

Botany, Fauna (Invertebrates, Amphibians, Reptiles, Mammals) & Avifauna

compiled by



October 2014

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I PROJECT DETAILS

Client:	GCS (Pty) Ltd, on behalf of Exxaro Matla Coal
Report name:	Strategic Terrestrial Biodiversity Impact Assessment for the proposed Stooping of Underground Works at Matla Colliery, Mpumalanga Province
Report type:	Biodiversity Impact Assessment
BEC Project number:	GCS – MSP – 2014/19
Report Version:	2014.10.31.1
Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting cc

II SPECIALIST INVESTIGATORS

The Natural Scientific Professions Act of 2003 aims to '*provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'.*

Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

Table 1: Biodiversity specialists for this project

Botanical Investigator:	**Riaan Robbeson (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	*400005/03*
Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	*667.08/08*
Faunal Investigator:	**Dewald Kamffer (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*
Avifaunal Investigator:	**Lukas Niemand (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Restoration Ecology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400095/06*

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VI ACRONYMS & ABBREVIATIONS

BEC	Bathusi Environmental Consulting cc
CBD	Convention of Biological Diversity
CITES	Convention on International Trade in Endangered Species
CR	Critically Endangered
DDD	Data Deficient (Insufficient Information)
DDT	Data Deficient (Taxonomically Problematic)
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
EN	Endangered
GCS	GCS (Pty) Ltd
IUCN	International Union for Conservation of Nature
MAP	Mean Annual Precipitation
NEM:WA	National Environmental Management: Waste Act
NEMA	National Environmental Management Act
NGO	Non-Governmental Organisation
NT	Near Threatened
PoC	Probability of Occurrence
POSA	Plants of Southern Africa
Pr.Sci.Nat.	Professional Natural Scientist
SACNASP	South African Council for Natural Scientific Professions
SADC	South African Development Community
SANBI	South African National Botanical Institute
VU	Vulnerable

1 EXECUTIVE SUMMARY

The major objective of this Biodiversity Impact Assessment is to establish the presence/absence of ecologically sensitive areas or species within the proposed project area. In order to assist with the planning of the proposed mining activities, it is necessary to assess potential impacts of the development on the natural environment (terrestrial biodiversity), provide pertinent comments on the suitability of the area for the proposed project and to provide development guidance to limit impacts as far as possible.

Matla Coal intends to stoop (to totally extract) pillars at the previously underground mined areas with the intent to reclaim the remaining coal reserves, by using the conventional board and pillar mining method (drill and blast). The proposed activities will occur on certain farms portions within the Matla Coal mining boundary. The reclamation of the remaining coal reserves will utilise most of the existing current operations' infrastructure, but will require additional associated infrastructure (access roads, conveyor belts, water pipelines, power lines, etc).

Matla Coal has appointed GCS (Pty) Ltd (GCS) as the Environmental Assessment Practitioner (EAP) to undertake the environmental authorization processes for the proposed development. Bathusi Environmental Consulting cc (BEC) was appointed by GCS as independent ecologists to compile the impact rating reports for the terrestrial biodiversity component of this project.

1.1 BIOPHYSICAL ATTRIBUTES

The study area is situated approximately 15 km south of Ogies, 12 km northeast of Leandra and 13 km west of Kriel. The original (principal) study area comprises approximately 21,000 ha, while the respective stooping areas comprise approximately 7,333.5 ha. Two district municipalities are spatially represented within the various stooping areas, namely the Emalahleni and Govan Mbeki District Municipalities. Summarised information for these municipalities is as follows:

- Govan Mbeki DM comprises approximately 295,496 ha, of which 182,735 ha (61.8%) is regarded untransformed (38.2 % transformed). No formally protected conservation areas or Ramsar sites are spatially present within this district municipality; and
- Emalahleni DM comprises approximately 267,761 ha, of which only 137,489 ha (51.3%) is regarded untransformed (48.7 % transformed). The Witbank Nature Reserve (889.1 ha, 0.33 %) is the only formally protected area. No Ramsar sites are spatially present within this district municipality.

The mosaical appearance of land cover of the landscape strongly reflects the severe transformation effect of commercial agriculture (commercial maize production). This highly transformed status represents one of the major reasons for the 'Endangered' conservation status ascribed to the regional ecological type. Road infrastructure in the region, similarly, caused a moderate level of habitat fragmentation. Commercial agriculture (dry land maize production) and cattle grazing represents the major land use categories of the region, while mining and associated industrial land use activities secondarily contributed to habitat transformation on a local and regional scale. These anthropogenic influences resulted in the creation of highly fragmented portions of remaining natural habitat, characterised by a high degree of isolation.

The general region consists primarily of a combination of 'Cultivated land' and 'Untransformed grassland', which is strongly associated with ecotonal wetland/ grassland interface.

The study area falls within the upper reaches of the Olifants-North Primary Catchment areas, specifically the B20E, B11E and B11D Quarterny Catchments. A number of wetland habitat types are situated within the site, including perennial and non-perennial drainage lines, rivers, hillslope seepages, channelled and unchannelled valleybottoms, dams, and endorheic pans. No major rivers, dams or wetlands are situated within the study area, however, it is mentioned that a large endorheic pan is situated in the central part of the study area.

The study area is divided into two land morphological categories that are similar in broad physical appearances, namely 'Slightly irregular undulating plains and hills' and 'Moderately undulating plains and pans'. No habitat of significant physical variability, such as ridges, mountains, escarpments or hills, are present within the study area and the topography is relatively flat or slightly undulating. The most significant geomorphical attribute of the study area is the presence of low outcrops situated to the south of Stooping Area I. Various shallow drainage lines intersect the landscape. Altitude varies between 1,555 and 1,655 meters above sea level. Highpoints of the study area are located in the western part and the south central area. Low-lying areas are located in the central parts and the southern sections.

The geology of the study area conforms mostly to the Vryheid Arenite Formation with fragments of Karoo Dolerites in the southern part of the study area. Arenite is a sedimentary rock composed of sand-sized fragments irrespective of composition. The Vryheid Formation follows conformably, and in most localities by way of a transition, on the Pietermaritzburg Shale Formation, from the southern part of Natal northwards. The formation is characterized by thick beds of yellowish to white cross-bedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale and a few seams of coal. Land types Ab9 and Bb4 are represented in the study area.

The MBCP maps the distribution of Mpumalanga Province's known biodiversity into six categories. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The study area comprises four of these categories, namely:

- No Natural Habitat Remaining;
- Least Concern;
- Important and Necessary; and
- Highly Significant

Areas included in the 'Important and Necessary' category represent significantly important areas of natural vegetation that play an important role in meeting biodiversity targets. The MBCP suggests that areas included in the Highly Significant category should remain unaltered and managed for biodiversity by suitable means. Other categories (Important and Necessary, Least Concern and No Natural Habitat Remaining) incorporate increasing options for different types of land use that should be decided by the application of EIA procedures and negotiation between stakeholders.

The proposed development relates to 'Urban and Industrial Land Uses' (Land Use Type 14 – Underground Mining) and is included in the category with other development types, such as Surface Mining, Dumping & Dredging and Urban & Business Development, Major Development Projects, Linear Engineering Structures and Water Projects & Transfers. Classification in terms of Underground Mining Restrictions place most of the study area within the 'Permitted' category with selected portions within the 'Restricted' category. Parts of the study area are situated within areas where major developments are likely not to be permitted according to the MBCP. This does not necessarily imply that any development will be denied, but rather that

specialists studies clearly need to indicate that the proposed development will not adversely affect any sensitive floristic or faunal attributes that occur, or potentially could occur, within the study area or on a local and regional scale. Specialist studies are furthermore required to show that the proposed development will not add to existing cumulative impacts, regional degradation and habitat transformation and the loss of biodiversity on a local or regional scale.

1.2 BOTANICAL ASSESSMENT

The study area is located in the Mesic Highveld Grassland Bioregion, more specifically defined by Mucina and Rutherford (2006) as the Eastern Highveld Grassland (Endangered). The study area also includes isolated portions of the Eastern Temperate Freshwater Wetlands (Vulnerable) vegetation type are captured within the study area.

Existing data records indicate the presence of approximately 5,226 plant species within Mpumalanga Province (POSA, 2014/09/16). Information obtained from the SANBI database indicates the known presence of approximately only 183 plant species within the ¼ degree grids that is sympatric to the study area (refer **Appendix 1**). However, a high paucity of floristic data for the region is indicated by poor sampling records. In spite of the moderate floristic knowledge of the region, an appraisal of the growth forms reflects the grassland physiognomy with a high percentage of the species comprising herbs, grasses and geophytes. The prominence of wetlands in the region is indicated by the presence of numerous cyperoides. The grassland physiognomy is further highlighted by the absence of trees and shrubs. Existing data records indicate the presence of approximately 5,226 plant species within Mpumalanga Province (POSA, 2014/09/16), of which an estimated 272 species (5.2 %) are included in various conservation categories (POSA, 2014/09/16). Almost 80 % of the threatened flora within Mpumalanga Province is associated with the herbaceous stratum and comprises mainly as forbs. While no threatened species is known to occur in the ¼-degree grids, in which the proposed stooping areas are situated, it is however regarded likely that threatened plant taxa could be present within the study region.

A species richness of 236 plant taxa were recorded during the field investigations (refer **Appendix 2**). This recorded species diversity is regarded representative of the regional ecological types that is spatially represented in the study area. The grassland physiognomy (within areas of natural/ habitat) of the region is reflected by a well-developed and diverse herbaceous layer, comprising of 114 forbs, 49 grass species and 15 geophytes. Although the wetlands of the study area are likely to be more diverse as indicated in this report, the 23 sedge species recorded in this habitat type indicates that most of the wetlands comprises relatively natural habitat. The absence of a diverse shrub or tree component (other than exotic species) reflects the grassland physiognomy. The floristic diversity comprises 58 plant families, dominated by Poaceae, Asteraceae, Cyperaceae and Fabaceae.

Plant taxa of national[1] and provincial[2] conservation importance that were recorded within the study area include the following:

- *Crinum bulbispermum* (Declining Status, Protected Plant, Schedule 11);
- *Gladiolus elliotii* (Protected Plant, Schedule 11);
- *Gladiolus* species (Protected Plant, Schedule 11);
- *Kniphofia porphyrantha* (Protected Plant, Schedule 11); and
- *Nerine krigei* (Protected Plant, Schedule 11).

[1] IUCN Red List Categories and Criteria, POSA, 2011
[2] Mpumalanga Nature Conservation Act 10 of 1998

Remaining natural (untransformed) vegetation of the study area is regarded moderately representative of the Eastern Highveld Grassland ecological type, exhibiting varying degrees of divergence from the species composition, diversity, species abundance and vegetation structure described by Mucina and Rutherford (Vegmap, 2006).

Results of the photo analysis and site investigations revealed the presence of the following macro habitat types and habitat variations within the study area:

- Transformed Habitat, including
  - Agricultural Fields;
  - Buildings, Homesteads, Infrastructure & Existing Developments;
  - Mining Areas;
  - Roads & Linear Infrastructure;
- Degraded Habitat, including;
  - Cultivated Fields;
  - Dams/ Impoundments - Artificial;
  - Excavations;
  - Exotic Stands;
- Wetland Habitat, including:
  - Channelled Valley Bottoms;
  - Dams/ Impoundments – Natural;
  - Endorheic pans;
  - Unchannelled Valley Bottoms
- Grassland Habitat, including;
  - Degraded Grassland;
  - Hillslope Seeps;
  - Natural Grassland; and
  - Ridges.

No impacts were identified that could lead to a beneficial impact on the floristic environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status. The following impacts are regarded relevant to this type of development/ activity:

- Direct impacts on flora species of conservation importance;
- Loss or degradation of natural vegetation/ sensitive habitat types;
- Impacts on ecological connectivity & ecosystem functioning
- Indirect impacts (loss/ degradation/ pollution) on surrounding habitat;
- Impacts on SA's conservation obligations & targets; and
- Increase in local and regional fragmentation/ isolation of habitat.

While extensive parts of the study area comprehend transformed and degraded habitat that does not exhibit any inherent floristic attributes of sensitivity, remaining areas of natural terrestrial grassland and wetland habitat types are regarded representative of the regional ecological types, and therefore sensitive. The high sensitivity ascribed to these parts is not only the result of a relative high probability conservation important plants occurring within these areas, but also because of the high conservation value that is ascribed to the regional vegetation types (Endangered, Vulnerable – VEGMAP, 2006). The loss of natural habitat would therefore represent a significant cumulative impact on the conservation status of the regional vegetation

types. The potential loss, or degradation, of approximately 8,400 ha of natural habitat in the study area is likely to have a significant effect on the regional vegetation.

The status of terrestrial natural grassland, vary greatly across the study area. Considering the extent of habitat transformation on a local and regional scale, the high floristic importance ascribed to remaining natural grassland does not only reflect the national status (Endangered), but also the effect of fragmentation, isolation factors and general degradation that results from land use, particularly cultivation and inappropriate grazing strategies. The conservation of pristine portions of grasslands of the area should therefore be prioritised. The floristic diversity of pristine grasslands is significantly higher than that of degraded grassland. This might not be immediately visible from data presented in the report, but a closer inspection reveals that an artificial high diversity of degraded habitat results due to the presence of numerous weeds and opportunistic species that are not associated with the natural grasslands. When these species are not taken into account, it is evident that the diversity of degraded areas is particularly poor.

Similarly, wetland habitat types are generally accepted as sensitive for numerous reasons other than only vegetation, or biodiversity. Results of this assessment confirmed the high sensitivity and, in spite of the high utilisation factor that is noted across the study area, most areas were found to be relatively pristine. Particular reference is made to the three perennial streams occurring in the study area. These areas are regarded high in floristic diversity and are visually attractive. Reference is also made to the Vaalbankspruit situated in the southern part of the study area (Area I). This area is regarded a prime example of the regional vegetation, comprising a concomitance of habitat types that result in an exceptionally high local diversity. In addition to the drainage lines and ephemeral grasslands that typify the study area, the presence of numerous endorheic pans contributes to the importance of the wetland habitat type. While the status of these areas is not pristine because of severe effects of grazing by cattle and nearby agriculture, their importance and contribution to the local and regional diversity cannot be overestimated.

A low sensitivity is ascribed to transformed and degraded areas, but these areas do play an important role as buffers around areas of natural/ sensitive habitat. The importance of these areas as buffers will be amplified during the proposed development. Strong recommendations for i) the exclusion of all areas of high sensitivity, and ii) the inclusion of buffers (consisting of areas of low sensitivity), will form part of the recommended mitigation measures of this report that will ultimately be incorporated in the EMP for the development. The estimated sensitivity of certain portions were therefore adapted to allow for protection of nearby sensitive areas, in spite of a low floristic importance that these portions might hold on a local or regional scale.

The significance of impacts associated with the proposed stooping operations is directly related to the floristic sensitivity ascribed to the study area. The large extent of planned mining operations in the study area will undoubtedly result in significant impacts on the floristic environment. These impacts, largely, will result from habitat destruction associated with surface operations. The exclusion of all areas of natural and sensitive habitat will therefore be advocated as the most important mitigation measure. Impacts associated with stooping are likely to be severe on a different scale since the vegetation are not affected directly, implying destruction through surface clearance activities. However, surface changes (topographical alteration) are likely to affect the moisture balances of the top part of the soil and long-term species changes will result.

These effects are regarded particularly important in the case of lower landscapes and depressions (wetlands). Vegetation of these habitat types are strongly zonal and has been established within extremely

narrow environmental parameters that include soil types, moisture levels, dependence on adjacent grasslands, topographical aspects, etc. Changes to the flow directions, moisture regimes, or any other definitive factor, are likely to result in severe and permanent damage to these areas. The exclusion of all wetland habitats will form the basis of mitigation of impacts within this habitat type.

Mitigation of direct impacts resulting from mining activities is largely restricted to the exclusion of sensitive areas. Direct impacts on vegetation are irreversible, even with the application of detailed rehabilitation procedures. Furthermore, the inherent dependence of various grassland habitat types (upland/ lowland interface) on each other limits the blanket approach of excluding only sensitive areas from a development of this nature. The creation of buffer zones and connective corridors is critical to avert peripheral (indirect) impacts from affecting the status of grassland and wetland habitat types on the long term. Generic mitigation measures, which are detailed in a later section of this report, will form the basis of protection from indirect, direct and peripheral impacts, but must be strongly controlled and monitored.

Biodiversity offsite interventions are strongly recommended in cases where unavoidable impacts will result in areas of high floristic sensitivity. The inclusion of sensitive areas in local conservation and management strategies will benefit the diversity on a regional scale.

1.3 FAUNAL ASSESSMENT

The main objectives for the faunal assessment is to present an overview of the faunal habitat types, the inherent sensitivity of remaining natural habitat and potential faunal assemblages and provide a brief rating of expected and likely impacts on the faunal environment of the proposed project area.

Animals previously recorded in the Q-grids 2628BD, 2629AA and 2629AC were considered potential inhabitants of the study area; all species known to occur in Mpumalanga Province were therefore included in the assessment to limit the known effects of sampling bias. During the field investigations, conducted during July, 2011, January, 2012 and August, 2014, a total of 61 animals were recorded in the study area. It should be noted that this list is not regarded as comprehensive. Three of the mammals found in the study area were introduced and one species, Serval, is a conservation important animal. Invertebrates from 36 families were recorded in the study area. This diversity of animal species recorded in the study area represents typical grassland-wetland faunal assemblages of the fragmented landscape of the southwestern Mpumalanga Province.

The close relationship between vegetation units and specific faunal composition has been noted in several scientific studies. For the purpose of this investigation, floristic units are therefore considered representative of the faunal habitat types. Two distinct groups of natural faunal habitats exist in the study area, namely terrestrial grasslands, including cultivated fields, degraded grassland and natural grassland, and wetland habitat types, including channelled valley bottoms, artificial dams, natural dams, endorheic pans, hillslope seepage and un-channelled valley bottoms. These macro-habitats exhibit unique ecological characteristics that influence the faunal communities, assemblages and species that are associated with it. Three faunal habitat types are considered to have a high faunal sensitivity, namely endorheic pans, natural grassland and un-channelled valley bottoms. Channelled valley bottoms, natural dams and hillslope seepage are estimated to have medium-high faunal sensitivities.

Extensive parts of the study area have been transformed and degraded. Most of the study area is characterized by existing impacts associated with commercial crop agriculture and coal mining. These areas

represent transformed faunal habitat and contain, at best, only trace elements of the original ecological characteristics of the region. Remaining untransformed faunal habitats include terrestrial grassland and wetland-associated habitat. Grasslands and wetlands of the study area exhibit high species richness, species diversity, biodiversity value, effective ecological functionality; a high ecological connectivity is noted and these parts should therefore act as refuges for many animal species, including a significant number of threatened taxa.

A total of 88 Red Data animals, excluding birds, are known to occur in the Mpumalanga Province. This includes 26 listed as Data Deficient, 31 as Near Threatened, 20 as Vulnerable, 8 as Endangered and 3 as Critically Endangered. Results of the Red Data assessment indicate that that 69 of these animals have a low probability of occurring in the study area, 10 have a moderate-low probability, 6 a moderate probability and 2 were attributed a high probability of occurring in the study area. Two Red Data wetland animals, the Forest Shrew and Marsh Sylph, are estimated to have a high probability of occurring in the study area. Both these species are well known from the region in which the study area is located and all of their habitat requirements are met within the study area's boundaries. One wetland red data species were confirmed to occur in the study area, namely the Serval.

1.4 AVIFAUNAL ASSESSMENT

The terms of reference for the avifaunal assessment are to:

- provide a general overview of the bird community on the study area with particular reference to the waterbird community (e.g. artificial impoundments and endorheic pans);
- to comment on the probability for threatened, "near-threatened" and conservation important species to occur;
- provide an indication of the avifaunal importance and ecological function of the study area; and
- to provide recommendations and ecological mitigation measures for the proposed development, if ecologically viable.

A site survey was undertaken during 18- 20 July 2011 and 10-13 January 2012 with the aim to evaluate the composition and conservation value of the avifaunal community on the study area. Significant conclusions reached during the survey include the following:

- The study area is characterised by four broad habitat types that range from natural grassland, wetland-associated features (i.e. endorheic pans), agricultural land and exotic plantations;
- The endorheic pans and the southern and central grassland units (Area F, H and I) are regarded as important avifaunal habitat - these areas sustain high bird diversities and species of conservation concern;
- 128 bird species were recorded during the survey and are represented by (1) a community confined to the grassland seres (irrespective of grass composition) and (2) a species-rich community pertaining to areas of open surface water and shoreline habitat;
- The endorheic pans (especially the pans on Area H and the northern parts of Area I) are responsible for > 50 % of the observed avifaunal diversity and support high numbers of waterbird species. In addition, they provide foraging habitat for the globally '"near-threatened' Maccoa Duck (*Oxyura maccoa*) and the regionally "near-threatened" Greater Flamingo (*Phoenicopterus ruber*);
- Six bird species of conservation concern were recorded on the study area. These include the globally "vulnerable" Secretarybird (*Sagittarius serpentarius*), regionally "endangered" African Marsh Harrier (*Circus ranivorus*), globally "near-threatened" Blue Korhaan (*Eupodotis caerulescens*), globally "near-

threatened" Maccoa Duck (*Oxyura maccoa*), regionally "near-threatened" Greater Flamingo (*Phoenicopterus ruber*) and regionally "vulnerable" Lanner Falcon (*Falco biarmicus*);

- Major impacts associated with the proposed mining activities will include:
  - Long-term loss of waterbird habitat caused by construction activities (placement of surface infrastructure) and displacement of bird species occupying adjacent grassland areas;
  - Indirect, long-term impacts associated with the acidification of soils and surface water (acid mine drainage), thereby affecting avifaunal reproduction and mortality, as well as accidental spillage of dirty/wastewater into nearby endorheic/wetland systems; and
  - Possible skewed bird compositions and increased competition due to the creation of artificial habitat (pollution control dams - depending on design) and waste handling facilities.
- A number of recommendations and impacts were also discussed in the main document, including a number of monitoring programs.

2 TERMS OF REFERENCE

The major objective of this Biodiversity Impact Assessment is to establish the presence/absence of ecologically sensitive areas or species within the proposed project area. In order to assist with the planning of the proposed mining activities it is necessary to assess potential impacts of the development on the natural environment (terrestrial biodiversity), provide pertinent comments on the suitability of the area for the proposed project and to provide development guidance to limit impacts as far as possible.

The Terms of Reference for the floristic assessment are as follows:

- Obtain all relevant Précis and Red Data flora information;
- Conduct a photo analysis of the proposed area;
- Identify floristic variations;
- Survey habitat types to obtain a broad understanding of the floristic diversity;
- Assess the potential presence of Red List flora species according to information obtained from SANBI;
- Incorporate existing knowledge of the region into the assessment;
- Describe broad habitat variations present in the study area in terms of biophysical attributes and phytosociological characteristics;
- Compile a floristic sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects;
- Compile relevant Biodiversity Action Plans that will guide operations in terms of the protection of botanically sensitive aspects;
- Provide pertinent development and management recommendations;
- Recommend areas and methods to include in a botanical monitoring programme; and
- Present all results in a suitable format.

The Terms of Reference for the faunal assessment are as follows:

- Obtain available faunal distribution records and Red Data faunal information
- Survey the site to obtain a broad overview of available faunal habitat types;
- Assess the potential presence of Red Data fauna species;
- Incorporate existing knowledge of the region;
- Describe the status of available habitat in terms of faunal attributes, preferences and conservation potential;
- Compile a faunal sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Compile relevant Biodiversity Action Plans that will guide operations in terms of the protection of faunally sensitive aspects;
- Provide pertinent development and management recommendations;
- Recommend areas and methods to include in a faunal monitoring programme; and
- Map all relevant aspects; and
- Present all results in a suitable format.

The Terms of Reference for the avifaunal assessment are as follows:

The information provided in this report was sourced from (1) relevant literature, (2) personal observations obtained from similar habitat types in close proximity to the study site (Pachnoda Consulting, 2011a; 2011b; 2008a; 2008b) and during (2) two site visits, namely July 2011 (dry season) and January 2012 (wet season). The terms of reference for the assessment are to:

- provide a general overview of the bird community on the study sites with particular reference to the waterbird community (*e.g.* artificial impoundments and endorheic pans);
- to comment on the probability for threatened, "near-threatened" and conservation important species to occur;
- provide an indication of the avifaunal importance and ecological function of the study site;
- to provide recommendations and ecological mitigation measures for the proposed development, if ecologically viable;
- Compile relevant Biodiversity Action Plans that will guide operations in terms of the protection of avifaunal aspects;
- Provide pertinent development and management recommendations; and
- Recommend areas and methods to include in an avifaunal monitoring programme.

3 INTRODUCTION

Why is Biodiversity Conservation Important? Biodiversity sustains life on earth. An estimated 40 percent of the global economy is based on biological products and processes (www.unep.org). Biodiversity has allowed massive increases in the production of food and other natural materials, which in turn have fed the (uncontrolled) growth and development of human societies. Biodiversity is also the basis of innumerable environmental services that keep humans and the natural environment alive, from the provision of clean water and watershed services to the recycling of nutrients and pollination (ICMM, 2004). Conservation of biodiversity has taken many different forms throughout history, including setting aside land for such reasons as their rare ecology (endemic or Red Listed species) or exceptionally high species diversity; their critical environmental services, such as watershed protection or evolutionary functions; or their continued use by indigenous peoples who are still pursuing 'traditional' lifestyles based on 'wild' resources.

South Africa is recognized as one of the world's few 'megadiverse' countries. In addition to having an entire floral kingdom, it also includes two globally significant biodiversity 'hot spots' (the Cape and succulent Karoo regions), six Centres of Plant Diversity, two Endemic Bird Areas and the richest temperate flora in the world (Cowling, 2000). Recent increases in human demand for space and life-supporting resources are however resulting in rapid losses of natural open space in South Africa. When natural open space systems are rezoned for development, indigenous fauna and flora are replaced by exotic species and converted to sterile landscapes with no dynamic propensity or ecological value (Wood *et. al.,* 1994). The conservation of critical biodiversity resources and the use of natural resources therefore appear to be two conflicting ideologies.

In 1992, the Convention of Biological Diversity (CBD), a landmark convention, was signed by more than 90 % of all members of the United Nations. The subsequent enactment of the National Environmental Management Biodiversity Act in 2004 (Act No. 10 of 2004), focused on the preservation of biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. The CBD not only considers the protection of threatened species and ecosystems, but also recognizes the importance of using resources sustainably, of ensuring equity in the exploitation of such resources, and of the need for sustainable development in developing countries. This concept seeks to ensure that social and economic development follows a path that enhances the quality of life of humans whilst ensuring the long-term viability of the natural systems (resources) on which that development depends (United Nations Conference on Environment and Development, in Rio de Janeiro, Brazil 1992). In southern Africa, acceptance of the concept of sustainable development has been marked by the ratification of international conventions by most countries, particularly the Convention on Biological Diversity, Ramsar Convention and CITES, as well as the development of SADC-based protocols on environmental issues. However, severe capacity constraints in most countries have made it difficult to translate these policies and concepts into practice.

Transformative developments, mining and other invasive activities in particular, are often viewed as more damaging to the environment than other developments. The biodiversity conservation performance of these types of developments is therefore under increasing scrutiny from NGOs, commentators and financial analysts. In part, this is due to the legacy of industrial environmental neglect, and in part, it is due to the very nature of transformation developments. Losses and impacts associated with these developments require vigilance to ensure that the heritage of future generations – the biological as well as cultural heritage – is not adversely affected by the activities of today. Achieving a balance while doing this requires better understanding and recognition of conservation and development imperatives by all stakeholders, including governments, business and conservation communities.

Despite the significant potential for negative impacts on biodiversity, there is a great deal that companies can do to minimize or prevent such impacts in areas identified as being appropriate for mining. There are also many opportunities for companies to enhance biodiversity conservation within their areas of operations. Being proactive in the assessment and management of biodiversity is important not only for new operations but also for those that have been operating for many years, usually under regulatory requirements that were less focused on the protection and enhancement of biodiversity.

In summary, the threats to biodiversity are compelling. Unless they are addressed in a holistic manner, which considers social and economic as well as scientific considerations, the benefits of ecosystem services will be substantially diminished for future generations. Furthermore, the next 50 years could see a further acceleration in the degradation of ecosystem services unless action is taken to reverse current trends.

4 BRIEF PROJECT SYNOPSIS

Exxaro Matla Coal is an existing underground coal mining operation that began in 1973 and consists of four complexes (Mine 1, Mine 2, Mine 3 and E'Tingweni), situated in the Highveld Coalfields in the Mpumalanga Province of the Republic of South Africa. Matla Coal is proposing to amend their current operations by conducting stooping of certain areas of their historically undermined area and adding two (2) opencast pits along with associated infrastructure.

Matla Coal intends to stoop (to totally extract) pillars at the previously underground mined areas with the intent to reclaim the remaining coal reserves, by using the conventional board and pillar mining method (drill and blast). The proposed activities will occur on certain farms portions within the Matla Coal mining boundary. The proposed project will comprise of nine separate project areas, situated within the Matla mining right area, which is approximately 22,000 ha; however, this will exclude wetlands, rivers, registered servitudes, provincial and national roads and buildings or any other structure or sensitive natural stature protected in terms of national and/or international law.

The reclamation of the remaining coal reserves will utilise most of the existing current operations' infrastructure, but will require additional associated infrastructure (access roads, conveyor belts, water pipelines, power lines, etc). The proposed project targets mainly the 2, 4 and 5 Seam and has been subjected to several external and internal studies. The existing current operations' infrastructure will be utilised for this project with additions where required. Proposed activities that will form part of the proposed Matla Stooping Project will include:

- Mining activities (underground);
- Ancillary infrastructure;
- Offices, Workshops, Diesel storage, Power supply (electricity distribution);
- Water Treatment Plant;
- Water pipelines;
- Pollution control dam, return water dam; and
- Construction of haul roads.

Matla Coal has appointed GCS (Pty) Ltd (GCS) as the Environmental Assessment Practitioner (EAP) to undertake the environmental authorization processes for the proposed development. Bathusi Environmental Consulting cc (BEC) was appointed by GCS as independent ecologists to compile the impact rating reports for the terrestrial biodiversity component of this project.

This EIA report will assess the type, probability and significance of expected impacts on the terrestrial biological environment, ultimately making pertinent recommendations in order to ameliorate the significance of expected impacts, where possible.

For an illustration of the planned layout of operations, the reader is referred to **Figure 2**.

5 METHOD STATEMENT

5.1 ASSESSMENT PHILOSOPHY

Inherent characteristics of an assessment of this nature implies that no applied method will be foolproof, mainly as a result of shortcomings in available databases and lack of site specific detail that could be obtained from limited detailed site investigations conducted over a short period of time. This is an unfortunate limitation of every scientific study - it simply is not possible to know everything or to consider aspects to a level of molecular detail. However, to present an objective opinion of the biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of the study area in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects, namely:

- A desk-top assessment of all available biological and biophysical data;
- Augmentation of existing knowledge by means of site specific and detailed field surveys;
- Specialist interpretation of available data, or known sensitivities of certain regional attributes; and
- An objective impact assessment, estimating potential impacts on biological and biophysical attributes.

The Ecosystem Approach employed for the purpose of this assessment is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

The Ecosystem Approach includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. Species conservation is therefore largely replaced by the concept of habitat conservation. This investigation will therefore aim to:

- Determine the biological sensitivity of the receiving natural environment as it relates to the construction and operation of the plant and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity for the study area;
- Highlight taxa of conservation importance that are likely to occur within the study area;
- Estimate the level of potential impacts of the construction, operation and decommissioning of the proposed development on the biological resources of the study area;
- Apply the Precautionary Principal throughout the assessment[3].

[3] (www.pprinciple.net/the_precautionary_principle.html).

Available databases of biophysical attributes that are known to be associated with biodiversity aspects of importance, conservation potential or natural status of the environment were implemented to compile the ecological sensitivity analysis of the study area. This includes, but is not necessarily limited to the following:

- Areas of known biological importance (ENPAT);
- Geology and soil types;
- Areas of surface water (ENPAT);
- Degradation classes (ENPAT Land Cover Classes);
- Regional vegetation types (VEGMAP);
- Land cover categories (ENPAT); and
- Regional conservation plans (MBCP).

5.2 BOTANICAL ASSESSMENT

The floristic assessment was conducted by R. A. J. Robbeson (Pr.Sci.Nat.).

5.2.1 General Botanical Features

The botanical assessment is based on a variation of the Braun-Blanquet method whereby vegetation is stratified on aerial images with physiognomic[4] characteristics as a first approximation. These initial stratifications are then surveyed for floristic and environmental diversity during a site investigation and ultimately subjected to a desktop analysis to establish differences/ similarities between observed units. In preparation for the site survey, physiognomic homogenous units are identified and delineated on digital aerial photos, using standard aerial photo techniques (downloaded from www.googleearth.com and georectified on Arcview 3.2). A site visit was conducted to examine the general floristic attributes and -diversity of the study area.

A desktop analysis of sample data was conducted to establish differences/ similarities between delineated vegetation units, which were subsequently described in terms of species composition and dominance as well as driving (developmental) environmental parameters. Preliminary results and species lists that are provided should be interpreted with normal liabilities in mind. It is not the intention to provide exhaustive and comprehensive lists of all species that occur on this site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation worthy species and habitat associated with these species are considered the highest priority, the presence of which is most likely to result in significant negative effects on the ecological environment.

5.2.2 Flora Species of Conservation Importance

The purpose of listing Red Data plant species is firstly to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Secondly, the potential occurrence of these species can then be assessed in terms of their habitat requirements in order to determine whether they have a likelihood of occurring in habitats that may be affected by the proposed infrastructure. Red Listed flora information, as presented by SANBI was used as a point of departure for this assessment. A snapshot investigation of an area, such as this particular investigation, represents a severe limitation in terms of locating and identification potential Red Listed flora species.

[4] Physiognomy refers to the visual appearance of vegetation in terms of different growth classes, biomass, height, etc.

Particular emphasis was therefore placed on the identification and assessment of habitat deemed suitable for the potential presence of Red Listed.

It should be noted that Red List species are, by nature, usually rare and difficult to locate. Compiling a list of species that could potentially occur in an area is generally limited by the paucity of collection records and species-specific information, rendering presence predictions extremely complex. All factors considered, the likelihood of encountering Red Data species that are not currently included in available information, cannot be excluded.

5.2.3 Botanical Sensitivity

The aim of this exercise is to determine the inherent sensitivity of vegetation communities or habitat types by means of the comparison of weighted floristic attributes. Results of this exercise are not 'stand-alone' and will eventually be presented in conjunction with results obtained from the faunal investigation.

Each vegetation unit is subjectively rated on a scale of 1 to 10 in terms of selected attributes that could potentially influence the sensitivity of an area. These values are weighted in order to emphasise the importance/ triviality that the individual Sensitivity Criteria have on the status of each community. Ranked Values are expressed as a percentage of the maximum possible value (Floristic Sensitivity Value) and placed in a particular class, namely:

Low	0 %	–	20 %
Medium – low	20 %	–	40 %
Medium	40 %	–	60 %
Medium – high	60 %	–	80 %
High	80 %	–	100 %

This method is considered effective in highlighting sensitive areas, based on observed floristic attributes rated across the spectrum of communities. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics, *e.g.* human impacts, size, fragmentation are important in assessing the status of the various communities, but may vary from area to area.

In order to allow for a direct comparison with other disciplines, the classes assigned to botanical sensitivity is further divided into the following categories (refer **Table 2**):

Table 2: Botanical Sensitivity Categories

Sensitivity Value	*Calculated Botanical Sensitivity*	*Sensitivity Category*
1	Low Sensitivity	Highly Suitable
2		Low Sensitivity
3	Medium-low Sensitivity	Suitable
4	Medium Sensitivity	Medium Sensitivity
5		Medium Suitable
6	Medium-high Sensitivity	Sensitive
7		Low Suitability
8	High Sensitivity	Highly Sensitive
9		Restricted

5.3 FAUNAL ASSESSMENT

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.). The faunal assessment is based on holistic ecological principles and included qualitative surveys across the major habitat types of the study area. This approach prefers holistic biodiversity conservation to single species conservation; the focus is therefore on sensitive faunal habitats rather than single Red Data species; these two approaches often coincide, but not always. It is important to note that the study area was not considered in isolation, linkage to surrounding natural faunal habitats represents an important consideration in the assessment of conservation value of an area. Within an ecological consideration, there is no difference in importance between species found in a system and the interactions between these species. Therefore, this assessment also focused on assessing the status of available faunal habitats; the sensitivities of these habitats are therefore based on the status of each habitat as well as the level of isolation because of habitat transformation and fragmentation.

5.3.1 Ad Hoc Faunal Observations

Animals found within the study area's boundaries were identified using ad hoc visual observations, ecological indicators (tracks, dung, diggings, etc.), morphological characteristics (colour, size, shape etc.) and species-specific calls (especially for birds and frogs).

5.3.2 Data Analysis

- All GPS acquired data is converted from text to shapefiles to allow GIS analyses, where possible.
- Shapefiles of environmental attributes such as geology, soil, hydrology and vegetation are incorporated in the analyses of available faunal habitats.
- Sensitivity maps are compiled, where relevant, subsequent to data analyses.
- Species lists are compiled for relevant taxa using fieldwork data, literature and data supplied by various other institutions and specialists.

5.3.3 Red List Fauna Probabilities

Three parameters are used to assess the Probability of Occurrence for Red Listed species:

- Habitat requirements (HR) - Red Listed animals have specific habitat requirements and the presence of these habitat characteristics in the study area is evaluated.
- Habitat status (HS) - The status or ecological condition of available habitat in the study area is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Listed species (especially wetland-related habitats where water quality plays a major role); and
- Habitat linkage (HL) - Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Listed species within the study area.

The estimated Probability of Occurrence for Red Data fauna species is presented in five categories, namely:

- Very low;
- Low;
- Moderate;

- High; and
- Very high.

5.3.4 Faunal Habitat Sensitivities

Faunal habitat sensitivities are subjectively estimated based on the following criteria:

- Habitat status;
- Connectivity;
- Observed species composition & RD Probabilities; and
- Functionality.

and is place in one of the following classes:

- High;
- Medium-high
- Medium;
- Medium-low; or
- Low.

A similar approach to the assignment of sensitivity values of the botanical assessment are implemented in this faunal assessment.

5.4 AVIFAUNAL ASSESSMENT

The faunal assessment was conducted by L. Niemand (Pr.Sci.Nat.), which included qualitative surveys across major habitat types observed in the study area.

5.4.1 Literature Survey & Information Base

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the fieldwork exercise. These will include the following (although not limited to):

- Hockey *et al.* (2005) was consulted for general information on bird identification and life history attributes;
- Barnes (2000) and the IUCN Red List of Threatened Species, Version 2011.1 (2011) were consulted for information regarding the conservation status of selected bird species;
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison *et al.* (1997) for species recorded from the quarter-degree square (QDS) 2629AC Kinross. The SABAP1 data provides a "snapshot" of the abundance and composition of species recorded within a quarter degree square (QDS) which was the sampling unit chosen. It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDSs were surveyed between 1987 and 1991; and
- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.adu.org.za). Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min lat x 5 min long, equating to 9 pentads within a QDS). Therefore, the data is more site-specific, recent

and more comparable with observations made during the site visit (due to increased standardisation of data collection).

- Previous environmental impact assessment reports with reference to Pachnoda Consulting (2011a; 2011b; 2008a; 2008b).

5.4.2 Site Visit

Two site visits were conducted, namely during July 2011 and January 2012, to familiarise the author with the different habitat types on the study site and their respective ecological condition. During the site visits, an inventory of bird species was compiled and, where necessary, verified using Roberts Birds of Southern Africa, VIIth ed. (Hockey *et. al*. 2005).

The occurrence of bird species was also recorded by means of their calls and other signs such as nests, discarded egg shells (Tarboton, 2001), feathers and even roadkills (when encountered). Particular attention was paid to suitable roosting, foraging and nesting habitat for threatened, near-threatened and endemic species.

Bird data were also collected by means of 23 point counts (see Buckland *et. al.,* 1993) to provide an overview of the dominant species (according to Clarke & Warwick, 1994) on the study site and to identify areas (*e.g.* pans) with high waterbird numbers.

5.4.3 Limitations & Assumptions

In order to obtain a comprehensive understanding of the dynamics of terrestrial communities, as well as the status of endemic, rare or threatened species in any area, avifaunal assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and more often based on instantaneous sampling bouts.

The investigation surveys coincided with both the austral summer and winter periods in order to allow for seasonal variation in species presence/ absence. However, due to inherent limitations of EIA type surveys, this report and results cannot be regarded as conclusive or comprehensive. Long-term and detailed surveys over a period of several seasons are likely to reveal a higher diversity of species than indicated in this report. However, for the purpose of the EIA assessment, observations are regarded sufficient to provide conclusions and recommendations for the inclusion in the EIR report.

5.4.4 Avifaunal Sensitivity

The avifaunal sensitivity of any piece of land is based on its inherent ecosystem service (*e.g.* wetlands) and overall preservation of biodiversity. In addition, the sensitivity of any piece of land is a key consideration when identifying impacts.

- **Ecological Functionality**

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity or with extensive grassland and drainage systems amongst one another are perceived to be more sensitive and will be those contributing to important avifaunal flyways or overall preservation of bird diversity.

- **Avifaunal Importance**

Avifaunal importance relates to species diversity, endemism (unique species or unique processes) and the presence of topographical features or primary undulating grassland with the intrinsic ability to sustain threatened and species protected by legislation.

- **Sensitivity Scale**

High – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity (*e.g.* pans). Most of these systems represent ecosystems with high connectivity with other important bird flight paths OR with high bird diversity while providing suitable habitat for a number of threatened or rare species. These areas should be protected;

Medium – Slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and

Low – Degraded and highly disturbed/transformed systems with little ecological function and are generally poor in species diversity (most species are usually exotic or weeds).

A similar approach to the assignment of sensitivity values of the botanical assessment are implemented in this faunal assessment.

5.5 IMPACT EVALUATION

Impact assessments will be compiled for each of the disciplines respectively.

5.5.1 Construction Phase

The following activities will be included in the specialist study. The main construction activities for the infrastructure mentioned above that will have an impact on the biophysical environment will be:

- Footprint clearance;
- Establishment of infrastructure; and
- Waste Handling

5.5.2 Operational Phase

For the operational phase, the following activities will be included, and ranked per table:

- Stooping Activities – underground mining of coal;
- Coal product stockpiling;
- Conveyor Belts – transporting of coal;
- Coal product crushing;
- Control of clean and dirty water (pollution control dams, clean/dirty water separation infrastructure, stormwater, sewage); and
- Waste generation & handling;
- Hydrocarbon storage.

5.5.3 Closure & Decommissioning Phase

For the closure phase the following activities will be included, and ranked per table:

- Removal of infrastructure;
- Rehabilitation; and
- Residual impacts post closure.

In order to assess these factors for each impact, the following ranking scales are implemented (refer **Table 3**):

Table 3: EIA Ratings used in this assessment

Probability	*Duration*	*Scale*	*Magnitude*
5 - Definite/ don't know	5 - Permanent	5 - International	10 - Very high/ don't know
4 - Highly probable	4 - Long term (ceases with the operational life)	4 - National	8 - High
3 - Medium probability	3 - Medium term (5-15 years)	3 - Regional	6 - Moderate
2 - Low Probability	2 - Short Term (0-5 years)	2 - Local	4 - Low
1 - Improbable	1 Immediate	1 - Site only	2 - Minor
0 - None		0 - None	

Once the above factors have been ranked for each impact, the environmental significance of each impact can be assessed using the following formula:

SP = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). Environmental effects were rated as either of high, moderate or low significance on the following basis:

- More than 60 SP indicate High (H) environmental significance.
- Between 30 and 60 SP indicate Moderate (M) environmental significance.
- Less than 30 SP indicate Low (L) environmental significance.

6 BACKGROUND TO GRASSLAND ECOLOGY

From: Mpumalanga Biodiversity Conservation Plan Handbook (2007).

Grassland defines itself: landscapes dominated by grass. Although grasses are the most visible plants, grasslands have a higher diversity than simply grasses. In particular, those with belowground storage organs such as bulbs or tubers produce many of our spectacular wild flowers and contribute to biodiversity that is second only to the Cape Fynbos in species richness. Grassland species are particularly well adapted to being defoliated, whether by grazing, fire or frost. Repeated defoliation, within reason, does not cause real harm to such plants nor does it reduce productivity.

African grasslands are particularly old, stable and resilient ecosystems. Most plants are perennials and surprisingly long lived, with very few annual species, which are the pioneer plants needed to repair disturbance. This makes our grasslands vulnerable to destruction by cultivation; once ploughed they are invaded by weedy pioneer plants that are mostly alien. Although many grassland plants do produce seed, very little germinates, most being used as vital food for their rich rodent and insect fauna. Mpumalanga's grasslands are mainly found in the highveld above 1,000 m. These are cool, dry open landscapes, with rainfall of over 500 mm/yr. Frost, hailstorms and lightning strikes are common. The natural occurrence of fire and other defoliating events favour grassland plants over woody species and help maintain the open treeless character of grasslands.

Grasslands have shallow-rooted vegetation with a growing season limited to about six months of the year. The non-growing seasons are characterised by cool and dry conditions, during which time most foliage is removed or killed by frost, and dies back to ground level.

Large parts of our grasslands occur on deep fertile soils of high agricultural value. Much of this landscape has already been converted to crops, timber or intensive animal production. The unproductive winter and spring seasons in grassland require agricultural strategies for livestock and cultivation that bridge this gap in economic productivity. Crop rotation, cultivated pastures and fallow intervals, as well as supplementary feeding of livestock, including the use of crop residues, are all part of good farming practice in these regions. Grasslands originally covered 61 % of Mpumalanga, but 44 % of this has been transformed by agriculture and other development. This substantial and irreversible reduction of the biome is due mainly to cultivation, especially industrial scale agriculture and timber growing. These land uses destroy biodiversity but extensive livestock grazing can be reasonably biodiversity-friendly, provided good management and safe stocking rates are applied.

The palatability of grass and its value as food for livestock increases with decreasing rainfall, which is also correlated with altitude. In grazing terms, this corresponds to Sourveld in the moist highveld and sweetveld in the dryer lowveld. This grass palatability gradient extends from grassland into savannas. Although sweetveld grasses produce less biomass than sourveld grasses, they have higher food value and lower fibre. This means the plant nutrients are more available in lower rainfall areas due to less leaching of the soil by high rainfall. The 650 mm rainfall isoline approximately separates these two livestock zones. Fire is a characteristic feature of grassland (and savannas) and is a necessary component of good land management. Grassland plants depend on fire, they resprout annually from their rootstocks.

Without frequent fire, grasslands eventually become invaded with woody species and some herbaceous plants die. Regular burning to complement good grazing management helps to prevent the increase of

species unpalatable to livestock, including woody species that form bush encroachment. Timber growing is mainly restricted to grasslands but its impact is not limited to the plantation "footprint". It significantly reduces surface and underground water and causes the spread of some of the most damaging alien species. These effects, along with flammability of its tree species and the fire protection measures required, also substantially change the fire regime in grasslands. The large number of rare and endangered species in grasslands is a particular problem for environmental impact assessment. They are mostly small, very localised and visible for only a few weeks in the year when they flower. Most surveys will not pick them up and special skills are required to locate and identify them reliably. Highest biodiversity is found in rocky grassland habitats and on sandy soils. Clay soils generally have the lowest biodiversity in grasslands.

6.1 SENSITIVE LANDSCAPES OF THE GRASSLAND – ENDORHEIC PANS

Pans are easily defined ecosystems, typical oval to round in shape and shallow, even when fully inundated, which is characteristically ephemeral. Waterloss from pans is largely due to evaporation. The term endorheic refers to the closed (no outlet) nature of the drainage system of pans. Factors influencing pan formation are complex of nature, including the availability of geologically susceptible surfaces, the disturbance of the surface by animals and by salt weathering, the lack of integrated drainage systems as well as deflational processes including wind. Four basic factors are implicated in pan distribution, namely bedrock, drainage, slope and climate.

The climate of Transvaal varies markedly on an east-west gradient. Average annual rainfall increases and the average annual evaporation rate decreases, from west to east. This high variation in the climatological conditions of the Transvaal profoundly affects the nature and functioning of endorheic pans in this region.

Ninety-seven plant species have been recorded at the endorheic pans in the Transvaal highveld. Pans in the eastern and western highveld have the highest diversity of plant species and are represented by 81 and 58 species respectively, with the central highveld having 31 species of which only 3 % were restricted to pans of the central Transvaal. Seventeen species (20 %) were shared by pans in all three regions.
Based on vegetation characteristics, three pan types are recognized, namely Reed pans, Sedge pans and Open pans, with a considerable overlap in common plant species. Eleven plant species present at the reed pans are shared with open pans as common plants at both and eight species are shared with both sedge and open pans as common at all three pan types. Only one species present at sedge pans is shared with open pans as a common plant. A close association is noted between open and reed pans and this is probably due to these open pans holding water virtually permanently and therefore supporting plants typical of the permanent reed pans. The clear isolation between sedge and reed pans reflects the atypical characteristics of their vegetation.

Only two faunal components have received much research attention. These are aquatic invertebrates and avifauna. Both these distantly related forms show life-history strategies adapted to the difficulties in inhabiting ephemeral and unpredictable habitats. This, however, is achieved in widely different ways. Aquatic invertebrates have hardy stages of their life cycles, able to withstand prolonged desiccation while responding quickly to inundation. Waterbirds overcome the problems of habitat desiccation and unpredictable inundation by their unique mobility.

The wide variety of aquatic invertebrates associated with temporary pans have opportunistic lifestyles and unique adaptations against extreme temperatures and prolonged desiccation and they are able to reproduce

within an extremely short periods. Although fish are generally absent from the majority of pans in the Transvaal (former), some of the larger and more permanent pans have introduced alien fish species.

Relatively little is known about the amphibians and reptiles of endorheic pans, but the importance of ephemeral pans in the grassland biome is pointed out as important habitat for the threatened bullfrog (*Pyxicephalus adspersus*).

Birds are the most conspicuous utilizers of pans and exploit the habitats for feeding, drinking, roosting, moulting and breeding sites. No species is entirely restricted to pan habitat, but some species, such as the whiskered tern, are characteristic of such habitat and before the construction of dams, probably were largely restricted to inundated pans. Small mammals can be an important faunal component of many pans and their role in affecting the ecology of these ecosystems has been indicated.

True reed pans are the most permanent of all the pan types and they usually retain water throughout the year, even during droughts. Sediment of the reed pans contains mainly clay and silt with high levels of organic material. Water is relatively deep.

Sedge pans are semi-permanent, usually drying up during the winter or at least during dry periods. Their substratum is shallow soil or exposed bedrock. Although water in the basin is relatively shallow, some of the larger pans exceed 4 m in depth when full.

6.2 GRASSLAND THREATS & CONSERVATION

The grassland biome contains some of the most threatened vegetation types in South Africa. It is estimated that 60 to 80 % of South African grasslands have already been irreversibly transformed by agriculture, forestry, urban and industrial development and mining. An alarmingly low 2 % of the remaining pockets of pristine grasslands – areas of surprisingly high plant and animal diversity – are formally under conservation in 142 publicly owned nature reserves. On the positive side, by correlation of the geographic distribution, the 3,378 plant species found in the grassland biome, and the distribution of these nature reserves, it is estimated that 78 % of these species are indeed represented in conservation areas.

A reason for concern is the extensive commercial afforestation over large areas of land in the high rainfall eastern Escarpment area, a region of exceptionally high biodiversity, which contains 30 % of the endemic and rare plant species of the former Transvaal Province. While it is too late to bring back the large migratory herds of grassland herbivores, it is imperative that the existing reserve network be maintained and expanded to conserve viable populations of South Africa's unique grassland species. The first step is to alert the South African public to the fact that a hitherto disregard heritage is slipping away. Warwick Tarboton, an eminent South African ornithologist, expressed it succinctly:

'If ever a biome needed a champion, it is the grassland'

7 THE BIOPHYSICAL ENVIRONMENT

7.1 LOCATION

An illustration of the regional setting of the study area is presented in **Figure 1**. Aerial images were downloaded from www.googleearth.com and georeferenced using Arcview GIS 3.2a, illustrated in **Figure 2**. Dates of the images that were downloaded are as recent as 2011 and 2010. The largest extent of the study area is however depicted by images from 2007, which implies that a certain measure of habitat change has occurred that is not accurately captured on the images; visual observations during the field surveys confirmed these changes in some parts of the study area. The paucity of detailed and recent images resulted in some inaccuracies of the maps that were produced during this assessment. To some extent, these inaccuracies were corrected during the ground truthing phase of the project.

The study area is situated approximately 15 km south of Ogies, 12 km northeast of Leandra and 13 km west of Kriel. The original (principal) study area comprises approximately 21,000 ha; the respective sizes of the stooping areas are presented in **Table 4**, totalling approximately 7,333.5 ha. Two district municipalities are spatially represented within the various stooping areas, namely the Emalahleni and Govan Mbeki District Municipalities. Farms spatially represented within the respective development portions are presented in **Table 5.**

Table 4: Footprint sizes & district placement of respective stooping areas

Stooping Area	*Footprint Size (ha)*	*District Municipality*
Area A	237.6 ha	Emalahleni District Municipality
Area B	291.0 ha	Govan Mbeki District Municipality
Area C	114.5 ha	Emalahleni District Municipality
Area D	173.0 ha	Emalahleni District Municipality
Area E	192.3 ha	Govan Mbeki District Municipality
Area F	1,327.8 ha	Govan Mbeki District Municipality
Area G	299.7 ha	Emalahleni District Municipality
Area H	594.8 ha	Emalahleni District Municipality
Area I	4,102.8 ha	Emalahleni District Municipality

Table 5: Farms spatially represented within the various stooping areas

Farm Name	*Development Portion*
Bakenlaagte 84	Area I
Grootpan 86	Area H
Kortlaagte 67	Areas A, B, C, E & F
Kuisementfontein 95	Area I
Matla Power Station 141	Area I
Moedverloren 88	Area I
Nooitgedacht 37	Area I
Onverwacht 97	Areas A & I
Rietfontein 100	Area I
Rietvlei 64	Areas C & D
Uitvlugt 255	Area A
Vierfontein 61	Areas C, D, G & H
Weltevreden 307	Area F

Figure 1: Regional setting of the study area

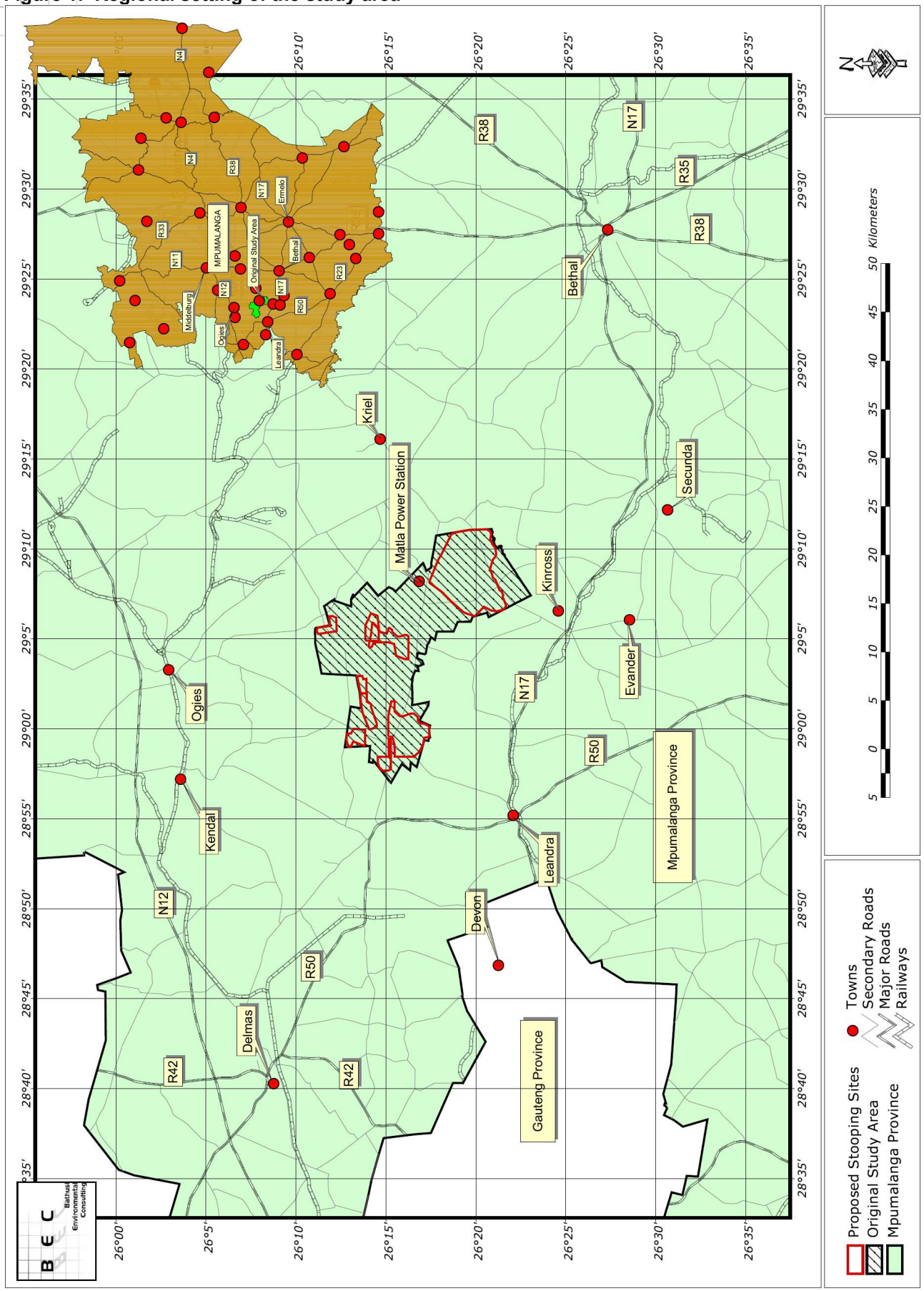
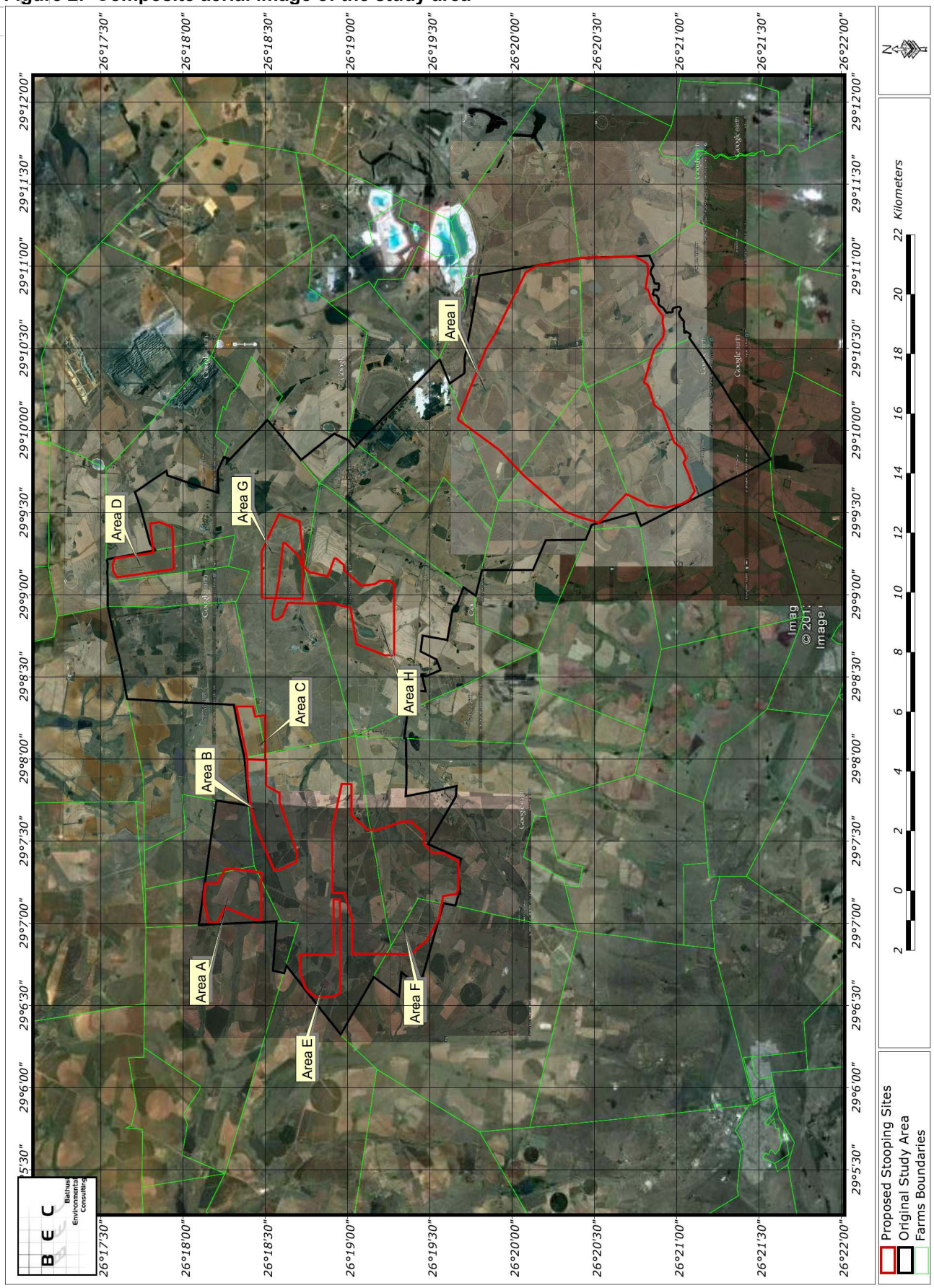


Figure 2: Composite aerial image of the study area



Images courtesy of www.googleearth.com

7.2 LAND COVER & LAND USE OF THE REGION

Land cover categories are presented in **Figure 3**. The respective stooping areas are situated within the Govan Mbeki and Emalahleni District Municipalities (refer **Table 4**). Summarised information for these municipalities is as follows:

- Govan Mbeki DM comprises approximately 295,496 ha, of which 182,735 ha (61.8%) is regarded untransformed (38.2 % transformed). No formally protected conservation areas or Ramsar sites are spatially present within this district municipality; and
- Emalahleni DM comprises approximately 267,761 ha, of which only 137,489 ha (51.3%) is regarded untransformed (48.7 % transformed). The Witbank Nature Reserve (889.1 ha, 0.33 %) is the only formally protected area. No Ramsar sites are spatially present within this district municipality.

For the purpose of this assessment, land cover is loosely categorised into classes that represent natural habitat and other categories that are characterised by degraded and transformed habitat types (most often the result of anthropogenic impacts). In terms of the importance for biodiversity, the assumption is that landscapes exhibiting high transformation levels will be occupied by communities and assemblages that are unlikely to reflect the original or pristine status or comprise of a high proportion of 'natural' species and habitat types. This is particularly important in the case of conservation important taxa as these plants and animals generally exhibit extremely low tolerances levels towards disturbances. The loss of natural habitat is not only one of the major (continued) threats to conservation important species, but also one of the major causes of their threatened status.

Three important aspects are associated with habitat changes that accompany certain land uses. Habitat transformation that follows anthropogenic activities such as agriculture, mining and urbanisation, results in permanent decimation of natural habitat, which is unlikely to recover to the original pristine status. A second aspect of habitat transformation or degradation is that it affects species directly, namely species presence, absence and community composition. This result from the exodus of species for which habitat conditions have become unfavourable, the decrease in abundance of certain species because of decreased habitat size, or an influx of species that are better adapted to the altered environment. While some, or most, of the new species that occupy an area might be indigenous, they are not necessarily endemic to the affected area. Lastly, a larger threat to the natural biodiversity of a region is represented by the influx and proliferation of invasive and/ or exotic species that can effectively sterilise large tracts of remaining natural habitat.

The mosaical appearance of land cover of the landscape (refer **Figure 3**, also refer **Figure 2** for a visual representation) strongly reflects the severe transformation effect of commercial agriculture (commercial maize production). This highly transformed status represents one of the major reasons for the 'Endangered' conservation status ascribed to the regional ecological type (refer **Section 9.1**). Road infrastructure in the region, similarly, caused a moderate level of habitat fragmentation. Commercial agriculture (dry land maize production) and cattle grazing represents the major land use categories of the region, while mining and associated industrial land use activities secondarily contributed to habitat transformation on a local and regional scale. These anthropogenic influences resulted in the creation of highly fragmented portions of remaining natural habitat, characterised by a high degree of isolation.

The general region consists primarily of a combination of 'Cultivated land' and 'Untransformed grassland', which is strongly associated with ecotonal wetland/ grassland interface. Evidence from aerial images as well as ENPAT data indicates the extremely high transformation levels of the larger region. Agriculture is largely responsible for the loss of natural habitat on a local and regional scale. Most, if not all, of available arable

land has been cultivated, remaining areas comprises either small, isolated areas of remaining natural grassland, or wetland habitat types. Furthermore, many of the portions currently classified as 'Untransformed grassland' are currently subjected to agricultural practices that result in severe deterioration thereof, to the extent that many portions can effectively be regarded as transformed beyond the point of recovery to a natural state.

Little urban development is noted in the region, but the presence of mining and industrial activities to the east of the study area indicates that the status of the region is likely to change significantly in the near future, enhancing current pressures on remaining natural habitat of the region.

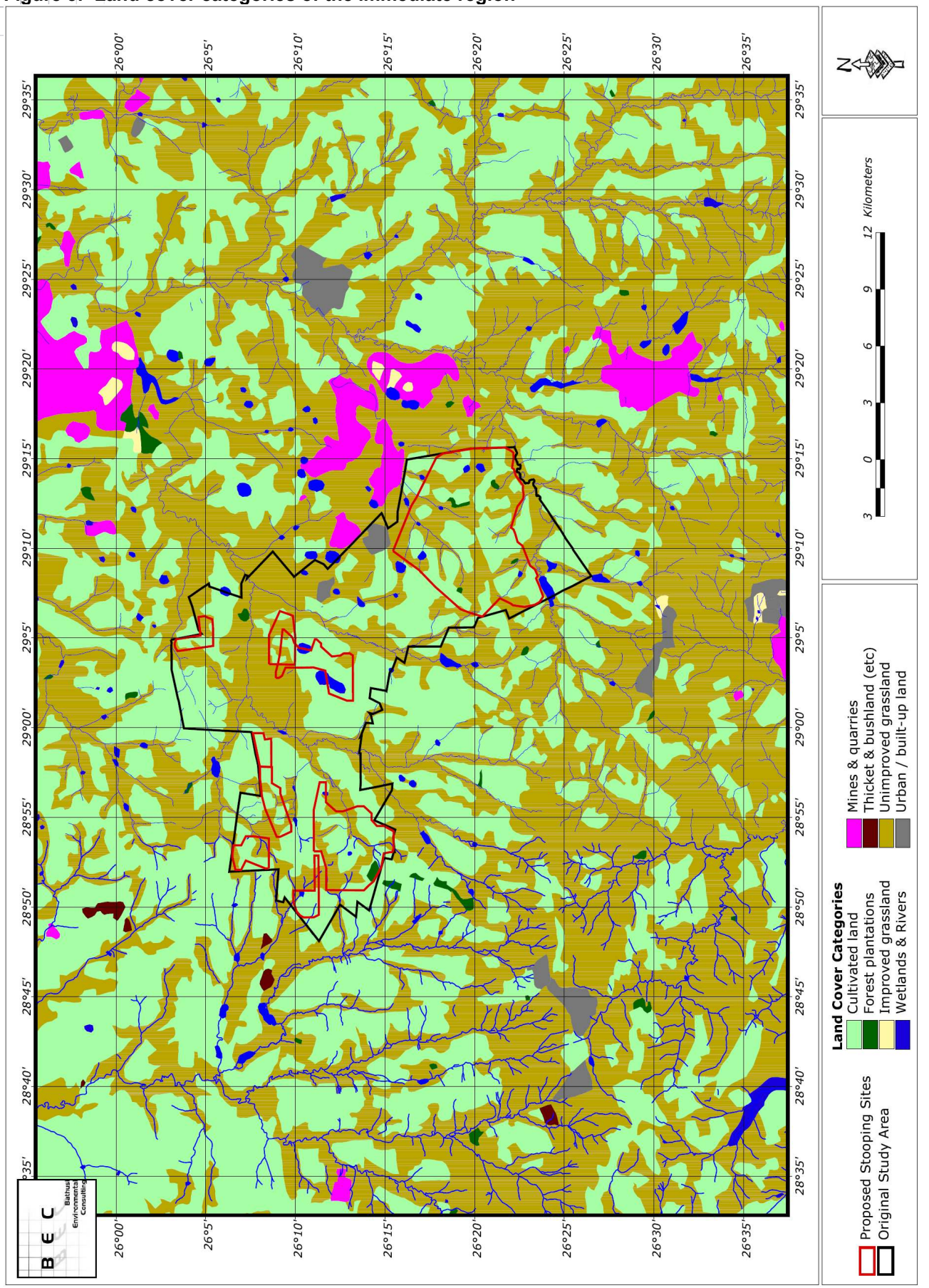
The extent of wetland related habitat, similar to natural grassland, is not accurately reflected on the ENPAT and regional databases (mostly because of the regional scale implemented in the assessments). Numerous smaller rivers drainage lines and dams are present throughout the study area, showing a strong affinity with remaining portions of natural grassland habitat. These areas remain natural, relatively unaffected by transformation activities because they are not arable; however, visual observations indicate severe grazing pressure from cattle. Grazing pressure, coupled with the degradative physical actions of cattle, results in severe impacts on most of these areas.

In most cases, as with the ENPAT database, the depiction of grassland however represents an overestimation of the true extent of remaining natural (pristine) grassland habitat in the region. This statement is based on the following:

- The current land cover, as presented in ENPAT does not accurately reflect the current land cover status in all instances; in particular, recent agricultural activities and localised stands of exotics are not accurately captured within the existing data (*pers. obs*.); and
- The status of much of the remaining portions of 'natural grassland' is not accurately summarized in the assessment. These 'natural grasslands' frequently comprehend poor quality grassland or even pastures that exhibit severely altered species compositions and depleted diversity that does not reflect the natural grassland of the region (*pers. obs*.).

By inclusion of portions of other land cover categories, sub-climax grassland types in particular, within the category of 'Natural Grassland' a fallacious view is created of the extent of remaining natural (pristine) grassland habitat in the region. It is therefore likely that remaining untransformed grassland habitat is much lower than initially assumed. Ultimately, the greater region is characterised by high levels of habitat transformation, isolation and habitat fragmentation, resulting from persistent increases in agricultural activities, urban developments, linear infrastructure and industrial related activities.

Figure 3: Land cover categories of the immediate region



7.3 SURFACE WATER

Please note that hydrology, wetland and aquatic habitat disciplines are addressed as separate specialist reports. Brief comments to these disciplines are however included in this report as some aspects do relate to the local and regional biodiversity.

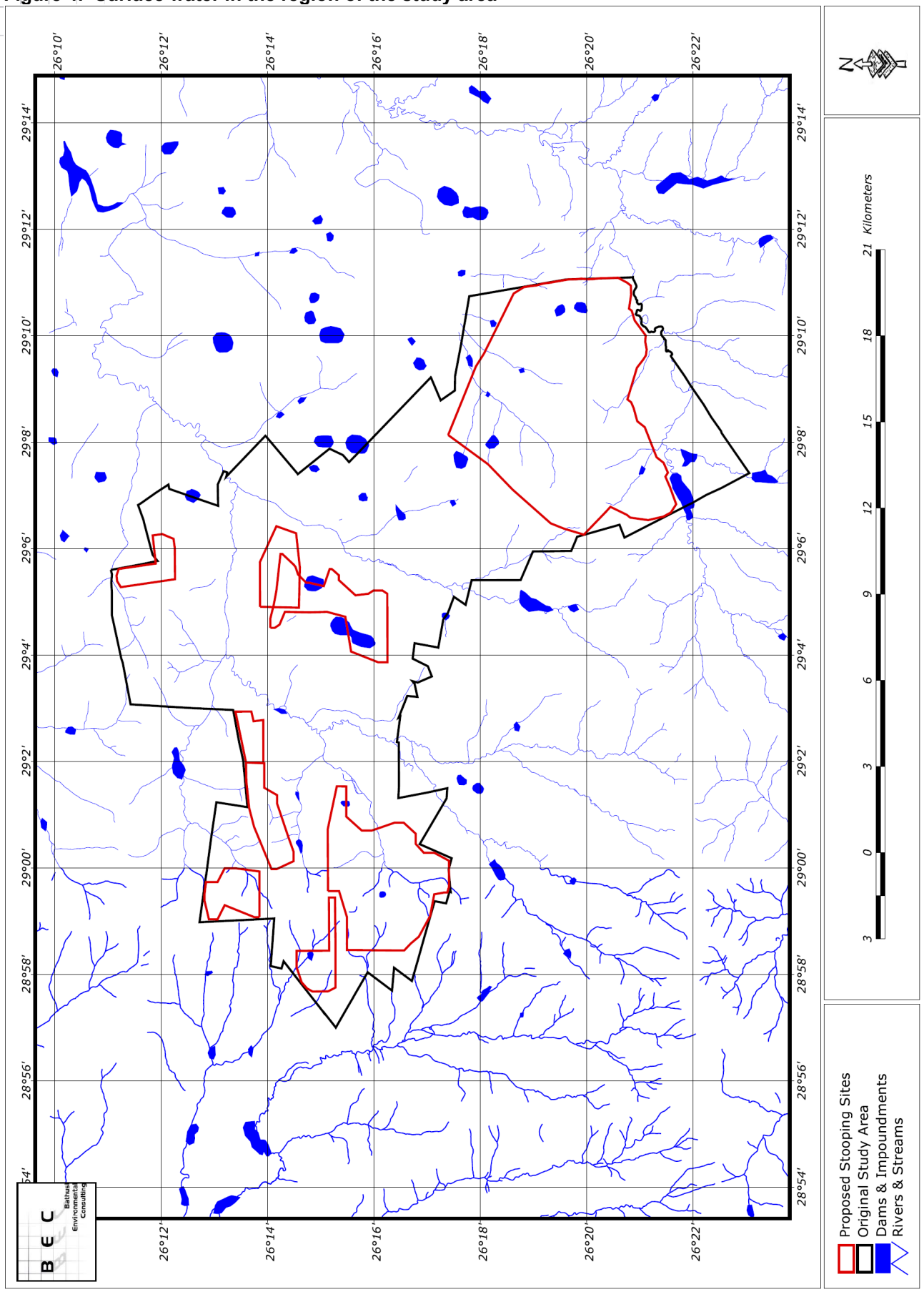
Water, salt and processes linked to concentration of both are the major controls of the creation, maintenance and development of peculiar habitats. Habitats formed in and around flowing and stagnant freshwater bodies, experiences waterlogging (seasonal or permanent) and flooding (regular, irregular or catastrophic), leading to formation of special soil forms. Habitats with high levels of salt concentration form a highly stressed environment for most plants and often markedly affect the composition of plant communities. Invariably, both waterlogged and salt-laden habitats appear as 'special', deviating strongly from the typical surrounding zonal vegetation. They are considered to be of azonal character (Mucina & Rutherford, 2006). Water, in conjunction with geology, soil, topography and climate, is responsible for the creation of remarkably many types of habitats. Water chemistry, temperature and temporary changes in both, together with the amount of water (depth of water column), timing of occurrence (regular tides or irregular floods) and speed of its movement (discharge, flow and stagnation) are the major factors shaping the ecology of biotic communities occupying such habitats.

Areas of surface water contribute significantly towards the local and regional biodiversity due to atypical habitat that is present within ecotonal areas. Ecotones (areas or zones of transition between different habitat types) are occupied by species occurring in both the bordering habitats, and are generally rich in species due to the confluence of habitats. In addition to daily visitors that utilise the water sources on a frequent basis, some flora and fauna species are specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas, exhibiting extremely low tolerance levels towards habitat variation. Ecotonal interface areas form narrow bands around areas of surface water and they constitute extremely small portions when calculated on a purely mathematical basis. However, considering the high species richness, these areas are extremely important on a local and regional scale. Rivers also represent important linear migration routes for a number of fauna species as well as a distribution method for plant seeds.

The study area falls within the upper reaches of the Olifants-North Primary Catchment areas, specifically the B20E, B11E and B11D Quarterny Catchments. A number of wetland habitat types are present within the site, including perennial and non-perennial drainage lines, rivers, hillslope seepages, channelled and unchannelled valleybottoms, dams, and endorheic pans. **Figure 4** presents a rough illustration of the occurrences of these habitat types within the immediate region of the study area[5]. The proximity of wetland habitat types to certain terrestrial grassland habitat types is expected to influence the sensitivity of the various areas. Viewed in isolation, these areas are regarded highly sensitive and important in terms of biodiversity attributes and generally represent the last stronghold of relatively untransformed habitat within a highly fragmented region that is characterised by intensive agriculture and mining activities. No major rivers, dams or wetlands are situated within the study area, however, it is mentioned that a large endorheic pan is situated in the central part of the study area.

[5] For a detailed illustration and description of the presence, variability and location of all wetland habitat types within the study area, the reader is referred to the wetland specialist report (Wetland Consulting Services, D. Kassier)

Figure 4: Surface water in the region of the study area



7.4 TOPOGRAPHY, RELIEF AND SLOPES

The presence of variable habitat types is particularly important in providing for the habitat preferences and requirements of a high diversity of species, both fauna and flora. Hills and ridges have generally been shown to be rich in biodiversity, also representing an important habitat type for sensitive species (GDARD, 2001).

The study area is divided into two land morphological categories that are similar in broad physical appearances, namely 'Slightly irregular undulating plains and hills' and 'Moderately undulating plains and pans' (**Figure 5**). No habitat of significant physical variability, such as ridges, mountains, escarpments or hills, are present within the study area and the topography is relatively flat or slightly undulating. The most significant geomorphical attribute of the study area is the presence of low outcrops situated to the south of Stooping Area I.

Various shallow drainage lines intersect the landscape. Altitude varies between 1,555 and 1,655 meters above sea level. Highpoints of the study area are located in the western part and the south central area. Low-lying areas are located in the central parts and the southern sections. A basic assessment of the drainage and contours of the study area indicates the presence of several local watersheds in the study area. These local highpoints are important on a local scale, determining the direction of waterflow on a local scale.

7.5 GEOLOGY

The geology of the study area conforms mostly to the Vryheid Arenite Formation with fragments of Karoo Dolerites in the southern part of the study area (refer **Figure 6**). Arenite is a sedimentary rock composed of sand-sized fragments irrespective of composition. The Vryheid Formation follows conformably, and in most localities by way of a transition, on the Pietermaritzburg Shale Formation, from the southern part of Natal northwards. The formation is characterized by thick beds of yellowish to white cross-bedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale and a few seams of coal.

Karoo Dolerites are dark-grey to nearly black, dense igneous rock, popularly known as "ysterklip", which invaded the rocks of the Karoo Sequence on a grand scale, especially in the Great Karoo, where it built mesas, buttes and hogbacks. The occurrence and the distribution of this rock are therefore mainly limited to the central Karoo basin and the adjoining areas. Dykes are present almost everywhere. A few have penetrated the Drakensberg Basalt, although most of them apparently stop at the base of the Drakensberg Formation. The texture of Dolerites varies appreciably. Most are fine- to medium-grained, but coarse-grained types are also found. Porphyritic varieties, with phenocrists of plagioclase, are frequently encountered and basaltic glass is sometimes found. Important outcrops of this formation are present in the southern part of the study area.

Figure 5: Topographical features of the study area

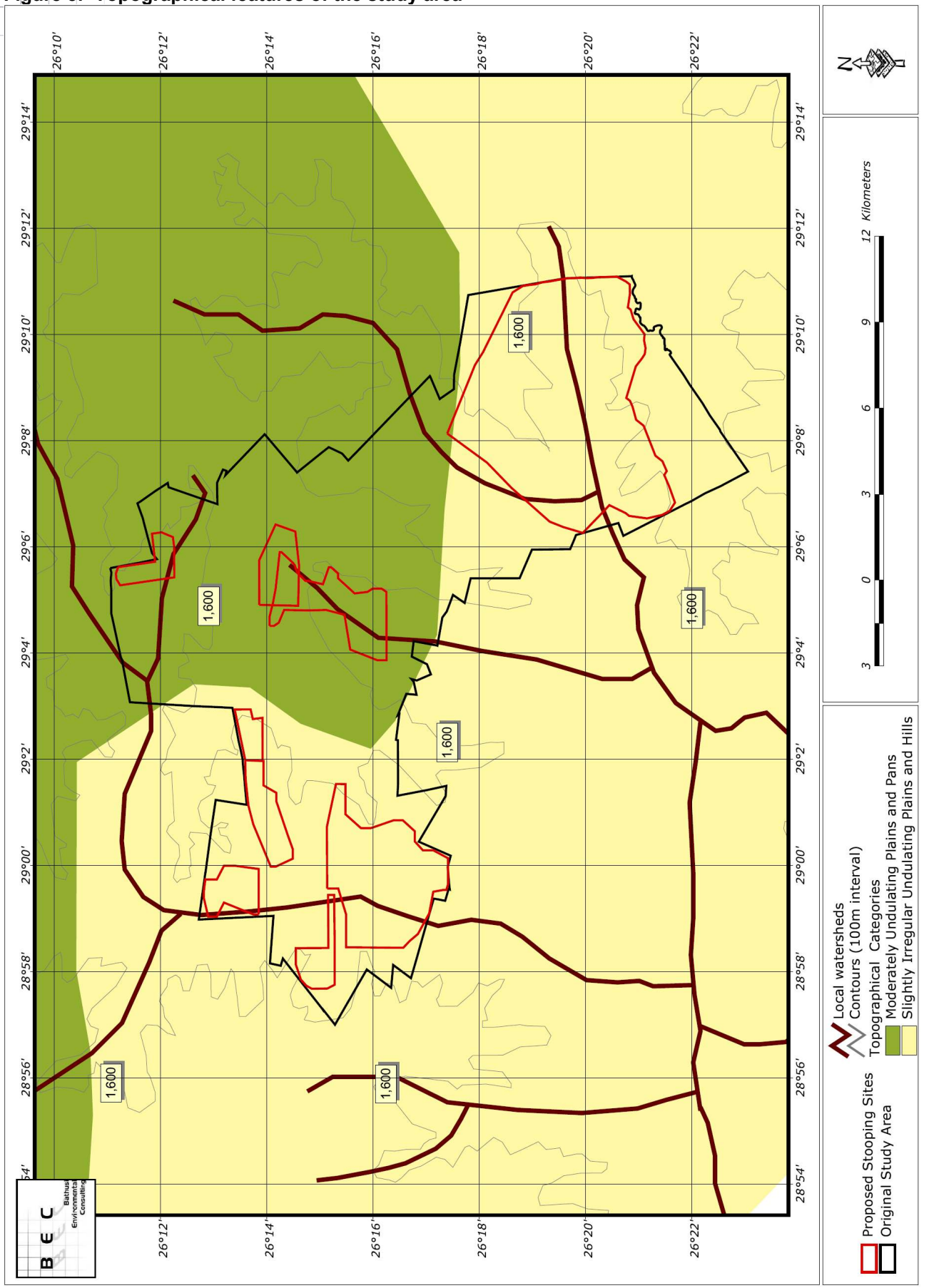
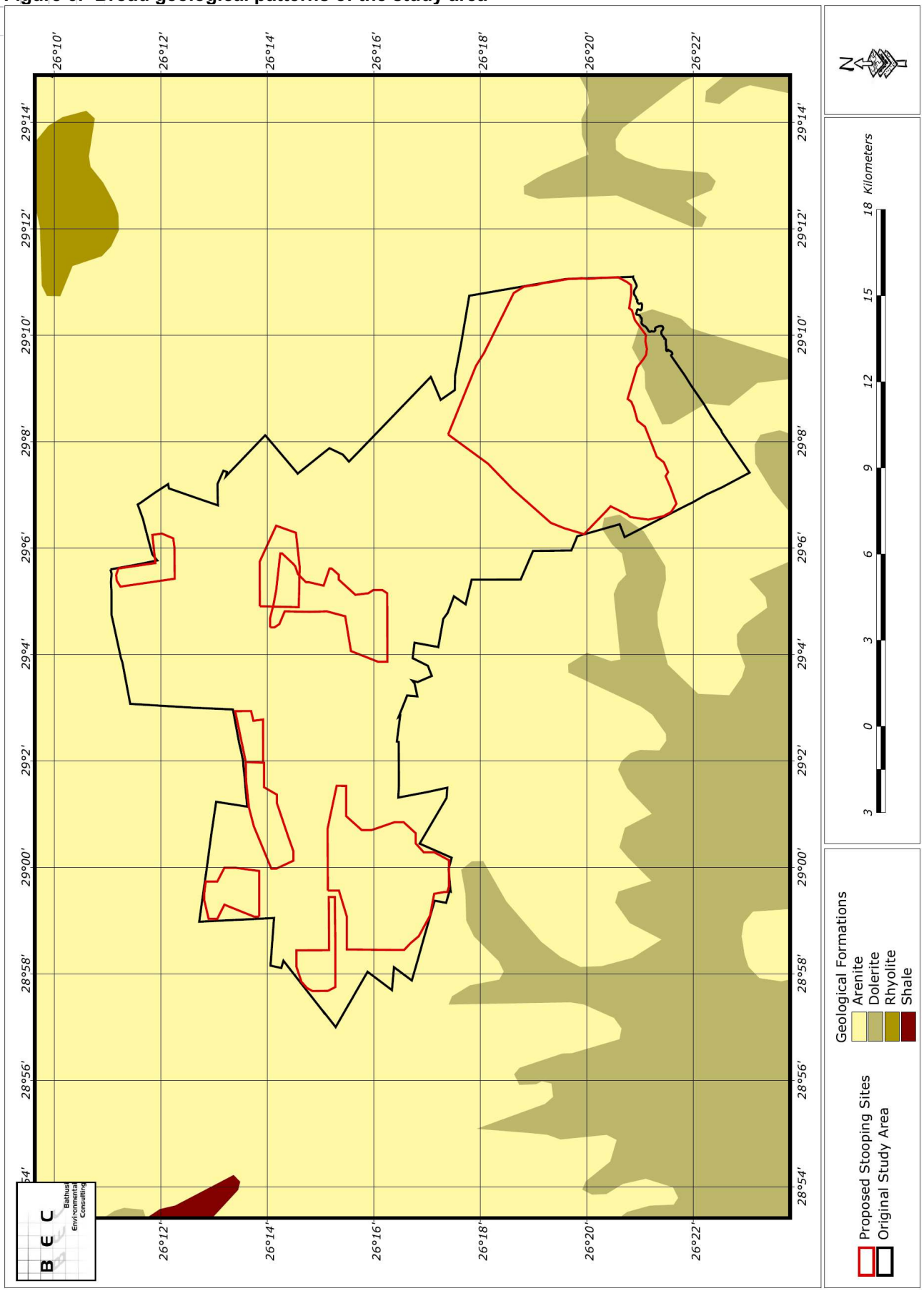


Figure 6: Broad geological patterns of the study area



7.6 LAND TYPES

Although it is not in the scope of this report to present a detailed description of the soil types of the area, a basic description will suffice for this assessment as the association of habitat types and land types (soils) are typical of grassland vegetation. Land types Ab9 and Bb4 (refer **Figure 7**) are represented in the study area.

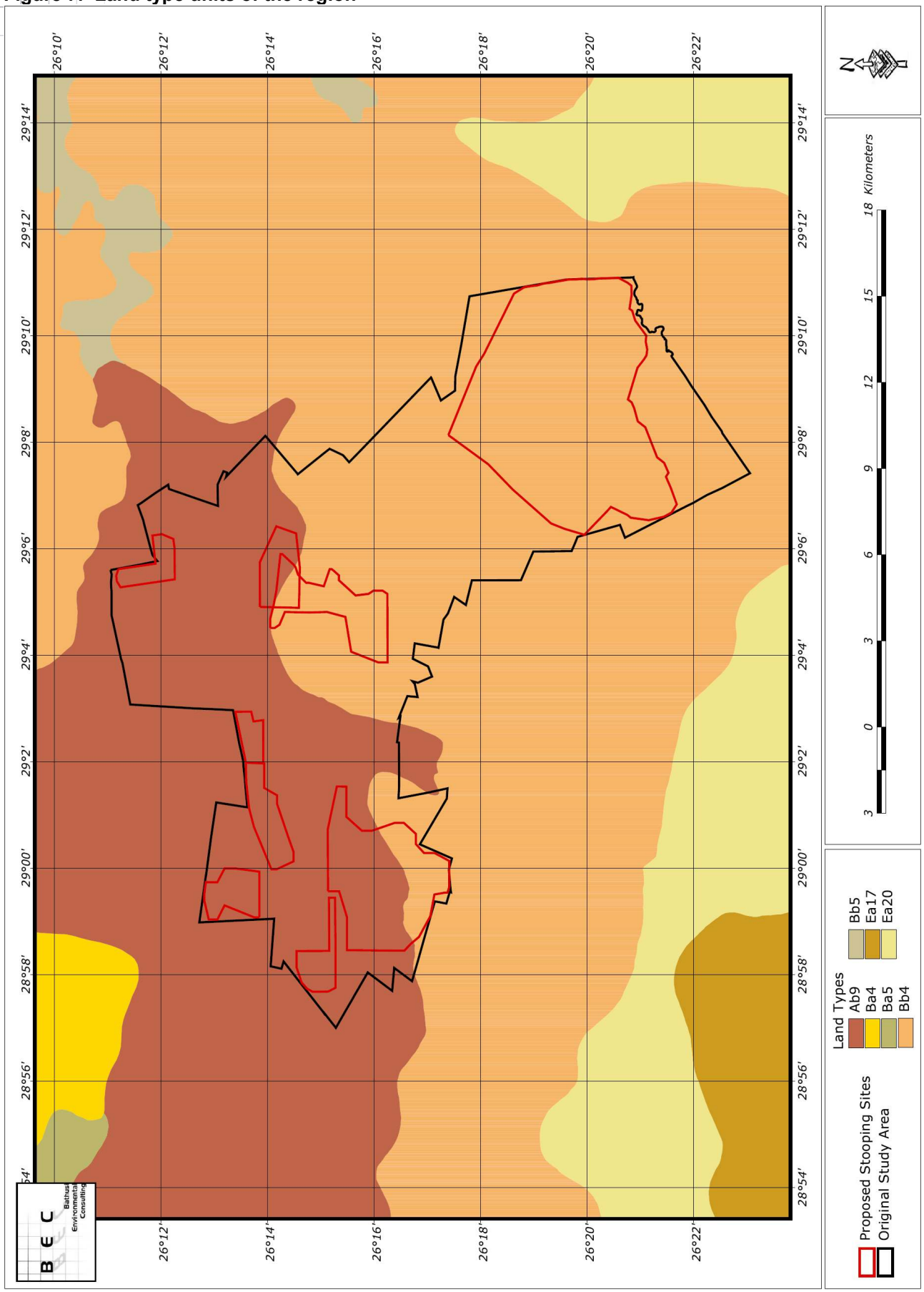
Map units Aa to Ai refer to yellow and red soils without water tables and belonging in one or more of the following soil form: Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly. The map units refer to land that does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40 % of the area. In Ab (red, dystrophic and/ or mesotrophic), yellow soils occupy less than 10 % of the area and /or mesotrophic soils occupy a larger area than high base status red-yellow apedal soils.

A large part of the South African interior is occupied by a catena which in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottoms are occupied by one or other gley soil (*e.g.* Rensburg, Willowbrook, Katspruit, Champagne forms). In addition to these, Glencoe, Wasbank, Westleigh, Kroonstad, Pinedene and Tambankulu (rare) forms, and Klipfontein and (occasional) Hillside soil series are found. Soils with hard plinthite are particularly common over sandstones in the moist climate zones in the eastern parts of the country. Depending on the extent to which tater tables have been operative over a landscape, Longlands, Avalon and other related grey and yellow soils may predominate, even to the exclusion of red soils. Where water tables have not extended far beyond the valley bottoms, red soils may predominate with plinthic soils restricted to narrow strips of land around valley bottoms or pans. However, plinthic soils must cover more than 10 % of the area for to qualify for inclusion in units Ba to Bd. Upland margalitic soils are absent or occupy less than 10 % in units Ba to Bd. Crests and midslopes are dominated by the Avalon, Glencoe and Hutton soil formations, with limited occurrences of Mispah and Glenrosa. The clay content of the A-horizon varies between 15 and 25 %. Footslopes and valley bottoms are dominated by Longlands, Rensburg, Escourt, Katspruit, Vaalbank, Arcadia and Swartland. The clay content of the A-horizon may locally be as high as 60 %.

7.7 DECLARED AREAS OF CONSERVATION

No biosphere, conservancy or other declared area of conservation are present in the immediate surroundings of the study area.

Figure 7: Land type units of the region



8 MPUMALANGA BIODIVERSITY CONSERVATION PLAN

8.1 TERRESTRIAL BIODIVERSITY SENSITIVITIES ON A LOCAL SCALE

The local and regional designation of Terrestrial Biodiversity Conservation Categories is illustrated in **Figure 8**.

The mandate for conserving biodiversity lies with state agencies at national, provincial and local levels of government, forming part of a wider responsibility for the environment and the sustainable use of natural resources. Constitutional and national laws require these environmental issues to be dealt with in cooperative, participatory, transparent and integrated ways. The Mpumalanga Biodiversity Conservation Plan (MBCP) (Lötter & Ferrar, 2006) is the first spatial biodiversity plan for Mpumalanga that is based on scientifically determined and quantified biodiversity objectives. The purpose of the MBCP is to contribute to sustainable development in Mpumalanga.

The MBCP maps the distribution of Mpumalanga Province's known biodiversity into six categories. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The categories are:

1 Protected areas - already protected and managed for conservation;
2 Irreplaceable areas - no other options available to meet targets—protection crucial;
3 Highly Significant areas - protection needed, very limited choice for meeting targets;
4 Important and Necessary areas - protection needed, greater choice in meeting targets;
5 Ecological Corridors – mixed natural and transformed areas, identified for long term connectivity and biological movement;
6 Areas of Least Concern – natural areas with most choices, including for development;
7 Areas with No Natural Habitat Remaining – transformed areas that do not contribute to meeting conservation targets.

The study area comprises four of these categories (refer **Figure 8**), namely:

- No Natural Habitat Remaining;
- Least Concern;
- Important and Necessary; and
- Highly Significant

Areas of '**No Natural Habitat Remaining**' comprise approximately 35.8 % of the Province. This category has already lost most of its biodiversity and ecological functioning. In the remnants of natural habitat that occur between cultivated lands and along river lines and ridges, residual biodiversity features and ecological processes do survive, but these disconnected remnants are biologically impoverished, highly vulnerable to damage and have limited likelihood of being able to persist. The more transformed a landscape becomes; the more value is placed on these remnants of natural habitat. Areas with no natural habitat remaining are preferred sites for developments, taking the potential presence of lands with high agricultural potential into consideration.

Biodiversity assets in landscapes categorized as '**Least Concern**' contributes to natural ecosystem functioning, ensuring the maintenance of viable species populations and providing essential ecological and environmental goods and services across the landscape. This category comprises approximately 25.5 % of the Mpumalanga Province and although these areas contribute the least to the achievement of biodiversity

targets, they have significant environmental, aesthetic and social values and should not be viewed as wastelands or carte-blanche development zones. Development options are widest in these areas. At the broad scale, these areas and those where natural habitat has been lost serve as preferred sites for all forms of development. It is still required to consider other environmental factors such as socioeconomic efficiency, aesthetics and the sense-of-place in making decisions about development. Prime agricultural land should also be avoided for all non-agricultural land uses. Land-use and administrative options for positive biodiversity outcomes include:

- Where this category of land occurs close to areas of high biodiversity value, it may provide useful ecological connectivity or ecosystem services functions, *e.g.* ecological buffer zones and corridors or water production. Encouragement needs to be given to biodiversity-friendly forms of management and even restoration options where appropriate;
- Develop incentives to reverse lost biodiversity for selected parcels of land where buffer zones and connectivity are potentially important;
- Standard application of EIA and other planning procedures are required; and
- These areas might serve as preferred sites for all forms of urban and industrial development (Land-Use Types 10 – 15).

Areas included in the '**Important and Necessary**' category represent significantly important areas of natural vegetation that play an important role in meeting biodiversity targets. This category comprises approximately 9 5 % of the Mpumalanga Province. The designation as seeks to minimise conflict with competing land uses and represents the most efficient selection of areas to meet biodiversity targets. No significant increase in the transformation of remaining natural habitat should be permitted and every opportunity to revert to economic options using natural land cover should be taken. Some agricultural land uses may be permitted but with best-practice guidelines made conditional and aimed at benefiting the biodiversity assets and reducing the vulnerability of each site.

Land in the '**Highly Significant**' category should be maintained as natural vegetation cover. Permissible land uses should be limited to those that are least harmful to biodiversity, i.e. Land-Use Types 1 – 4. No cultivation- based agriculture and urban/industrial developments (Land-Use Types 5 – 15) should be permitted. If development is unavoidable, it must be made sufficiently dispersed (sometimes clumped) and of the right scale to be as biodiversity friendly as possible. Specialist ecological advice will be required in such cases to reinforce standard EIA procedures.

'Biodiversity reinforced EIA procedures' require that a specialised biodiversity study be undertaken as part of the EIA. This requires a survey by an experienced and locally knowledgeable biodiversity expert. Destruction of biodiversity on 'Highly Significant' land may result in the area being moved into the 'Irreplaceable' category. Land-use and administrative options for positive biodiversity outcomes include:

- All land in this category should be maintained as natural vegetation cover;
- Land-use planners to refer all development applications in 'Highly Significant' land to MTPA and or DALA for evaluation by biodiversity specialists;
- Consider economic development only via land use Types 1 – 4 only, and within specified limits, to benefit biodiversity, *e.g.* extensive livestock management without routine supplementary feeding or pasture enhancement;
- Encourage cooperative conservation arrangements, *e.g.* Protected Environments or conservancies where appropriate;
- Conduct focused public awareness and/or extension effort on biodiversity values and uses of these areas, especially to land owners;

- Prioritise for MTPA/DALA to carry out environmental monitoring and reporting on biodiversity status and/or change of land use;
- Develop a more detailed list of unsustainable land uses that are site- or area- specific, including relevant aspects of scale and extent;
- Require a biodiversity specialist study as part of the EIA for all development applications;
- Develop best practice guidelines for all permitted land uses;
- Provision for biodiversity offsets being exchanged for biodiversity loss should only be considered at an exchange rate of at least 250 %, i.e. more than twice the area or biodiversity value, calculated as a comparable contribution to targets, and only as a last resort;
- Devise new financial and other incentives (*e.g.* resource economic approaches) for achieving sustainable conservation management;
- Unavoidable development requires special mitigation measures such as dispersed and/or small scale placement of site;
- Consider special projects to develop biodiversity management / sustainable use guidelines and procedures for communal land;
- Develop and apply appropriate legal penalties for non-compliance subject to regulation; and
- Prioritise these areas for land care projects: i.e. MTPA, DALA, WfW, Working on Wetlands and NGOs to redirect their conservation projects, programmes and activities.

8.2 DEVELOPMENT RESTRICTIONS IN TERMS OF THE MBCP

The MBCP suggests that areas included in the Highly Significant category should remain unaltered and managed for biodiversity by suitable means. Other categories (Important and Necessary, Least Concern and No Natural Habitat Remaining) incorporate increasing options for different types of land use that should be decided by the application of EIA procedures and negotiation between stakeholders.

The proposed development relates to 'Urban and Industrial Land Uses' (Land Use Type 14 – Underground Mining) and is included in the category with other development types, such as Surface Mining, Dumping & Dredging and Urban & Business Development, Major Development Projects, Linear Engineering Structures and Water Projects & Transfers. These six land uses cause the greatest environmental impacts and are almost completely destructive of natural vegetation and natural biodiversity. Where biodiversity persists, it is artificially maintained, generally supporting only opportunistic assemblages of plants and animals. Ecosystem processes are completely disrupted, heavily impacted or artificially maintained at high cost. These land uses not only produce the highest local impacts but also dominate the dispersed and cumulative impacts. They are the most destructive and wide-ranging, often spreading hundreds of kilometres from their source, especially along river systems. These land-use types also require special provision in land-use planning, impact assessment and mitigation.

Restrictions in terms of major developments according to the MBCP are illustrated in **Figure 9** (Underground Mining Restrictions). Classification in terms of Underground Mining Restrictions place most of the study area within the 'Permitted' category with selected portions within the 'Restricted' category. Parts of the study area are situated within areas where major developments are likely not to be permitted according to the MBCP. This does not necessarily imply that any development will be denied, but rather that specialists studies clearly need to indicate that the proposed development will not adversely affect any sensitive floristic or faunal attributes that occur, or potentially could occur, within the study area or on a local and regional scale. Specialist studies are furthermore required to show that the proposed development will not add to existing

cumulative impacts, regional degradation and habitat transformation and the loss of biodiversity on a local or regional scale.

Figure 8: Terrestrial and Biodiversity Conservation categories of the study area

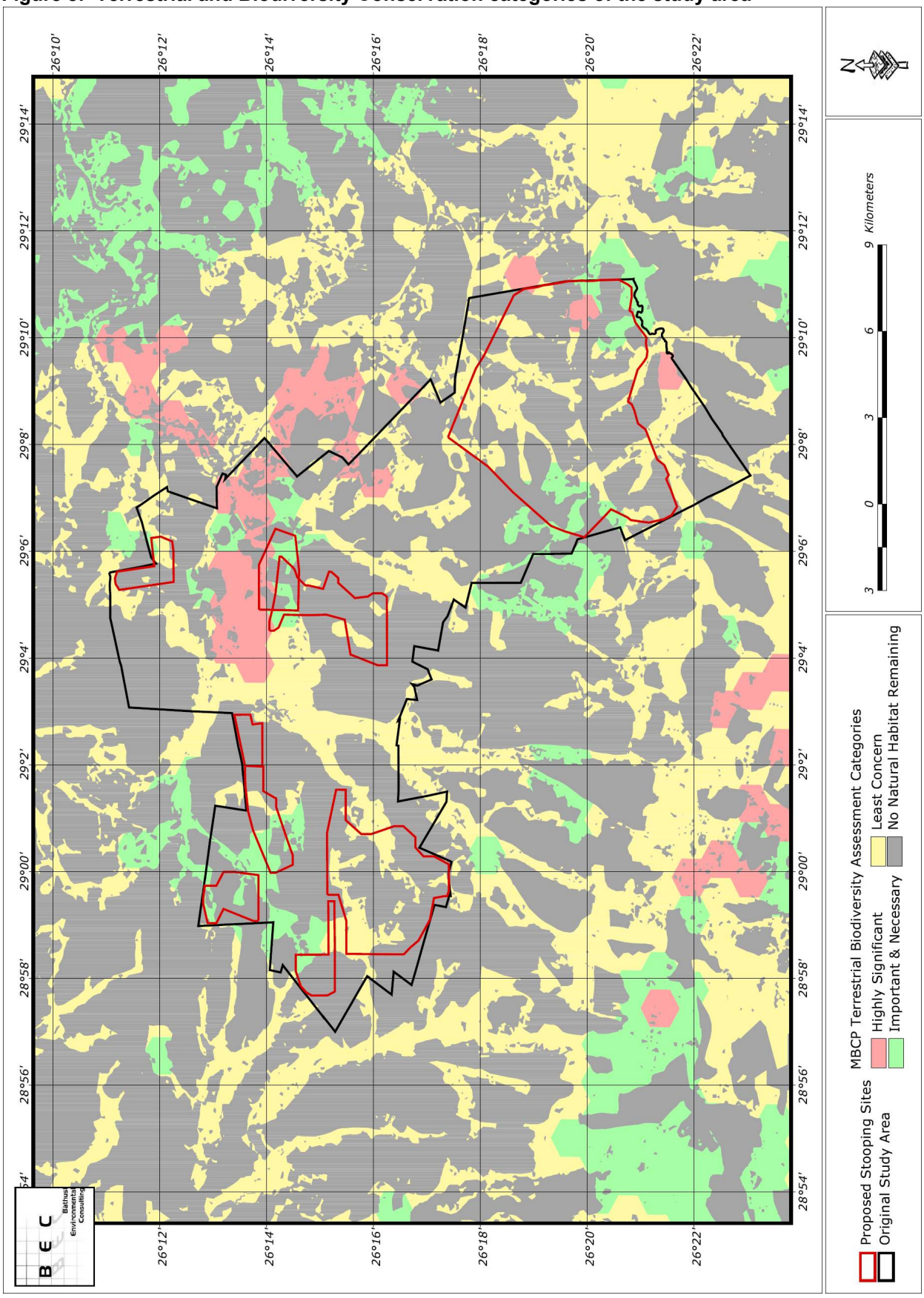
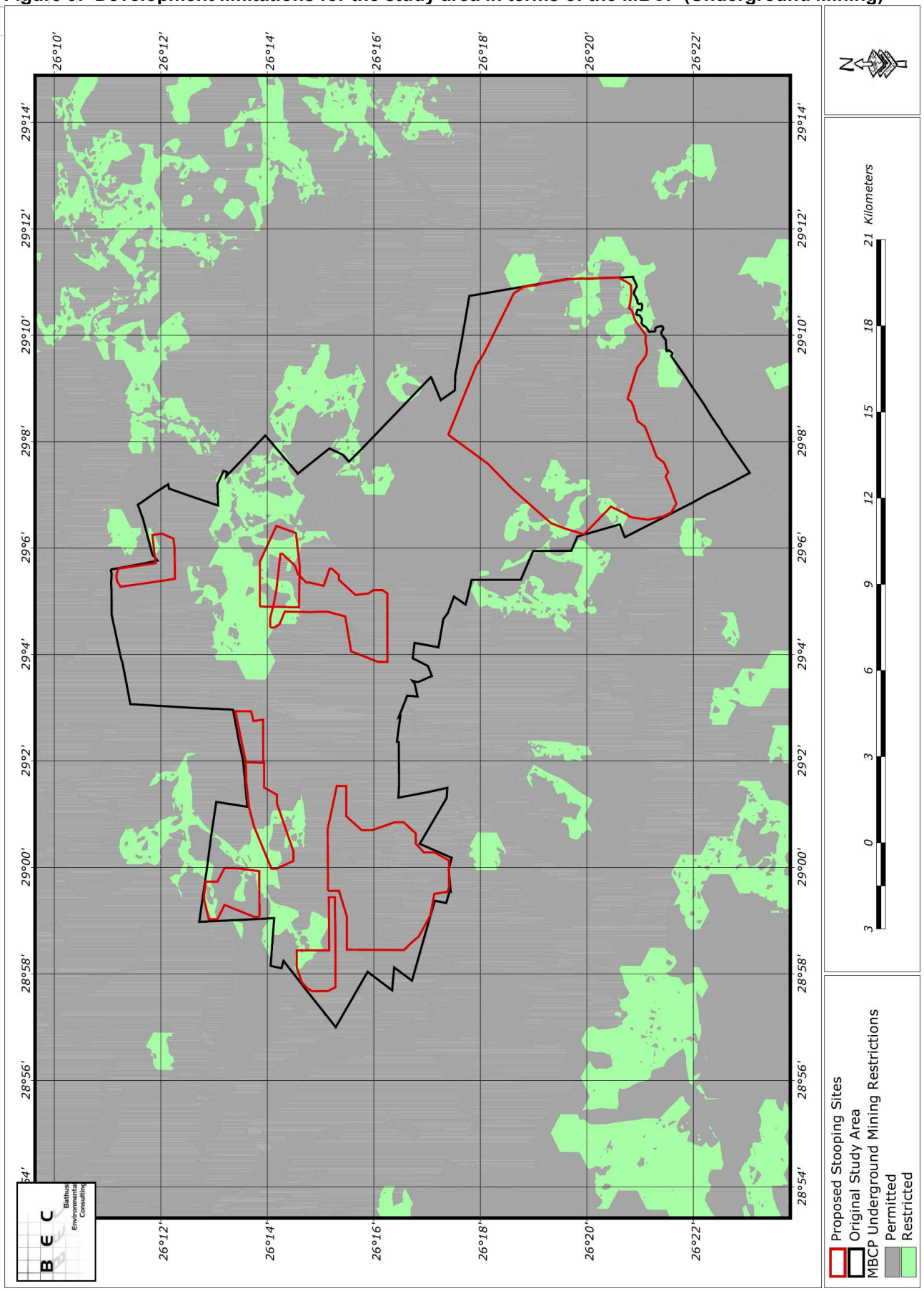


Figure 9: Development limitations for the study area in terms of the MBCP (Underground Mining)



9 BOTANICAL ASSESSMENT

9.1 REGIONAL VEGETATION

The study area is located in the Mesic Highveld Grassland Bioregion, more specifically defined by Mucina and Rutherford (2006) as the Eastern Highveld Grassland (Endangered). The study area also includes isolated portions of the Eastern Temperate Freshwater Wetlands (Vulnerable) vegetation type are captured within the study area (refer **Figure 10**).

9.1.1 Eastern Highveld Grassland

This grassland vegetation type is regarded Endangered and only small fractions are conserved in statutory reserves. Some 44 % of this ecological type is already transformed by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land cover data (refer **Figure 3**) – a basic analysis of the available land cover data indicates that approximately 51.5 %of the land within the study area is already irreversibly transformed (ENPAT, 2001) by anthropogenic activities. The Endangered status of this vegetation type therefore warrants a (at least) medium-high environmental sensitivity. The vegetation is short, dense grassland dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (Aca*cia caffra, Celtis africana, Diospyros lycioides, Parinari capensis, Protea caffra, P. Welwitschii,* and *Searsia magalismontana*). The following species are regarded representative of the Eastern Highveld Grassland vegetation type.

- **Graminoids**

Aristida aequiglumis, A. congesta, A. junciformis subsp*. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp*. eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Eragrostis capensis, E. gummiflua, E. patentissima, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris,* and *Urelytrum agropyroides.*

- **Herbs**

Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp*. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp*. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala Wahlenbergia undulata, Gladiolus crassifolius, Haemanthus humilis* subsp*. hirsutus, Hypoxis rigidula* var*. pilosissima, Ledebouria ovatifolia,* and *Aloe ecklonis.*

- **Low Shrubs**

Anthospermum rigidum subsp*. pumilum* and *Stoebe plumosa.*

9.1.2 Eastern Temperate Freshwater Wetlands

This vegetation type occurs around water bodies with stagnant water (lakes, pans, periodically flooded vleis, and edges of calmly flowing rivers) and is embedded within the Grassland Biome.

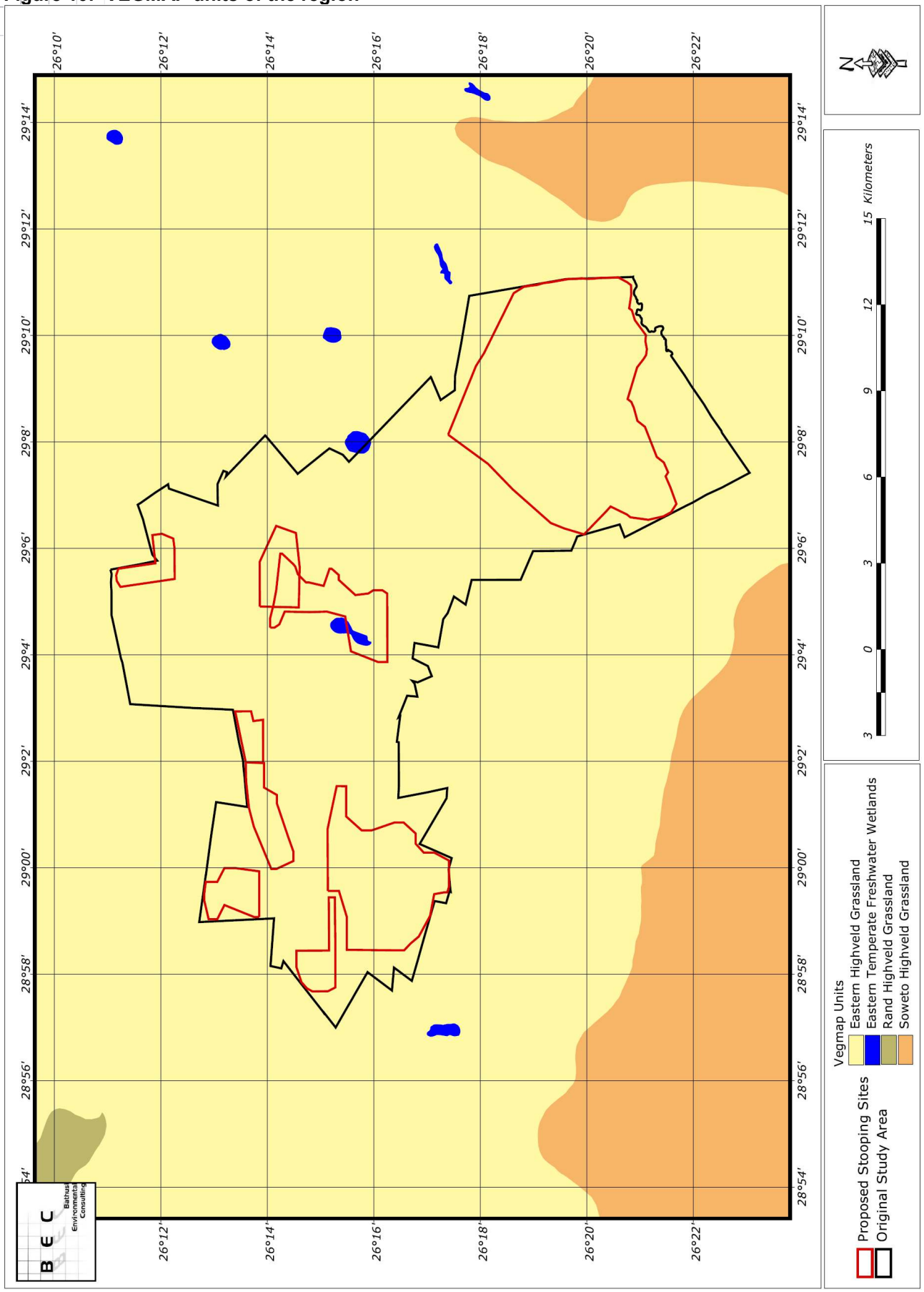
The landscape is generally flat, or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands. The vleis from where flow of water is impeded by impermeable soils and/ or by erosion resistant features, such as dolerite intrusions. Many vleis and pans of this type of wetlands are inundated and/ or saturated only during the summer rainfall season and for some months after this into the middle of the dry winter season, but they may remain saturated all year round. Surface water inundation may be present at any point while the wetland is saturated and some plan species will be present only under inundated condition, or under permanently saturated conditions. The presence of standing water should not be taken as a sign of permanent wetness.

The highveld endemic species *Rorippa fluviatilis* var. *caledonica* and the endemic taxa *Disa zuluensis, Kniphofia flammula, Nerine platypetala,* and the succulent herb *Crassula tuberella* occur in this vegetation type.

About 5 % is statutorily conserved in the Blesbokspruit, Hogsback, Marievale, Olifantsvlei, Seekoeivlei, Wakkerstroom Wetland, Umgeni Vlei and Pamula Park Nature Reserves. It is also protected in private nature reserves such as the Korsman Bird Sanctuary and Langfontein. A Vulnerable conservation status is ascribed to this unit. Some 15 % has been transformed to cultivated land, urban areas or plantations. In places intensive grazing and use of lakes and freshwater pans as drinking pools for cattle or sheep cause major damage to the wetland vegetation. Alien species that are encountered in this type of wetland include *Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum, Trifolium pratense, Verbena bonariensis, V. brasiliensis,* and *Xanthium strumarium.*

Vegetation patterning in rings in concentric rings is often found in pans. Pan size and depth may be a factor limiting vegetation, as large water bodies with shallow water may experience wave action. This limits the presence of species with floating leaves as well as some submerged and marginal macrophytes. The situation is more complex in vleis as these often have variable microtopography and soil types within as single wetland. It is possible for seasonally inundated zones to occur embedded inside the permanently inundated zone of a vlei, if this zone is present.

Figure 10: VEGMAP units of the region



9.2 REGIONAL PHYTODIVERSITY

Existing data records indicate the presence of approximately 5,226 plant species within Mpumalanga Province (POSA, 2014/09/16). Information obtained from the SANBI database indicates the known presence of approximately only 183 plant species within the ¼ degree grids that is sympatric to the study area (refer **Appendix 1**). Taking cognisance of the floristic diversity of South Africa, and the Grassland biome in particular, it is generally estimated that any grid where data records indicate a diversity of lower than 300 species generally reflects a poor sampling history of the region. The paucity of floristic data for the region is emphasised by poor sampling records, as follows:

- 2628BB – 44 recorded taxa;
- 2628BD – 49 recorded taxa;
- 2629AA – 81 recorded taxa; and
- 2629AC – 49 recorded taxa.

The existing database is therefore not regarded an accurate reflection of the true floristic diversity of the region, considering that 235 species were identified in the study area alone during the survey period.

In spite of the moderate floristic knowledge of the region, an appraisal of the growth forms (refer **Table 6**) reflects the grassland physiognomy with a high percentage of the species comprising herbs (58 species, 31.7 %) grasses (34 species, 18.6 %), and geophytes (29 species, 15.8 %). The prominence of wetlands in the region is indicated by the presence of numerous cyperoides (22 species, 12.0 %). The grassland physiognomy is further highlighted by the absence of trees and shrubs.

Table 6: Growth forms of the region

Growth Form	*Number*	*Percentage*
Bryophyte	10	5.5 %
Climber	3	1.6 %
Cyperoid	22	12.0 %
Dwarf shrub	13	7.1 %
Geophyte	29	15.8 %
Graminoid	34	18.6 %
Helophyte	8	4.4 %
Herb	58	31.7 %
Hydrophyte	1	0.5 %
Shrub	2	1.1 %
Succulent	3	1.6 %
Total	**183**	

9.2.2 Flora species of Conservation Importance of the Region

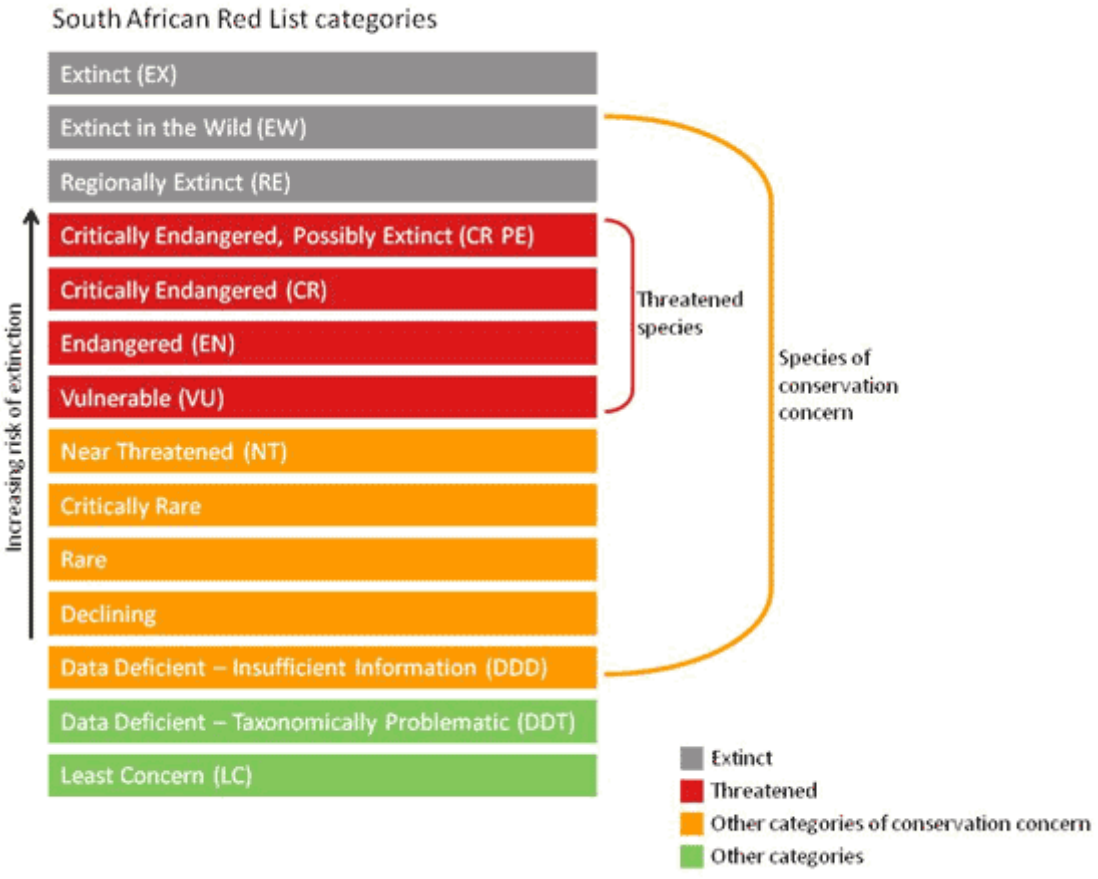
South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the assessment of the conservation status of South African plants. This system is designed to measure species' risk of extinction. The purpose of this system is to highlight those species that are most urgently in need of conservation action. Due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. Because the Red List of South African plants is used widely in South African conservation practices such as systematic conservation planning or protected area expansion, an amended system of categories designed to highlight those species that are at low risk of extinction but of conservation concern are used. Species

that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

Guidelines for the assessment of Red List species include (but are not necessarily limited to):

- A botanical specialist with local botanical and ecological knowledge and experience should undertake the survey;
- A suitable survey should be undertaken; in the summer-rainfall areas of the country, botanical surveys should take place between October and April while in the winter-rainfall areas they should take place between August and October;
- Prior to visiting the site, the specialist consultant should download a list of species that could potentially occur at the site from POSA;
- It is important that specimens are collected as part of the botanical survey, especially for taxonomic groups likely to be of conservation concern;
- Plants should be identified to species level wherever possible, not genus level;
- Species that may be dormant should also be reported;
- Once specimens are collected, they should be identified at a herbarium. Potential species of conservation concern sampled should be identified by a taxonomist specializing in the plant group in question;
- Specialist botanists should also include in their reports a list of species of conservation concern that may occur at a site but may be dormant as a result of unfavourable environmental conditions, for example species that were not seen because the vegetation at a site has not been burnt for many years.

Figure 11: South African Red List Categories (courtesy of SANBI)



Existing data records indicate the presence of approximately 5,226 plant species within Mpumalanga Province (POSA, 2014/09/16), of which an estimated 272 species (5.2 %) are included in the following conservation categories (POSA, 2014/09/16):

- 1 Extinct (EX);
- 11 Critically Endangered (CR);
- 1 Critically Endangered, Possibly Extinct (CR: PE);
- 29 Endangered (EN);
- 75 Vulnerable (VU);
- 35 Near Threatened (NT);
- 1 Critically Rare;
- 43 Rare;
- 22 Declining;
- 20 DDD; and
- 34 DDT.

Almost 80 % of the threatened flora within Mpumalanga Province is associated with the herbaceous stratum and comprises mainly as forbs. De Frey (2012) concluded Red Data plants persisting in Mpumalanga Province occur mainly between 1,000 and 2,000 metres above sea level, associated mainly with sandstone, on ridges, hills and mountains, where rocks occur, in well-drained areas within undisturbed and pristine grassland. While no threatened species is known to occur in the ¼-degree grids, in which the proposed stooping areas are situated, it is however regarded likely that threatened plant taxa could be present within the study region.

Table 7: Plant species of conservation importance within the region of the study area

Species Name	***Family***	***Status***
Alepidea peduncularis	Apiaceae	Data Deficient[6]
Boophone disticha	Amaryllidaceae	Declining[7]
Callilepis leptophylla	Asteraceae	Declining
Crinum bulbispermum*	**Amaryllidaceae**	**Declining**
Hypoxis hemerocallidea	Hypoxidaceae	Declining
Pelargonium sidoides	Geraniaceae	Declining
Gladiolus robertsoniae	Iridaceae	Near Threatened[8]
Kniphofia typhoides	Asphodelaceae	Near Threatened
Nerine gracilis	Amaryllidaceae	Near Threatened
Alepidea peduncularis	Apiaceae	Data Deficient

Note: These species are mostly associated with wetland and pristine grassland habitat types and flowers during the summer period.

**Recorded during the field survey period*.

[6] A species is Data Deficient when there is inadequate information to assess its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate

[7] The Declining category was developed to include widespread taxa that do not qualify for threatened status under any of the IUCN criteria but that are nonetheless under pressure, often because of harvesting for medicinal purposes, are also noted on the national list as taxa of conservation concern

Near Threatened

[8] A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future

9.3 RECORDED PHYTODIVERSITY OF THE SITE

It should be noted that the compilation of a comprehensive botanical checklist or catalogue for the study areas was not an objective of the principal assessment. Areas of obvious transformation and degradation areas were effectively excluded from the surveys; many of the weeds, exotics and introduced plant species associated with these areas are therefore not necessarily included in this particular report. Surveys were mainly conducted in areas where natural habitat abound, aiming to establish the floristic diversity and sensitivity of the remaining natural habitat of the study area and, in particular, the potential presence of plant species of conservation importance. Even within these areas, the floristic inventory should not be regarded as comprehensive since it represents a single and short-term sampling event. The compilation of a comprehensive, and multi-seasonal, species list should ideally form part of the eventual environmental monitoring programme for the mining activity.

A species richness of 236 plant taxa were recorded during the field investigations (refer **Appendix 2**). This recorded species diversity is regarded representative of the regional ecological types that is spatially represented in the study area (refer **Section 9.1**). The presence of various weeds and invasive species within the grassland and, in particular, at the interface of natural habitat and transformed areas, indicates the extensive presence of degraded/ transformed habitat. The grassland physiognomy (within areas of natural/ habitat) of the region is reflected by a well-developed and diverse herbaceous layer (refer **Table 8**), comprising of 114 forbs (48.5 %), 49 grass species (20.9 %) and 15 geophytes (6.4 %). Although the wetlands of the study area are likely to be more diverse as indicated in this report, the 23 sedge species (9.8 %) observed in this habitat type indicates that most of the wetlands comprises relatively natural habitat. The absence of a diverse shrub or tree component (other than exotic species) reflects the grassland physiognomy.

Table 8: Growth forms of the study area

Growth Form	*Number*	*Percentage*
Climber	3	1.3%
Dwarf shrub	3	1.3%
Fern	2	0.9%
Forb	114	48.5%
Geophyte	15	6.4%
Grass	49	20.9%
Hydrophilic	9	3.8%
Parasite	2	0.9%
Prostrate herb	2	0.9%
Sedge	23	9.8%
Shrub	7	3.0%
Succulent	4	1.7%
Tree	2	0.9%
Total	**235**	

The floristic diversity comprises 58 plant families, dominated by Poaceae (50 species, 21.3 %), Asteraceae (41 species, 17.4 %), Cyperaceae (22 species, 9.4 %) and Fabaceae (14 species, 6.0 %).

9.4 RECORDED FLORA SPECIES OF CONSERVATION IMPORTANCE

Plant taxa of national[9] and provincial[10] conservation importance that were recorded within the study area during the survey period are presented in **Table 9**.

Table 9: Conservation Important plant taxa recorded in the study area (national & provincial legislation)

Species Name	*Family*	*Status*
Crinum bulbispermum	Amaryllidaceae	Declining Status, medicinal uses, indicator of moist conditions, Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)
Gladiolus elliotii	Iridaceae	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)
Gladiolus species	Iridaceae	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)
Kniphofia porphyrantha	Asphodelaceae	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)
Nerine krigei	Amaryllidaceae	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)

This list is not regarded a comprehensive catalogue of conservation important plants of the area since it is the result of a single sampling event. The compilation of a comprehensive inventory of conservation important taxa should therefore form part of a multi-season assessment as part of the environmental management plan (environmental monitoring).

Crinum bulbispermum (Declining) was recorded within the ephemeral grasslands and wetland habitat types of the study area. Although only one plant species of conservation importance was recorded, the likelihood of other species being present cannot be discounted, taking cognisance of the presence and status of pristine grasslands and, in particular, ephemeral grasslands and wetland habitat types of the study area. The following species are known to persist in the immediate region and are therefore regarded likely to be present in the study area include the following:

- *Boophone disticha* (Declining)*;*
- *Hypoxis hemerocallidea* (Declining)*;*
- *Gladiolus robertsoniae* (Near Threatened)*;*
- *Kniphofia typhoides* (Near Threatened)*;* and
- *Nerine gracilis* (Vulnerable).

9.5 WEEDS, INVASIVE & ALIEN PLANTS

Invasive and alien plant species, according to national[11] and provincial[12] legislation, recorded during the survey period are presented in **Table 10**. The reader is referred to **Section 21** of this report for annotations on legislation pertaining to alien and invasive species.

Table 10: Weeds, Invasive & Alien plants recorded in the study area

Species Name	*Family*	*Status*
Amaranthus hybridus	Amaranthaceae	Naturalised exotic
Argemone ochroleuca	Papaveraceae	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)
Berkheya insignis	Asteraceae	Weed
Berkheya pinnatifida	Asteraceae	Weed
Berkheya radula	Asteraceae	Weed
Berkheya seminivea	Asteraceae	Weed

[9] IUCN Red List Categories and Criteria, POSA, 2011
[10] Mpumalanga Nature Conservation Act 10 of 1998
[11] National Environmental Management: Biodiversity Act 2004 (Act No, 10 of 2004).
[12] Mpumalanga Nature Conservation Act 10 of 1998 (Schedule 13)

Table 10: Weeds, Invasive & Alien plants recorded in the study area

Species Name	*Family*	*Status*
Berkheya setifera	Asteraceae	Weed, widespread
Bromus catharticus	Poaceae	Weed, average grazing potential, naturalised exotic
Ciclospermum leptophyllum	Apiaceae	Exotic weed (S America)
Cirsium vulgare	Asteraceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Conyza podocephala	Asteraceae	Weed, indicator of disturbed areas
Cortaderia selloana	Poaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Cosmos bipinnatus	Asteraceae	Weed, exotic (S. America)
Crepis hypochoeridea	Asteraceae	Weed, indicator of disturbed areas, naturalised exotic
Cuscuta campestris	Cuscutaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), exotic invader from North America
Cynoglossum hispidum	Boraginaceae	Weed
Cyperus esculentus	Cyperaceae	Weed, edible parts (tuber)
Eleusine coracana	Poaceae	Poor grazing, weed, Increaser IIC
Eucalyptus species	Myrsinaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014) (see act for detail), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Gomphrena celosioides	Amaranthaceae	Weed, South America
Lactuca serriola	Asteraceae	Weed
Myriophyllum aquaticum	Haloragaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Aquatic invasive (S. America), Prohibited aquatic weed, Schedule 10 (Mpumalanga Nature Conservation Act 10 of 1998)
Oenothera rosea	Onagraceae	Weed (S. America), moist & degraded places
Oenothera tetraptera	Onagraceae	Weed (Mexico)
Opuntia ficus-indica	Cactaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), edible parts
Pennisetum clandestinum	Poaceae	Declared Invader - **Category 1B** in protected areas and wetlands (NEM:BA, 2004. AIP, 2014)
Persicaria lapathifolia	Polygonaceae	Indicator of moist conditions, naturalised exotic
Plantago lanceolata	Plantaginaceae	Weed (Europe)
Populus alba	Salicaceae	Declared Invader - **Category 2** (NEM:BA, 2004. AIP, 2014), America, timber, Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Pseudognaphalium luteo-album	Asteraceae	Weed (Europe)
Rubus rigidus	Rosaceae	Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), edible parts
Schkuhria pinnata	Asteraceae	Medicinal uses, weed (S. America)
Solanum panduriforme	Solanaceae	Weed, traditional medicine, poisonous
Solanum sisymbriifolium	Solanaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014)
Trifolium africanum	Fabaceae	Weed of damp and disturbed places
Typha capensis	Typhaceae	Cosmopolitan weed, edible parts, medicinal uses
Verbena bonariensis	Verbenaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Weed (S. America)
Verbena brasiliensis	Verbenaceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Weed (S. America)
Xanthium spinosum	Asteraceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Xanthium strumarium	Asteraceae	Declared Invader - **Category 1B** (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)

Similar to other species inventories for this assessment, this list is not regarded comprehensive, particularly since many of the transformed areas of the study area were excluded from the surveys. The compilation of a comprehensive inventory of alien and invasive plant taxa should therefore be prioritised as part of the environmental monitoring plan.

9.6 GRASSLAND DEVELOPMENT DRIVERS

Available information and casual observations indicate that extremely little pristine (terrestrial) grassland remains in the study area (approximately 43.6 % untransformed habitat remains, refer **Section 9.7**). Original grasslands of the region is the result of complex interacting driving forces that include climatic-, geological-, and topographical factors as well as moisture gradients. Agriculture remains the foremost reason for transformation of terrestrial grasslands on a local and regional scale in recent times (< 30 years). Remaining grassland portions furthermore exhibit characteristics and effects of inappropriate fire regimes and long term and sustained high grazing pressure. Additional impacts that affect the status of vegetation on a local scale include mechanical harvesting and alteration of the grass sward, the use of camp systems (fences), infestation by weeds and pioneer species and effects of herbicides and pesticides from nearby agricultural areas. These impacts resulted in divergence in species abundance and composition associated with the Eastern Highveld Grassland ecological type. The presence and status of grasslands of the immediate region are therefore driven mainly by anthropogenic activities and the result is therefore a grassland type that exhibits significant and artificial changes on a small scale. This is particularly evident from the mosaical appearance that can be noted from aerial imagery of the region (refer **Figure 2**).

Wetland related habitat, contrary to normal vegetation patterns of the region, comprises a large extent of natural habitat in the region, exhibiting moderate degradation levels. Development of these wetland communities and variations is driven by a rich interplay of local and regional substrate-, moisture- and topographical gradients. Regionally the development of these habitat types are placed on a topographical and complex geological gradient that is also likely to affect the moisture duration of the soils, resulting in the variation between ephemeral and permanent wetland types. Locally, the development of vegetation patterns are likely to be driven by topographical placement, slopes, local soil characteristics and moisture content and inundation of the soils. These factors result in the establishment of a continuum, or a gradient, ranging between obligate (permanent) wetland and ephemeral (temporary) moist grasslands. A clear distinction between these types is noticeable from the absence/ presence and abundance of specific species.

While the species composition and physiognomy of wetland habitat types mostly reflect original, fundamental wetland characteristics, the floristic status, ecological functionality and integrity of these areas are determined by anthropogenic driving forces. Persistent high grazing pressure, surface disturbances from livestock and agricultural vehicles, chemical changes from nearby agricultural activities and livestock excretions, incorrect burning regimes, species changes through infestation, changes in normal moisture regimes, etc. are included in this category. More important, ecological functionality (biophysical, floristic & faunal interaction) on a local and regional scale is significantly (adversely) affected by habitat isolation that results from sterilisation of connecting, adjacent terrestrial grassland habitat. Similarly, the absence of local or regional management/ preservation programmes that have conservation principles as objectives implies a constant and irreversible decline in the status of these wetlands.

9.7 MACRO HABITAT TYPES & VARIATIONS

Remaining natural (untransformed) vegetation of the study area is regarded moderately representative of the Eastern Highveld Grassland ecological type (refer **Section 9.1**), exhibiting varying degrees of divergence from the species composition, diversity, species abundance and vegetation structure described by Mucina and Rutherford (Vegmap, 2006).

An important criterion used for the delineation of macro habitat types in this assessment (natural vs. transformed) is the assumption that the application of proper, scientific management principles will result in a recovery from moderate or poor status grassland areas to a primary climax status with a physiognomy and species composition that is typical of the regional vegetation. Zonality of remaining natural habitat of the study area is represented by the interplay of terrestrial and wetland related habitat types that include endorheic pans, natural impoundments and drainage lines with varying character. Similar to the terrestrial grasslands, wetland habitat types exhibit severe signs of recent anthropogenic impacts.

Vegetation of heavily disturbed and manmade habitat, termed anthropogenic, synanthropic, ruderal or agrestal, also fall within the broadly conceived concept of azonality. Results of the photo analysis and site investigations revealed the presence of the following macro habitat types (refer **Figure 13**) and habitat variations (refer **Figure 14**) within the study area:

- Transformed Habitat, including
  - Agricultural Fields;
  - Buildings, Homesteads, Infrastructure & Existing Developments;
  - Mining Areas;
  - Roads & Linear Infrastructure;
- Degraded Habitat, including;
  - Cultivated Fields;
  - Dams/ Impoundments - Artificial;
  - Excavations;
  - Exotic Stands;
- Wetland Habitat, including:
  - Channelled Valley Bottoms;
  - Dams/ Impoundments – Natural;
  - Endorheic pans;
  - Unchannelled Valley Bottoms
- Grassland Habitat, including;
  - Degraded Grassland;
  - Hillslope Seeps;
  - Natural Grassland; and
  - Ridges.

Some variations that are grouped in macro habitat types might appear not to be interrelated. For the purpose of this assessment however, these variations are combined into macro habitat types as they exhibit similar attributes in terms of ecological functionality, inherent botanical features, environmental importance and sensitivity. While local sensitivities ascribed to portions thereof might vary as a result of the local status, the overall contribution to the botanical importance on a local and regional scale are regarded to be of a similar scale and nature.

9.7.1 Transformed Habitat

Species that were observed within this unit are presented in **Table 11**. Please note that this list is based on casual observations and is not regarded as comprehensive since transformed and severely degraded areas were generally excluded from the assessments.

Table 11: Species Diversity of the Transformed Areas

Species Name	*Family*	*Growth Form*
Abildgaardia ovata	Cyperaceae	Sedge
Amaranthus hybridus	Amaranthaceae	Forb
Anthospermum rigidum	Rubiaceae	Forb
Argemone ochroleuca	Papaveraceae	Forb
Aristida bipartita	Poaceae	Grass
Berkheya pinnatifida	Asteraceae	Forb
Berkheya setifera	Asteraceae	Forb
Bromus catharticus	Poaceae	Grass
Chaetacanthus costatus	Acanthaceae	Forb
Ciclospermum leptophyllum	Apiaceae	Forb
Cirsium vulgare	Asteraceae	Forb
Cosmos bipinnatus	Asteraceae	Forb
Crabbea acaulis	Acanthaceae	Forb
Crepis hypochoeridea	Asteraceae	Forb
Cuscuta campestris	Cuscutaceae	Climber
Cynodon dactylon	Poaceae	Grass
Cyperus esculentus	Cyperaceae	Sedge
Cyperus species	Cyperaceae	Sedge
Eleusine coracana	Poaceae	Grass
Eragrostis capensis	Poaceae	Grass
Eragrostis chloromelas	Poaceae	Grass
Eragrostis curvula	Poaceae	Grass
Eragrostis gummiflua	Poaceae	Grass
Eragrostis plana	Poaceae	Grass
Eucalyptus species	Myrsinaceae	Tree
Euphorbia striata	Euphorbiaceae	Forb
Gomphocarpus fruticosus	Apocynaceae	Shrub
Gomphrena celosioides	Amaranthaceae	Forb
Haplocarpha scaposa	Asteraceae	Forb
Helichrysum rugulosum	Asteraceae	Forb
Helictotrichon turgidulum	Poaceae	Grass
Hyparrhenia hirta	Poaceae	Grass
Hypoxis rigidula	Hypoxidaceae	Geophyte
Indigofera hedyantha	Fabaceae	Forb
Ipomoea oblongata	Convolvulaceae	Forb
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb
Juncus dregeanus	Cyperaceae	Sedge
Kniphofia porphyrantha	Asphodelaceae	Succulent
Lactuca inermis	Asteraceae	Forb
Monsonia angustifolia	Geraniaceae	Forb
Nidorella anomala	Asteraceae	Forb
Oenothera rosea	Onagraceae	Forb
Opuntia ficus-indica	Cactaceae	Succulent
Oxalis species	Oxalidaceae	Geophyte
Paspalum dilatatum	Poaceae	Grass
Pennisetum clandestinum	Poaceae	Grass

Table 11: Species Diversity of the Transformed Areas		
Species Name	***Family***	***Growth Form***
Pentarrhinum insipidum	Apocynaceae	Climber
Plantago longissima	Plantaginaceae	Forb
Populus alba	Salicaceae	Tree
Pseudognaphalium luteo-album	Asteraceae	Forb
Rorippa nudiuscula	Brassicaceae	Forb
Rubus rigidus	Rosaceae	Climber
Scabiosa columbaria	Dipsacaceae	Forb
Senecio achilleifolius	Asteraceae	Forb
Senecio erubescens	Asteraceae	Forb
Setaria species	Poaceae	Grass
Setaria sphacelata	Poaceae	Grass
Setaria verticillata	Poaceae	Grass
Solanum panduriforme	Solanaceae	Dwarf shrub
Solanum sisymbriifolium	Solanaceae	Dwarf shrub
Tagetes minuta	Asteraceae	Forb
Trifolium africanum	Fabaceae	Forb
Verbena bonariensis	Verbenaceae	Forb
Xanthium spinosum	Asteraceae	Forb

- **Agricultural Fields**

Commercial cultivation (*Zea mays*) represents the major land transformation activity in the region resulting in a mosaical pattern of agricultural fields within a natural grassland environment, of which extremely little remains. Areas included in this habitat type represents transformed and man-made habitat, termed anthropogenic, synanthropic, ruderal or agrestal. Rehabilitation of these areas to a state that approximates the natural regional vegetation is impossible, even with the application of detailed rehabilitation and management programmes. Importantly, this habitat type generally borders sensitive grassland and wetland habitat of the study area. Potential management programmes for the remaining natural/ sensitive habitat in the local region, will therefore have to include portions of this particular habitat as buffer zones.

The fringes of these areas are dominated weeds and pioneer species that invades bordering habitat. Species frequently noticed include the forbs *Amaranthus hybridus, Argemone ochroleuca, Berkheya radula, Bidens formosa, Conyza podocephala, Crepis hypochoeridea, Gomphocarpus fruticosus, Gomphrena celosioides, Plantago lanceolata, Schkuhria pinnata, Tagetes minuta, Verbena brasiliensis, Selago densiflora* and the grasses *Cynodon dactylon, Eleusine coracana, Eragrostis chloromelas,* and *Urochloa panicoides.*

Red Data plant species are unlikely to occur within these areas and a low floristic status is ascribed to these parts.

- **Buildings, Homesteads, Infrastructure & Existing Developments**

This habitat type represents areas where development and human settlement led to transformation of the natural vegetation. No natural vegetation remains in these areas, but introduced plants abound. Exotic trees and garden-variety plants are mostly present in these areas. Parts of the study area that comprises major developments and industrial sites, including the Matla Power Station, are included in this category.

The floristic status of these areas is therefore regarded low because of the secondary vegetation that characterises these areas. The likelihood of encountering Red Data species within these areas are regarded low and a low floristic status is ascribed to these parts.

- **Mining Areas**

Aerial imagery that was implemented in the compilation of the maps are, in some instances, not recent (>2 years) and mapping of these areas is likely to be slightly inaccurate.

The northern part of the study area comprises areas where surface disturbances resulted from opencast mining activities. Rehabilitation activities are being undertaken in parts of these areas, including resloping, revegetating and the creation of local impoundments. The status is characterised by areas of bare soil and parts where a baseline of grass cover has been established. The floristic status of these areas remains low and the likelihood that floristic attributes that characterise these parts will recover to a natural state is regarded negligent.

- **Roads & Linear Infrastructure**

This category includes some of the larger farm roads, tertiary and secondary (provincial) roads, railways and conveyor lines. Vegetation is generally absent from these areas, or comprises species that indicate a transformed and poor status. A low floristic status is ascribed to these parts.

9.7.2 Degraded Habitat

Species that are typical of this macro habitat type is presented in **Table 12**. Note that certain areas were excluded from the surveys and this inventory is therefore not regarded as comprehensive.

Table 12: Species diversity of the Degraded Habitat

Species Name	*Growth Form*	*Family*
Abildgaardia ovata	Sedge	Cyperaceae
Anthospermum rigidum	Forb	Rubiaceae
Aristida bipartita	Grass	Poaceae
Berkheya pinnatifida	Forb	Asteraceae
Bidens formosa	Forb	Asteraceae
Chaetacanthus costatus	Forb	Acanthaceae
Ciclospermum leptophyllum	Forb	Apiaceae
Cirsium vulgare	Forb	Asteraceae
Crabbea acaulis	Forb	Acanthaceae
Crepis hypochoeridea	Forb	Asteraceae
Cynodon dactylon	Grass	Poaceae
Cyperus esculentus	Sedge	Cyperaceae
Eragrostis chloromelas	Grass	Poaceae
Eragrostis curvula	Grass	Poaceae
Eragrostis plana	Grass	Poaceae
Euphorbia striata	Forb	Euphorbiaceae
Gomphocarpus fruticosus	Shrub	Asclepiadaceae
Gomphrena celosioides	Forb	Amaranthaceae
Helichrysum rugulosum	Forb	Asteraceae
Helictotrichon turgidulum	Grass	Poaceae
Hyparrhenia hirta	Grass	Poaceae
Hypoxis rigidula	Geophyte	Hypoxidaceae
Indigofera hedyantha	Forb	Fabaceae
Jamesbrittanea aurantiaca	Forb	Scrophulariaceae
Juncus dregeanus	Sedge	Cyperaceae
Kniphofia porphyrantha	Succulent	Asphodelaceae
Lactuca capensis	Forb	Asteraceae
Monsonia angustifolia	Forb	Geraniaceae

Nidorella anomala	Forb	Asteraceae
Oenothera rosea	Forb	Onagraceae
Opuntia ficus-indica	Succulent	Cactaceae
Oxalis species	Geophyte	Oxalidaceae
Paspalum dilatatum	Grass	Poaceae
Pennisetum clandestinum	Grass	Poaceae
Pseudognaphalium luteo-album	Forb	Asteraceae
Rorippa nudiuscula	Forb	Brassicaceae
Scabiosa columbaria	Forb	Dipsacaceae
Senecio achilleifolius	Forb	Asteraceae
Senecio erubescens	Forb	Asteraceae
Setaria species	Grass	Poaceae
Setaria sphacelata	Grass	Poaceae
Solanum panduriforme	Forb	Solanaceae
Tagetes minuta	Forb	Asteraceae
Themeda triandra	Grass	Poaceae
Ipomoea oblongata	Forb	Convolvulaceae
Verbena bonariensis	Forb	Verbenaceae

- **Cultivated Fields**

This category includes areas that are currently actively cultivated to establish a grass layer that is frequently harvested (reaped or mowed). While the original grass layer was not removed by mechanical means such as ploughing, the composition of the grass sward was altered by the insowing of popular grazing species, such as *Eragrostis curvula, E. chloromelas,* and *Cynodon dactylon*. Seasonal mowing of these areas produces bales of grass that are used during the dry period as fodder for cattle. The dominance of secondary grass species in these areas resulted in the disappearance of most of the herbaceous species that proliferate in natural grassland areas. Herb species that do occur in these areas are, mostly, of a weedy disposition. The floristic diversity and species richness of these areas are typically low.

The likelihood of encountering Red Data plant species within these areas is regarded low because of habitat transformation and persistent deterioration. A low floristic status is ascribes to these parts of the study area.

- **Dams/ Impoundments – Artificial**

This category includes impoundments that were constructed as part of infrastructure development in the region (mining and industrial related operations) and does not include impoundments on farms for water harvesting purposes. No natural vegetation, other than some exotic trees, remains in these areas and a low floristic status is ascribed to these areas.

- **Excavations**

Small-scale excavations are present in the study area, characterised by the remaining open voids that are partly filled with water or areas that are occupied by successional vegetation, comprising pioneer and opportunistic species that are able to withstand the biophysical conditions. These areas are characteristically low in diversity and a low floristic status is ascribed.

- **Exotic Stands**

This habitat type comprises all areas where natural vegetation has been replaced by stands of exotic trees, mostly *Eucalyptus* species. Numerous stands are present throughout the study area, mostly in close proximity to homesteads. A low floristic status is ascribed to these areas and it is regarded highly unlikely that these areas will be inhabited by any Red Data flora species.

9.7.3 Wetland Habitat

Wetland habitat of the study area is particularly diverse, probably more than the 127 species presented in the inventory for this habitat type (refer **Table 13**).

Table 13: Species diversity of the Wetland Habitat Types of the study area

Species Name	*Family*	*Growth Form*
Abildgaardia ovata	Cyperaceae	Sedge
Agrostis eriantha	Poaceae	Grass
Agrostis lachnantha	Poaceae	Grass
Andropogon appendiculatus	Poaceae	Grass
Anthospermum rigidum	Rubiaceae	Forb
Aristida bipartita	Poaceae	Grass
Asclepias stellifera	Apocynaceae	Forb
Aster species	Asteraceae	Forb
Berkheya pinnatifida	Asteraceae	Forb
Berkheya radula	Asteraceae	Forb
Berkheya setifera	Asteraceae	Forb
Brachiaria eruciformis	Poaceae	Grass
Brunsvigia natalensis	Amaryllidaceae	Geophyte
Calamagrostis epigejos var. *epigejos*	Poaceae	Grass
Carex glomerabilis	Cyperaceae	Sedge
Chironia palustris	Gentianaceae	Forb
Chloris virgata	Poaceae	Grass
Ciclospermum leptophyllum	Apiaceae	Forb
Cirsium vulgare	Asteraceae	Forb
Conyza canadensis	Asteraceae	Forb
Cortaderia selloana	Poaceae	Grass
Cosmos bipinnatus	Asteraceae	Forb
Crepis hypochoeridea	Asteraceae	Forb
Crinum bulbispermum	Amaryllidaceae	Geophyte
Cycnium tubulosum	Scrophulariaceae	Forb
Cynodon dactylon	Poaceae	Grass
Cynoglossum hispidum	Boraginaceae	Forb
Cyperus fastigiatus	Cyperaceae	Sedge
Cyperus sexangularis	Cyperaceae	Sedge
Cyperus solidus	Cyperaceae	Sedge
Cyperus species	Cyperaceae	Sedge
Denekia capensis	Asteraceae	Forb
Diclis species	Scrophulariaceae	Forb
Digitaria eriantha	Poaceae	Grass
Dipcadi species	Liliaceae	Forb
Eleocharis dregeana	Cyperaceae	Sedge
Eleocharis species	Cyperaceae	Sedge
Elionurus muticus	Poaceae	Grass
Eragrostis capensis	Poaceae	Grass
Eragrostis chloromelas	Poaceae	Grass
Eragrostis curvula	Poaceae	Grass
Eragrostis lehmanniana	Poaceae	Grass
Eragrostis plana	Poaceae	Grass
Eragrostis racemosa	Poaceae	Grass

Erythrina zeyheri	Fabaceae	Shrub
Euphorbia striata	Euphorbiaceae	Forb
Fimbristylis complanata	Cyperaceae	Sedge
Fingerhuthia africana	Poaceae	Grass
Fuirena coerulescens	Cyperaceae	Sedge
Gazania krebsiana	Asteraceae	Forb
Geigeria burkei	Asteraceae	Forb
Gladiolus elliotii	Iridaceae	Geophyte
Gomphocarpus fruticosus	Apocynaceae	Shrub
Gomphrena celosioides	Amaranthaceae	Forb
Haplocarpha scaposa	Asteraceae	Forb
Helichrysum rugulosum	Asteraceae	Forb
Helictotrichon turgidulum	Poaceae	Grass
Hemarthria altissima	Poaceae	Grass
Hermannia coccocarpa	Malvaceae	Forb
Hermannia transvaalensis	Malvaceae	Forb
Hibiscus micranthus	Malvaceae	Forb
Hibiscus microcarpus	Malvaceae	Forb
Hibiscus trionum	Malvaceae	Forb
Hyparrhenia hirta	Poaceae	Grass
Hypoxis rigidula	Hypoxidaceae	Geophyte
Imperata cylindrica	Poaceae	Grass
Ipomoea oblongata	Convolvulaceae	Forb
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb
Juncus dregeanus	Cyperaceae	Sedge
Juncus exsertus	Cyperaceae	Sedge
Juncus punctorius	Cyperaceae	Sedge
Juncus species	Cyperaceae	Sedge
Justicia anagalloides	Acanthaceae	Forb
Kyllinga alba	Cyperaceae	Sedge
Kyllinga erecta	Cyperaceae	Sedge
Lactuca capensis	Asteraceae	Forb
Lactuca inermis	Asteraceae	Forb
Lactuca serriola	Asteraceae	Forb
Ledebouria ovalifolia	Liliaceae	Geophyte
Leersia hexandra	Poaceae	Grass
Lobelia angolensis	Lobeliaceae	Forb
Mariscus congestus	Cyperaceae	Sedge
Marsilea species	Marsileaceae	Hydrophilic
Mentha aquatica	Lamiaceae	Hydrophilic
Monopsis decipiens	Lobeliaceae	Forb
Myriophyllum aquaticum	Haloragaceae	Hydrophilic
Nerine krigei	Amaryllidaceae	Geophyte
Oenothera rosea	Onagraceae	Forb
Oxalis semiloba	Oxalidaceae	Geophyte
Oxalis species	Oxalidaceae	Geophyte
Oxycarpus species	Polygonaceae	Sedge
Panicum schinzii	Poaceae	Grass
Paspalum dilatatum	Poaceae	Grass
Paspalum scrobiculatum	Poaceae	Grass
Paspalum urvillei	Poaceae	Grass
Pennisetum clandestinum	Poaceae	Grass

Persicaria lapathifolia	Polygonaceae	Hydrophilic
Phragmites australis	Poaceae	Hydrophilic
Plantago longissima	Plantaginaceae	Forb
Potamogeton species	Potamogetonaceae	Hydrophilic
Pseudognaphalium luteo-album	Asteraceae	Forb
Pycreus macranthus	Cyperaceae	Sedge
Ranunculus multifidus	Ranunculaceae	Forb
Richardia brasiliensis	Rubiaceae	Forb
Rorippa nudiuscula	Brassicaceae	Forb
Rumex species	Polygonaceae	Forb
Schkuhria pinnata	Asteraceae	Forb
Schoenoplectus corymbosus	Cyperaceae	Sedge
Senecio achilleifolius	Asteraceae	Forb
Senecio erubescens	Asteraceae	Forb
Senecio inaequidens	Asteraceae	Forb
Senecio inornatus	Asteraceae	Forb
Senecio polyodon var. *polyodon*	Asteraceae	Forb
Setaria nigrirostris	Poaceae	Grass
Setaria sphacelata	Poaceae	Grass
Solanum panduriforme	Solanaceae	Dwarf shrub
Sonchus asper	Asteraceae	Forb
Sphenostylis angustifolia	Fabaceae	Forb
Sutherlandia frutescens	Fabaceae	Forb
Tagetes minuta	Asteraceae	Forb
Themeda triandra	Poaceae	Grass
Trifolium africanum	Fabaceae	Forb
Trifolium burchellianum	Fabaceae	Forb
Typha capensis	Typhaceae	Hydrophilic
Urochloa panicoides	Poaceae	Grass
Verbena brasiliensis	Verbenaceae	Forb

- **Channelled & Unchannelled Valley Bottoms**

Numerous drainage lines and mesic grasslands are present in the study area, representing the upper parts of the catchment and tributaries draining towards the larger streams in the study area (refer **Figures 4** and **5**, local watersheds). The nature of these drainage lines varies between unchannelled valley bottoms, channelled valley bottoms (small drainage lines), non-perennial and perennial streams with clearly defined banks and streambeds. It should be noted that this habitat type is closely associated with Moist Grasslands as well as Natural Grasslands, depending on the prevalence of soil conditions and slopes. This concomitance of habitat types within a region typified by habitat transformation is characterised by waterlogged soil conditions that prevent agricultural activities.

The status of these areas varies greatly; grazing by livestock is recognised as the driving force behind habitat status of the vegetation. Intensive grazing results in physical habitat destruction. Trampling of soils, localised erosion and bank destabilisation is characteristic of areas where high stocking rates prevail. Construction of local impoundments (dams) affects the status of drainage lines adversely, affecting the local soil moisture content, water depth, amount of water (depth of water column), timing of occurrence (regular tides or irregular floods) and speed of its movement (discharge, flow and stagnation). Few pristine examples of this habitat type are present within the study area; one example is situated in the southeastern section of the study area. The vegetation in these areas is diverse, composed of a multitude of grasses and forbs,

notably some geophytes. While some evidence of utilisation is present, the intensity appears to be sufficiently low not to harm the status of this area.

The vegetation of these habitat types are dominated by a well developed herbaceous layer, including a wide variety of sedges and hydrophilic species (depending on the presence of standing water), forbs and grasses that are adapted to inundated soil conditions. Channelled Valley Bottoms are characterised by permanent water, hence hydrophilic species abound in these parts, including numerous sedges, submergent and other aquatic plants. These generally include *Carex glomerabilis, Cyperus fastigiatus, C.* species*, Fimbristylis complanata, Hemarthria altissima, Juncus exsertus, Juncus punctorius, Marsilea* species*, Mentha aquatica, Persicaria lapathifolia,* and *Phragmites australis.*

Conversely, Unchannelled Valley Bottoms, which does not have a clearly defined streambed, are frequently dry for periods of the year, and while inundated, streamflow tends to be less severe. The vegetation, as a result, tends to be analogous to the surrounding grassland habitat, comprising less water affiliated species and a higher degree of species that are adapted to periodic inundated soil conditions. These species include the grasses *Abildgaardia ovata, Agrostis eriantha, A. lachnantha, Calamagrostis epigeios, Fingerhuthia africana, Leersia hexandra, Panicum schinzii, Paspalum dilatatum, P. scrobiculatum, Setaria nigrirostris*, and the forbs *Centella asiatica, Chironia palustris, Ciclospermum leptophyllum, Crinum bulbispermum, Cycnium tubulosum, Fuirena coerulescens, Gladiolus elliotii, Kyllinga erecta, Monopsis decipiens, Pseudognaphalium luteo-album, Senecio achilleifolius, S. erubescens, S. inornatus,* and *Verbena brasiliensis*.

A high conservation status and sensitivity is ascribed to all riparian habitats at this stage, in spite of a medium-high floristic status of most of the drainage lines in the study area. Considering the Red Data species that occur in the region, these areas are highly suitable for the potential presence of most of these species. The 'Declining' species *Crinum bulbispermum* was recorded in these parts of the study area.

- **Dams/ Impoundments – Natural**

This category includes either impoundments that are natural occurrences in the drainage lines, or those that were created by human intervention for water harvesting purposes.

Several manmade impoundments of varying sizes are present in the study area. The status of these areas is moderately degraded due to intensive utilisation by cattle and a relative low floristic diversity is noted within these locales. Surrounding habitat similarly exhibits signs of the high grazing pressure, alteration of the grassland sward and, consequently, poor species diversity. A medium or medium-high floristic status is most often ascribed to these areas. The presence of these features also has an effect on surrounding habitat through the high frequentation rates of livestock to these areas. A normal scenario would dictate that available surface water be utilised along the entire length of a drainage line throughout the period that it is available (seasonal in the case of non-perennial drainage lines).

By impounding water (restricting occurrence) to a small area, impacts associated with intensive use by livestock are also concentrated in these areas. Trampling, high utilisation rates, changes in chemical balances (urine and faecal droppings) and the import of other species by seeds, represent some of the impacts observed within habitat surrounding local impoundments. These impacts represent a principle threat to wetlands of the region. Impounding causes changes in the functioning of the wetland by reducing the flow of water down-stream while increasing the inundation period and/or depth of inundation. These interventions initiate changes in the structure of biota populating the wetlands. Excessive water pollution

results in shifts from oligotrophic (usually diverse habitats of high conservation value) to eutrophic wetlands, often dominated by single ubiquitous species choked by algal blooms.

Normal (typical) drainage of a wetland involves both the diversion of water away from the wetland, as well as the extraction of water from the wetland itself via drains. This results in changes in the species composition from wetland species to a habitat dominated by purely terrestrial species, as well as changes in the soils from typically anaerobic to aerobic.

The species diversity in these areas is generally low; dominated by monospecific surrounding grasslands consisting mostly of the grasses *Digitaria eriantha, Eragrostis plana* and *E. curvula* and a low number of aquatic species that includes *Cirsium vulgare* (on the edges), *Cyperus sexangularis, Eleocharis dregeana, Mariscus congestus, Myriophyllum aquaticum, Persicaria lapathifolia,* and *Schoenoplectus corymbosus.*

- **Endorheic pans**

Endorheic pans of the study area represent an 'Intrazonal' vegetation type, occurring exclusively within a climatic (and vegetation or biome) zone.

A number of endorheic pans of varying sizes and character are present in the study area. While most pans in the study area are relatively small, a particularly large pan is situated in the central northern section of the study area and a moderate size pan towards the eastern part of the study area. Pans with open water (perennial as well as non-perennial) as well as smaller shallower pans with a dominant grass layer (usually *Leersia hexandra*) were noted.

In addition, a number of smaller pans can be observed from aerial images, located within and surrounded by agricultural fields, or sometimes entirely ploughed. All of these areas are already heavily impacted by agricultural activities and, in particular, by livestock grazing in the surrounds. The effects thereof can be observed on the hydromorphic grassland that surrounds the pans, which consists of grassland seepages that are currently infested by weed species or a severely altered grass stratum. In addition, trampling of the soils on the fringes of the pans and chemical changes that result from droppings and urine of cattle as well as chemicals that are used for agricultural purposes will affect the status of these features adversely. Although some *Typha capensis* is noted on some of the pans, the infestation rate is not high.

The floristic status of these features ranges from medium to medium-high, in most cases due to the moderately degraded status of vegetation and high impact levels from surrounding land uses. A few relative pristine (usually the larger ones) pans are present. A high sensitivity is ascribed due to the environmentally sensitive nature of endorheic pans. In spite of the moderately degraded status of the vegetation, it is regarded moderately likely that plant species of conservation importance might be present within this habitat type.

9.7.4 Grassland Habitat

A total of 189 species were recorded in this habitat type, it should be noted that, while these areas are diverse, the macro-habitat type does include significant variations, ranging from ridges, pristine and slightly degraded terrestrial grasslands to the moist grassland interface that interact with wetland habitat types. The wide range of environmental conditions gave rise to this high diversity of species.

An inventory of plant species recorded in the Grassland Habitat of the study area is presented in **Table 14**.

Table 14: Species diversity of the Grassland Habitat Types

Species Name	*Growth Form*	*Family*
Abildgaardia ovata	Cyperaceae	Sedge
Acalypha angustata	Euphorbiaceae	Forb
Agrostis eriantha	Poaceae	Grass
Ajuga ophrydis	Lamiaceae	Forb
Albuca species	Liliaceae	Geophyte
Amaranthus hybridus	Amaranthaceae	Forb
Andropogon appendiculatus	Poaceae	Grass
Anthospermum rigidum	Rubiaceae	Forb
Aponogeton junceus	Aponogetonaceae	Hydrophilic
Aristida bipartita	Poaceae	Grass
Aristida junciformis	Poaceae	Grass
Aristida meridionalis	Poaceae	Grass
Asclepias aurea	Apocynaceae	Forb
Asclepias eminens	Apocynaceae	Forb
Asclepias species	Apocynaceae	Forb
Asclepias stellifera	Apocynaceae	Forb
Aster species	Asteraceae	Forb
Berkheya insignis	Asteraceae	Forb
Berkheya pinnatifida	Asteraceae	Forb
Berkheya radula	Asteraceae	Forb
Berkheya seminivea	Asteraceae	Forb
Berkheya setifera	Asteraceae	Forb
Brachiaria serrata	Poaceae	Grass
Bromus catharticus	Poaceae	Grass
Calamagrostis epigejos var. *epigejos*	Poaceae	Grass
Carex cernua var. *austro-africana*	Cyperaceae	Sedge
Carex glomerabilis	Cyperaceae	Sedge
Centella asiatica	Apiaceae	Hydrophilic
Chaetacanthus costatus	Acanthaceae	Forb
Chamaecrista comosa	Caesalpiniaceae	Forb
Cheilanthes species	Sinopteridaceae	Fern
Chlorophytum cooperi	Liliaceae	Geophyte
Chlorophytum species	Liliaceae	Geophyte
Ciclospermum leptophyllum	Apiaceae	Forb
Cirsium vulgare	Asteraceae	Forb
Commelina africana	Commelinaceae	Forb
Conyza podocephala	Asteraceae	Forb
Cordylogyne globosa	Apocynaceae	Forb
Cosmos bipinnatus	Asteraceae	Forb
Crabbea acaulis	Acanthaceae	Forb
Crassula setulosa	Crassulaceae	Succulent
Crepis hypochoeridea	Asteraceae	Forb
Crinum bulbispermum	Amaryllidaceae	Geophyte

Table 14: Species diversity of the Grassland Habitat Types		
Species Name	***Growth Form***	***Family***
Cucumis africanus	Cucurbitaceae	Forb
Cyanotis speciosa	Commelinaceae	Forb
Cycnium tubulosum	Scrophulariaceae	Forb
Cymbopogon pospischilii	Poaceae	Grass
Cynodon dactylon	Poaceae	Grass
Cyperus esculentus	Cyperaceae	Sedge
Cyperus fastigiatus	Cyperaceae	Sedge
Cyperus obtusiflorus	Cyperaceae	Sedge
Cyperus solidus	Cyperaceae	Sedge
Cyperus species	Cyperaceae	Sedge
Denekia capensis	Asteraceae	Forb
Dianthus mooiensis	Capparaceae	Forb
Dicoma anomala	Asteraceae	Forb
Digitaria eriantha	Poaceae	Grass
Diospyros austro-africana	Ebenaceae	Shrub
Dipcadi species	Liliaceae	Forb
Eleocharis dregeana	Cyperaceae	Sedge
Elephantorrhiza elephantina	Fabaceae	Dwarf shrub
Eleusine coracana	Poaceae	Grass
Elionurus muticus	Poaceae	Grass
Eragrostis capensis	Poaceae	Grass
Eragrostis chloromelas	Poaceae	Grass
Eragrostis curvula	Poaceae	Grass
Eragrostis lehmanniana	Poaceae	Grass
Eragrostis plana	Poaceae	Grass
Eragrostis racemosa	Poaceae	Grass
Eragrostis species	Poaceae	Grass
Euphorbia clavarioides	Euphorbiaceae	Succulent
Euphorbia striata	Euphorbiaceae	Forb
Felicia muricata	Asteraceae	Forb
Fimbristylis complanata	Cyperaceae	Sedge
Gazania krebsiana	Asteraceae	Forb
Geigeria burkei	Asteraceae	Forb
Gladiolus species	Iridaceae	Geophyte
Gnidia capitata	Thymelaeaceae	Shrub
Gnidia species	Thymelaeaceae	Shrub
Gomphocarpus fruticosus	Apocynaceae	Shrub
Gomphrena celosioides	Amaranthaceae	Forb
Haplocarpha lyrata	Asteraceae	Forb
Haplocarpha scaposa	Asteraceae	Forb
Harpochloa falx	Poaceae	Grass
Helichrysum aureonitens	Asteraceae	Forb
Helichrysum coriaceum	Asteraceae	Forb
Helichrysum nudifolium	Asteraceae	Forb
Helichrysum pilosellum	Asteraceae	Forb
Helichrysum rugulosum	Asteraceae	Forb
Helictotrichon turgidulum	Poaceae	Grass
Hermannia coccocarpa	Malvaceae	Forb
Hermannia depressa	Malvaceae	Forb
Hermannia erodioides	Malvaceae	Forb
Hermannia transvaalensis	Malvaceae	Forb
Heteropogon contortus	Poaceae	Grass
Hibiscus aethiopicus	Malvaceae	Forb

Table 14: Species diversity of the Grassland Habitat Types		
Species Name	***Growth Form***	***Family***
Hibiscus micranthus	Malvaceae	Forb
Hibiscus microcarpus	Malvaceae	Forb
Hibiscus trionum	Malvaceae	Forb
Hilliardiella oligocephala	Asteraceae	Forb
Hyparrhenia hirta	Poaceae	Grass
Hypoxis iridifolia	Hypoxidaceae	Geophyte
Hypoxis rigidula	Hypoxidaceae	Geophyte
Indigofera filipes	Fabaceae	Forb
Indigofera hedyantha	Fabaceae	Forb
Ipomoea bathycolpos	Convolvulaceae	Prostrate herb
Ipomoea oblongata	Convolvulaceae	Forb
Ipomoea simplex	Convolvulaceae	Prostrate herb
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb
Juncus exsertus	Cyperaceae	Sedge
Juncus punctorius	Cyperaceae	Sedge
Kyllinga alba	Cyperaceae	Sedge
Kyllinga erecta	Cyperaceae	Sedge
Lactuca inermis	Asteraceae	Forb
Ledebouria ovalifolia	Liliaceae	Geophyte
Ledebouria revoluta	Liliaceae	Geophyte
Leersia hexandra	Poaceae	Grass
Lobelia angolensis	Lobeliaceae	Forb
Melinis repens	Poaceae	Grass
Melolobium wilmsii	Fabaceae	Forb
Microchloa caffra	Poaceae	Grass
Monopsis decipiens	Lobeliaceae	Forb
Monsonia angustifolia	Geraniaceae	Forb
Nesaea schinzii var. *rehmannii*	Lythraceae	Forb
Nidorella anomala	Asteraceae	Forb
Nidorella hottentotica	Asteraceae	Forb
Oenothera rosea	Onagraceae	Forb
Oenothera tetraptera	Onagraceae	Forb
Oldenlandia herbacea	Rubiaceae	Forb
Oxalis semiloba	Oxalidaceae	Geophyte
Oxalis species	Oxalidaceae	Geophyte
Oxycarpus species	Polygonaceae	Sedge
Panicum schinzii	Poaceae	Grass
Paspalum dilatatum	Poaceae	Grass
Pelargonium luridum	Geraniaceae	Forb
Pellaea calomelanos	Adianthaceae	Fern
Persicaria lapathifolia	Polygonaceae	Hydrophilic
Peucedanum magalismontanum	Apiaceae	Forb
Plantago lanceolata	Plantaginaceae	Forb
Plantago longissima	Plantaginaceae	Forb
Polygala hottentotta	Polygalaceae	Forb
Polygala uncinata	Polygalaceae	Forb
Pseudognaphalium luteo-album	Asteraceae	Forb
Pycreus macranthus	Cyperaceae	Sedge
Ranunculus multifidus	Ranunculaceae	Forb
Rhynchosia adenodes	Fabaceae	Forb
Rhynchosia caribaea	Fabaceae	Forb
Rorippa nudiuscula	Brassicaceae	Forb
Rumex crispus	Polygonaceae	Forb

Table 14: Species diversity of the Grassland Habitat Types		
Species Name	***Growth Form***	***Family***
Salvia runcinata	Lamiaceae	Forb
Scabiosa columbaria	Dipsacaceae	Forb
Schistostephium crataegifolium	Asteraceae	Forb
Schkuhria pinnata	Asteraceae	Forb
Searsia magalismontana	Anacardiaceae	Shrub
Selago densiflora	Selaginaceae	Forb
Senecio achilleifolius	Asteraceae	Forb
Senecio erubescens	Asteraceae	Forb
Senecio inaequidens	Asteraceae	Forb
Senecio polyodon var. *polyodon*	Asteraceae	Forb
Setaria nigrirostris	Poaceae	Grass
Setaria species	Poaceae	Grass
Setaria sphacelata	Poaceae	Grass
Solanum panduriforme	Solanaceae	Dwarf shrub
Striga asiatica	Scrophulariaceae	Parasite
Striga elegans	Scrophulariaceae	Parasite
Sutherlandia frutescens	Fabaceae	Forb
Tephrosia longipes	Fabaceae	Forb
Tephrosia species	Fabaceae	Forb
Themeda triandra	Poaceae	Grass
Trachyandra asperata	Liliaceae	Geophyte
Trachypogon spicatus	Poaceae	Grass
Trichoneura grandiglumis	Poaceae	Grass
Trifolium africanum	Fabaceae	Forb
Tristachya leucothrix	Poaceae	Grass
Verbena bonariensis	Verbenaceae	Forb
Verbena brasiliensis	Verbenaceae	Forb
Wahlenbergia undulata	Campanulaceae	Forb
Xanthium spinosum	Asteraceae	Forb
Ziziphus zeyheriana	Rhamnaceae	Shrub
Zornia capensis	Fabaceae	Forb

- **Degraded Grassland**

The vegetation of this category represents isolated areas where local surface disturbances resulted in some impacts on the natural vegetation, to the extent that the original vegetation has been altered to some extent. However, most of the species noted in surrounding natural grasslands are still present within these units and a recovery to a natural state is likely. Impacts associated with these areas, unlike in Cultivated Fields, occurred quite recently and usually during a single activity or event. The vegetation of these areas are typically in an intermediate, or secondary climax status and, together with the natural diversity, comprises some weeds and other pioneer species. A moderate floristic status is ascribed to these areas. *Hyparrhenia hirta, Eragrostis plana,* and *Eragrostis chloromelas* dominated areas are typical examples of this category.

- **Hillslope Seeps**

These ephemeral grasslands are included in the Grassland macro-habitat type rather than the wetland habitat types because of the physiognomic and composition affinity with the terrestrial grasslands. Soils are inundated for parts of the year subsequent to the austral summer period and numerous species are present that are associated with moist substrate conditions, but the association with the terrestrial grasslands are strong enough that the distinction and delineation of the categories is problematical in most cases. This unit represents the footslopes of the landscape that is situated between the midslopes (terrestrial grasslands) and valley bottoms (wetlands, streams, rivers), performing a critical role of water retention and accumulation

from upslope regions, which is then released towards the low-lying areas of the landscape over a period. The functionality of these areas is however adversely affected by intensive commercial agricultural activities in the upland part of the landscapes.

Low slopes and local soils with relative high clay content contribute to the retention of water in the top part of the soils, causing the higher horizons to be inundated or moist for some periods of the year. This the status of these areas varies greatly; grazing by livestock is recognised as the driving force behind current habitat status in these areas. Intensive grazing results in disappearance of many species; the vegetation is dominated by hardy and resilient species, mostly grasses that include the species *Eragrostis plana, Paspalum scrobiculatum, P. dilatatum* and *Hyparrhenia hirta.* Pristine areas, where limited impact occurs, are characteristically diverse, particularly in terms of forbs. In addition, the grass sward are not dominated by a low number of species (3 - 4 species), rather, a higher number of co-dominant species indicate more pristine conditions. Typically, 6 - 10 co-dominant grasses are noted in these parts.

Species frequently observed in this habitat type include the grasses *Abildgaardia ovata, Agrostis eriantha, Andropogon appendiculatus, Aristida bipartita, A. junciformis, Calamagrostis epigeios, Eragrostis curvula* (particularly dominant in certain areas, presumably because of species alteration practices), *E. plana, Helictotrichon turgidulum, Heteropogon contortus, Microchloa caffra, Panicum schinzii,* and *Setaria sphacelata.* The presence of the forbs *Ajuga ophrydis, Anthericum cooperi, Asclepias eminens, Berkheya pinnatifida, Ciclospermum leptophyllum, Cycnium tubulosum, Denekia capensis, Eragrostis plana, Haplocarpha lyrata, Helichrysum aureonitens, Hypoxis iridifolia, Kyllinga alba, Oenothera tetraptera, Oxalis semiloba, Ranunculus multifidus, Senecio erubescens, Verbena bonariensis,* and *Wahlenbergia undulata,* indicates an affinity with moist conditions.

- **Natural Grassland**

Natural grassland of the study area varies greatly in composition and physiognomy. Although this variation is normal in pristine grasslands that abound in the region, the variation noted in the study area displays a mosaical appearance that results from intensive grazing practices and the use of fence systems. In areas where high stocking rates and overgrazing occur, the vegetation is dominated by the secondary grasses *Hyparrhenia hirta, Eragrostis plana, E. chloromelas, Cynodon dactylon* and the weedy forbs *Cirsium vulgare, Berkheya pinnatifida,* and *Crepis hypochoeridea.* Areas that are subjected to lower grazing pressure exhibit vegetation with a higher floristic status, which can also be noted from a higher species richness of the herbaceous stratum.

The natural grassland of the study areas are characterised by a short, low cover of herbaceous species, physiognomically dominated by grasses. The floristic status of remaining areas of natural grassland is normally not as clearly defined as indicated in the description; more often, it is determined by a gradient of grazing pressure. However, even areas that were subjected to high grazing pressure remain different to transformed areas by the simple distinction that these areas would potentially be able to recover to a natural status under correct management regimes. The conservation status of these grasslands, on a regional scale, is regarded Endangered. All natural grassland habitats within the study area where the species composition and floristic character approximates that of the regional vegetation type, is therefore regarded highly sensitive.

Forbs that are frequently observed in this unit include *Ajuga ophrydis, Anthericum cooperi, Asclepias aurea, Aster species, Berkheya pinnatifida, B. radula, B. setifera, Chaetacanthus costatus, Ciclospermum leptophyllum, Crabbea acaulis, Cucumis africanus, Cyanotis speciosa, Dianthus mooiensis, Felicia muricata,*

Gazania krebsiana, Geigeria burkei, Helichrysum nudifolium, H. rugulosum, Hermannia depressa, H. transvaalensis, Hibiscus aethiopicus, Hypoxis rigidula, Indigofera hedyantha, Ledebouria ovalifolia, Nidorella hottentotica, Oenothera rosea, Plantago longissima, Rhynchosia adenodes, Senecio inaequidens, Ipomoea oblongata, and *Zornia capensis.*

Prominent grasses include *Aristida bipartita, Aristida meridionalis, Brachiaria serrata, Digitaria eriantha, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. plana, E. curvula, E. racemosa, Hyparrhenia hirta, Setaria sphacelata, Themeda triandra,* and *Tristachya leucothrix*.

The likelihood of encountering Red Data plant species within these areas are regarded medium because of moderate habitat suitability for Red Data plant species that do occur in the region.

- **Ridges**

A low ridge is situated in the southern part of the study area in proximity to the Vaalbankspruit (to the immediate south of Stooping Area I). Physical attributes of this unit include a relative high surface rockiness (Dolerite), relative high slopes (>9 %) that tends to flatten out at the crests.

This habitat comprises two relative small portions and represents the only occurrence of this habitat type in the study area, placing a high premium on this habitat. The pristine nature of this portion of land renders it highly sensitive. Furthermore, when viewed in conjunction with the presence of pristine natural grassland, ephemeral grassland and the perennial Vaalbankspruit, this particular complex of habitat types represent the most diverse section of the entire study area. Although only 45 species were observed within the ridge area, it should be noted that many of these species are not present in surrounding grassland areas.

Species that are characteristic of this unit include the forbs *Acalypha angustata, Asclepias species, Cheilanthes* species*, Crassula setulosa, Cyanotis speciosa, Dianthus mooiensis, Dicoma anomala, Haplocarpha lyrata, Pellaea calomelanos, Polygala hottentotta, Scabiosa columbaria, Schistostephium crataegifolium, Vernonia oligocephala,* the grasses *Aristida junciformis, Brachiaria serrata, Elionurus muticus, Eragrostis racemosa, Harpochloa falx, Heteropogon contortus, Themeda triandra* and the low shrubs *Diospyros austro-africana, Felicia muricata, Geigeria burkei, Melolobium wilmsii,* and *Searsia magalismontana.*

Pristine grassland habitat types typically do not comprise of any particularly dominant plant species; a number of co-dominant species are more often denoted in pristine grassland areas. However, on the crest/ plateau area the grass *Themeda triandra* tends to be dominant, which is a characteristic feature of the regional ecological grassland type and therefore providing significant evidence of the pristine nature of the vegetation of these parts as this species tends to disappear under intensive grazing.

The floristic status of these parts is high and the likelihood that species of conservation importance would be present in these parts is regarded moderate high. A high floristic sensitivity is therefore ascribed to these parts and it is strongly recommended that these areas be excluded from the proposed activity. In addition, a suitable buffer should be implemented that would prevent peripheral impacts from affecting these areas. This area is situated on the perimeter of the study area and the exclusion and preservation of these parts should therefore be straightforward.

Figure 12: Macro Habitat Types of the study area

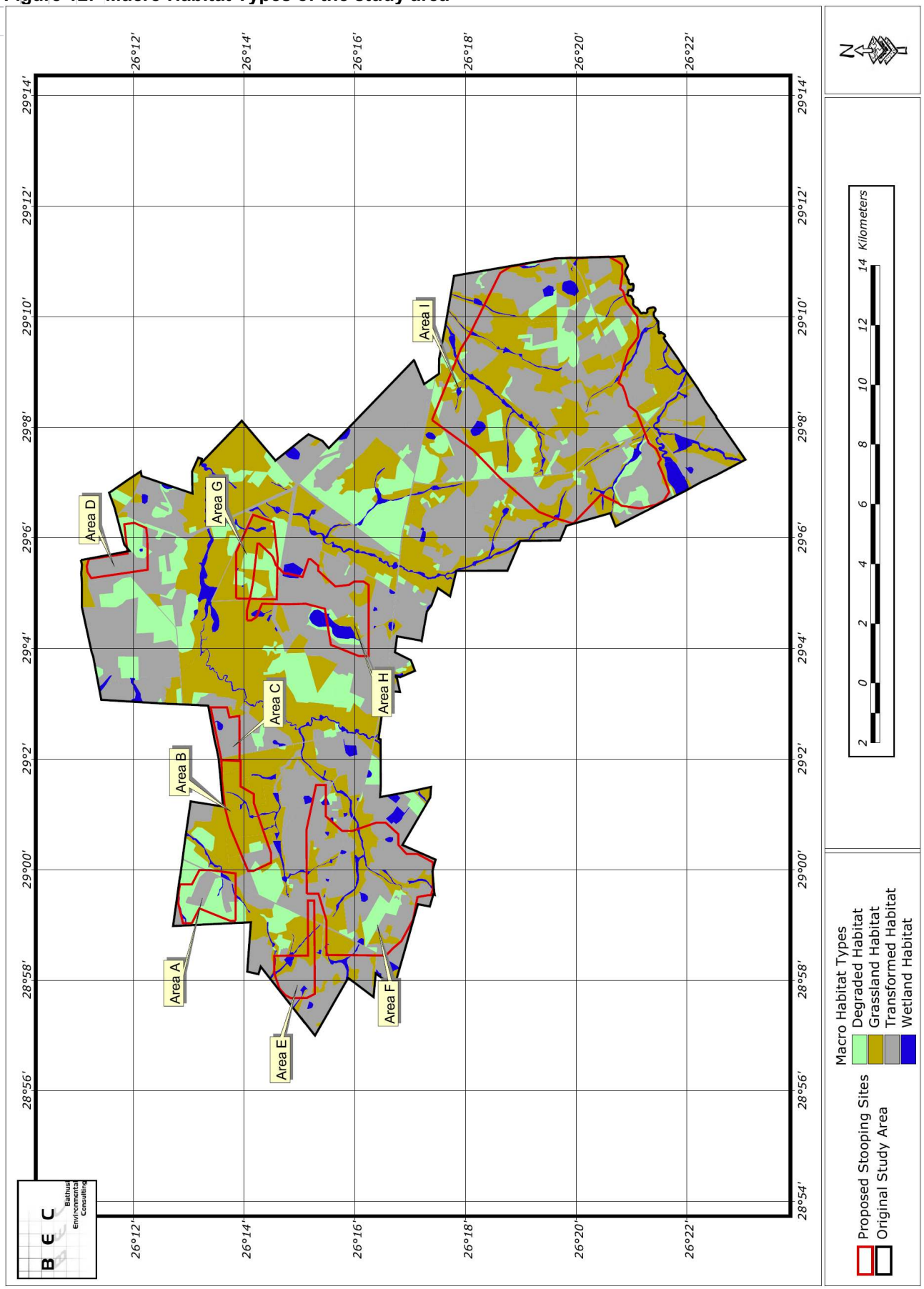
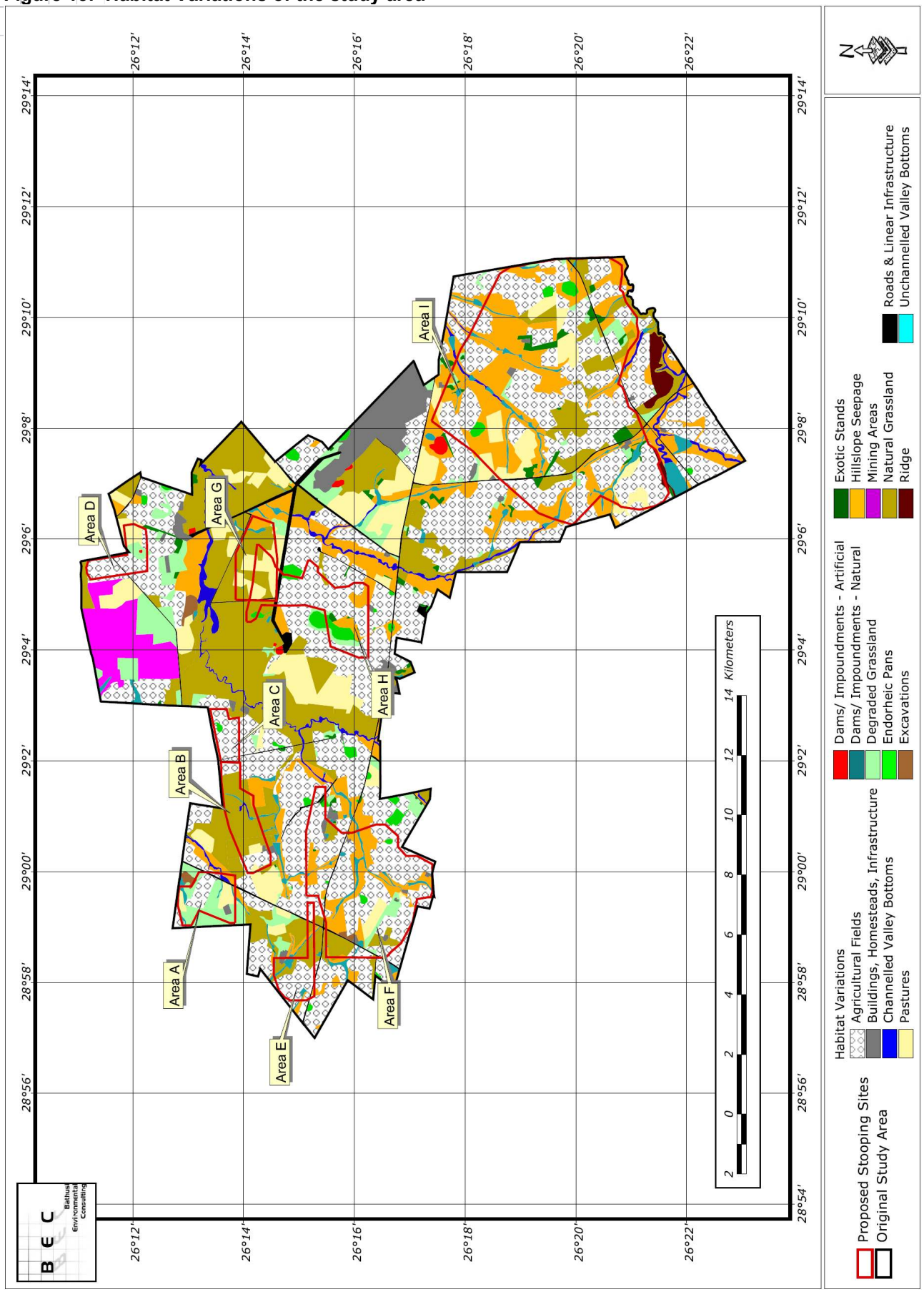


Figure 13: Habitat Variations of the study area



9.8 FLORISTIC SENSITIVITY OF THE STUDY AREA

For existing protected areas and species, the floristic importance ascribed to certain areas is obvious. Similarly, many countries will have differentiated the biodiversity importance of their protected areas (national or local) as part of their designation. Outside of protected areas, but within areas that are clearly of value for biodiversity, the evaluation of importance is more complex and vague. It is important to note that the absence of protected status should never be interpreted as low biodiversity importance; many areas of international importance for biodiversity lie outside of protected areas. The challenge is to include a suitable range of criteria to determine whether the site is of local, regional, national or international importance. Although no universal standard exists, some of the common criteria include the following:

- **Species/habitat richness:** In general, the greater the diversity of habitats or species in an area, the more valuable the area is. Habitat diversity within an ecosystem can also be very valuable. Habitat mosaics are extremely valuable, as some species that depend on different types of habitat may live in the transition zone between the habitats.
- **Species endemism:** Endemic species typically occur in areas where populations of a given species have been isolated for sufficiently long to evolve distinctive species-specific characteristics, which prevent out-breeding with other species populations.
- **Keystone species:** A keystone species is one that exerts great influence on an ecosystem relative to its abundance or total biomass. For example, a keystone predator may prevent its prey from overrunning an ecosystem. Other keystone species act as 'ecosystem engineers' and transfer nutrients between ecosystems.
- **Rarity:** The concept of rarity can apply to ecosystems and habitats as well as to species. Rarity is regarded as a measure of susceptibility to extinction, and the concept is expressed in a variety of terms such as vulnerable, rare, threatened or endangered.
- **Size of the habitat:** The size of a natural area is generally considered as important. It must be big enough to be viable, which relates to the resistance of ecosystems and habitats to activities at the margins, loss of species and colonization of unwanted species. Habitat connectivity is also of related importance and refers to the extent of linkages between areas of natural habitat – high levels of connectivity between different habitats or patches of the same habitat are desirable.
- **Population size:** For example, in international bird conservation, it has become established practice to regard 1 per cent of a species' total population as significant in terms of protective requirements. For some large predators, it is important to know that an area is large enough to encompass the home range of several individuals and allow them to persist successfully.
- **Fragility:** This refers to the sensitivity of a particular ecosystem or habitat to human-induced or natural environmental changes and its resilience to such changes.
- **Value of ecosystem services:** The critical importance of ecosystem services is widely appreciated.

Habitat sensitivity is categorised as follows:

Low No natural habitat remaining; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of plant species of conservation importance occurring in these areas is regarded negligent.

Medium – low All areas where the natural habitat has been degraded, with the important distinction that the vegetation has not been decimated and a measure of the original vegetation remain, albeit dominated by secondary climax species. The likelihood of plant species of conservation importance occurring in these

areas is regarded low. These areas also occur as highly fragmented and isolated patches, typical to cultivated fields, areas that have been subjected to clearing activities and areas subjected to severe grazing pressure. The species composition of these areas is typically low and is frequently dominated by a low number of species, or invasive plants.

Medium Indigenous natural habitat that comprehend habitat with a high diversity, but characterised by moderate to high levels of degradation, fragmentation and habitat isolation. Also includes areas where flora species of conservation importance could potentially occur, but habitat is regarded marginal;

Medium – high Indigenous natural vegetation that comprehend a combination of the following attributes:

- The presence of habitat that is suitable for the presence of these species;
- Areas that are characterised by a high/ moderate-high intrinsic floristic diversity;
- Areas characterised by moderate to low levels of habitat fragmentation and isolation;
- Regional vegetation types that are included in the lower conservation categories, particularly prime examples of these vegetation types;
- Low to moderate levels of habitat transformation;
- A moderate to high ability to respond to disturbance factors;

It may also include areas that are classified as protected habitat, but that are of a moderate status;

High Indigenous natural vegetation that comprehend for a combination of the following attributes:

- The presence of plant species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable);
- Areas where 'threatened' plants are known to occur, or habitat that is highly suitable for the presence of these species;
- Regional vegetation types that are included in the 'threatened' categories (Critically Endangered, Endangered, Vulnerable), particularly prime examples of these vegetation types;
- Habitat types are protected by national or provincial legislation (Lake Areas Act, National Forest Act, draft Ecosystem List of NEM:BA, Mountain Catchment Areas Act, Ridges Development Guideline, Integrated Coastal Zone Management Act, etc.);
- Areas that have an intrinsic high floristic diversity (species richness, unique ecosystems), with particular reference to Centres of Endemism;

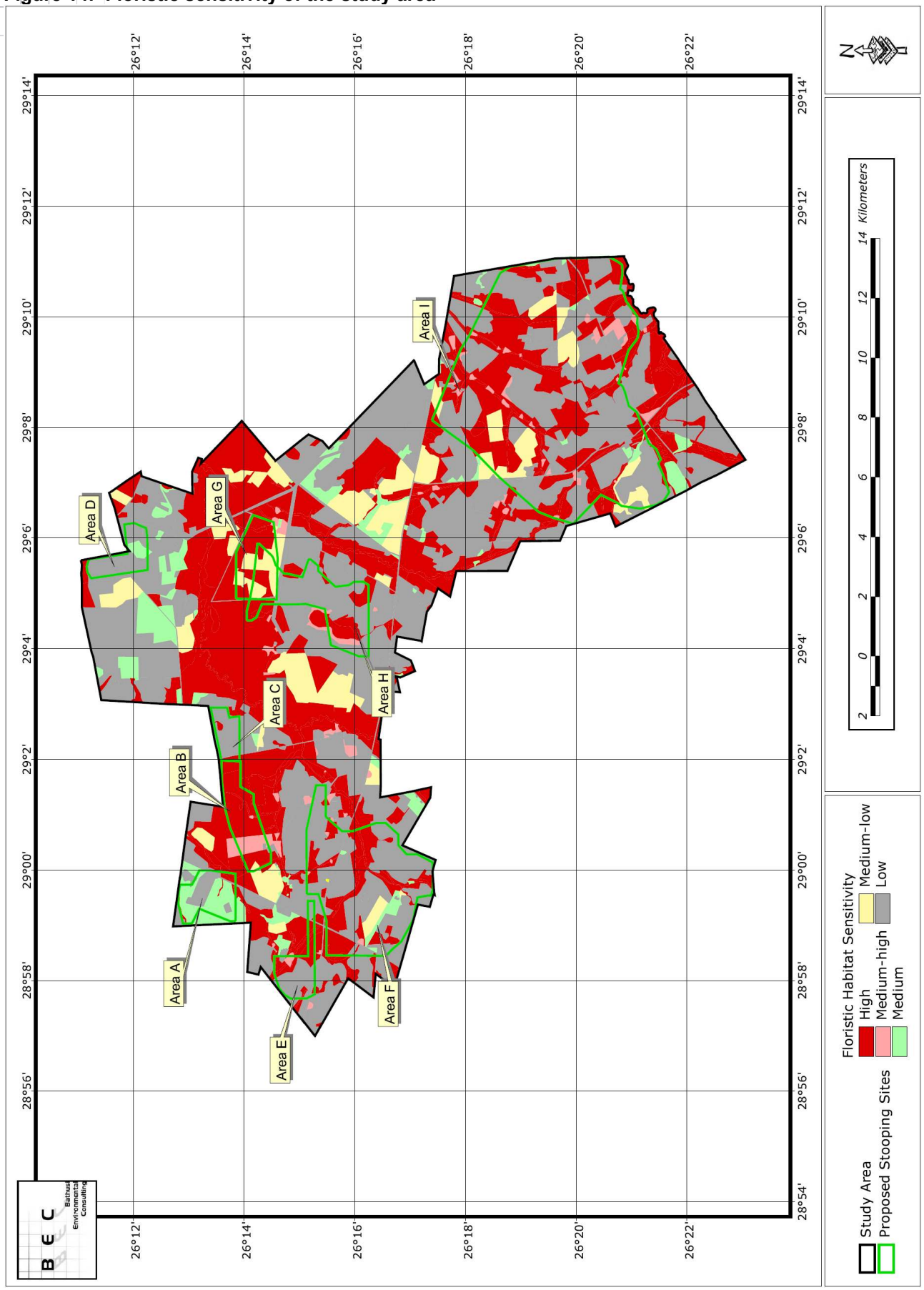
These areas are also characterised by low transformation and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby and dependent ecosystems, with particular reference to catchment areas, pollination and migration corridors, genetic resources. A major reason for the high conservation status of these areas is the low ability to respond to disturbances (low plasticity and elasticity characteristics).

Sensitivity Criteria employed in assessing the floristic sensitivity of separate units may vary between different areas comprising of a similar habitat type, depending on location, type of habitat, size, etc. General floristic sensitivity estimations are presented in **Table 15**. These estimations are used to ascribe a general floristic sensitivity value to units of the respective variations, illustrated in **Figure 14**. Additional aspects that are taken into consideration include surrounding habitat sensitivity, conservation potential, fragmentation and habitat isolation factors. Therefore, different units of a habitat variation might be ascribed a relative wide range of floristic sensitivities.

Table 15: General floristic sensitivity estimations for habitat types (floristic variations)								
Criteria	***RD species***	***Landscape sensitivity***	***Status***	***Species diversity***	***Functionality/ fragmentation***	***TOTAL***	***SENSITIVITY INDEX***	***SENSITIVITY CLASS***
Community	**Criteria Ranking**							
Agricultural Fields	0	1	2	2	1	33	10 %	low
Buildings	0	0	1	1	2	17	5 %	low
Channelled Valley Bottoms	8	10	9	8	9	281	88 %	high
Dams/ Impoundments - Artificial	0	1	0	1	1	16	5 %	low
Dams/ Impoundments - Natural	4	8	6	5	6	183	57 %	medium
Degraded Grassland	3	4	5	5	6	135	42 %	medium
Endorheic Pans	8	10	8	7	8	267	83 %	high
Exotic Stands	1	1	2	2	2	46	14 %	low
Hillslope Seepage	8	9	7	9	9	266	83 %	high
Natural Grassland	8	8	8	9	9	264	83 %	high
Roads & Linear Infrastructure	0	0	1	1	1	14	4 %	low
Unchannelled Valley Bottoms	8	10	8	8	9	275	86 %	high
Excavations	1	2	2	2	2	54	17 %	low
Mining Areas	0	2	2	3	4	55	17 %	low
Ridge	8	9	10	9	9	284	89 %	high
Pastures	1	2	2	3	5	68	21 %	medium-low

Please note that illustration of the floristic sensitivity might not correspond entirely with the 'general sensitivity estimations' as fine-scaled changes might be applied due to localised impacts, effects and characteristics that have a bearing on the floristic sensitivity of a particular parcel of land.

Figure 14: Floristic sensitivity of the study area



9.9 BOTANICAL IMPACT ASSESSMENT

The impact assessment is aimed at presenting a description of the nature, extent significance and potential mitigation of identified impacts on the floristic environment. These tabular assessments are presented in **Section 9.10** in the form of an Impact Rating Matrix for expected impacts within the development area.

9.9.1 Identification of Impacts

No impacts were identified that could lead to a beneficial impact on the floristic environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status.

Impacts resulting from the proposed development on floristic attributes of the study area are largely restricted to the physical effects. Direct impacts include any effect on populations of individual species of conservation importance and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof are immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured at a moment in time. In addition, the extent of the effect is frequently at a scale that is larger than the actual site of impact. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts. Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

The following impacts are regarded relevant to this type of development/ activity:

- Direct impacts on flora species of conservation importance;
- Loss or degradation of natural vegetation/ sensitive habitat types;
- Impacts on ecological connectivity & ecosystem functioning
- Indirect impacts (loss/ degradation/ pollution) on surrounding habitat;
- Impacts on SA's conservation obligations & targets; and
- Increase in local and regional fragmentation/ isolation of habitat.

9.9.2 Nature of Impacts

Impacts that are likely to result from the proposed activities are described briefly below. This list was compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of this type of development on the floristic environment. The most significant impact will result from a potential loss of habitat, which may have direct or indirect impacts on individual organisms or communities.

- **Direct Impacts on Flora Species of Conservation Importance**

This is a direct impact since it results in the physical damage or destruction of Red Data species/ communities, areas where these species are known to occur or areas that are considered particularly suitable for these species. Threatened plant species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human activities is one of the greatest reasons for these species having a threatened status. Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest limitations in terms of mitigating or preventing this particular impact, is the paucity of species specific information that describe their presence, distribution patterns, population dynamics and habitat requirements. To allow for an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited largely.

Since the proposed stooping activity is unlikely to result in the direct destruction of large expanses of grassland habitat (since much of the operation is located underground), it could be reasoned that little impact will be effected on the actual flora of the proposed stooping areas. However, resultant effects of the stooping activity, such as surface subsidence and altered hydromorphic conditions, will result in altered habitat conditions, which in turn will have a direct impact on the habitat qualities and status of areas where conservation important plants are likely to persist.

The likelihood of Red Data flora species occurring within the study area is regarded high, although survey data indicated the presence of only one species. Certain areas are however regarded as prime grassland; the conservation of these areas should be prioritised and would likely provide protection of plant species of conservation importance that could potentially occur in the region.

- **Loss or Degradation of Natural Vegetation/ Sensitive Habitat**

The loss or degradation of natural vegetation or habitat that are regarded sensitive as a result of restricted presence in the larger region (atypical habitat) represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types might include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities and faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region. Furthermore, it has been established that plant species of conservation importance are frequently associated with habitat types that exhibit restricted representation on a regional scale.

- **Impacts on Ecological Connectivity & Ecosystem Functioning**

The larger region is characterised by highly transformed and fragmented grassland habitat. This is also reflected in the study area and immediate surrounds. Therefore, the ecological connectivity that natural habitat provides within this regional setting of habitat fragmentation and isolation, is therefore particularly important in the effective functioning of the regional and local ecological processes. Evidence obtained during the investigation period revealed that the biodiversity aspects recorded within both the terrestrial grassland types and wetland related habitat is much higher than would be expected when looking at the study area in isolation, providing insight into the regional importance of these habitat types. It is therefore reasonable to assume that the biodiversity persisting in these habitat types migrate extensively across the region for various reasons.

The ecological interconnectivity of terrestrial and wetland related habitat types is important for the functioning; without terrestrial grasslands, the reservoirs of water that feed wetland habitat types will disappear and the characteristics and features that makes these features suitable for a high biodiversity will disappear, effectively destroying the remaining biodiversity to a large extent.

- **Indirect Impacts (loss/ degradation/ pollution) on Surrounding Habitat**

Surrounding areas and species present in the direct vicinity of the study areas will likely be affected adversely by indirect impacts resulting from construction and operational activities. These indirect impacts also include adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

These impacts lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases, these effects are not bound and is dispersed, or diluted over an area that is much larger than the

actual footprint of the causal factor. The nature of mining is such that pollution and degradation of the surrounding areas can reasonably be expected. This is evident from existing activities.

These impacts lead to a reduction in the resilience of peripheral ecological communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of drainage lines, is regarded important. It is well known that the status of a catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines might be insignificant on a regional scale, but the combined impact on numerous such small drainage lines will affect the quality of larger rivers further downstream adversely.

- **Impacts on SA's Conservation Obligations & Targets**

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas or threatened areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types (VEGMAP, 2006) and because impacts that result in irreversible transformation of natural habitat is regarded significant, a significant disruption of ecosystem functioning is assumed in the Endangered and Vulnerable vegetation types that occupy the study area.

Considering the potential loss of natural vegetation within the study area, a moderately significant impact is expected on the conservation status of the regional vegetation type.

- **Increase in Local & Regional Fragmentation/ Isolation of Habitat**

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are usually beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by high levels of transformation and habitat fragmentation. However, in spite of this fragmented nature, a measure of connectivity is still present along the wetland habitat types and grassland portions that are not actively cultivated. This connectivity is critical in the preservation of pollinator species that provide important ecological services. The isolation of parcels of natural habitat is likely to contribute to loss of genetic variability, decrease in diversity and accentuated impacts from surrounding land uses.

9.10 BOTANICAL IMPACT RATING TABLES

9.10.1 Construction Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CONSTRUCTION PHASE ACTIVITIES																		
Area A																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	2	34	-	M	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	6	5	2	1	13	-	L	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	5	2	2	26	-	L		4	5	2	1	11	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	4	3	3	45	-	M		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area B																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams,	10	5	3	4	72	-	H	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from	8	5	3	2	32	-	M	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat, Natural grassland habitat types		8	5	3	4	64	-	H		6	4	3	2	26	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem	Wetland habitat, Degraded Grassland, Natural		8	4	3	4	60	-	M		6	4	3	2	26	-	L	Biodiversity monitoring programme, erosion management programme, alien

functioning	Grassland habitat types	coal storage facilities, etc								construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors								and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		6	4	2	4	**48**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area C																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pan)	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	4	2	2	**28**	-	**L**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	6	4	2	1	**12**	-	**L**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pan)		6	4	2	1	**12**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pan)		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area D																			
Direct impacts on flora species of conservation importance	None	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	4	2	2	**28**	-	**L**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	6	4	2	1	**12**	-	**L**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	None		6	4	2	1	**12**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Degraded Grassland		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

Area E																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	8	5	2	2	**30**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	4	**48**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area F																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	8	5	3	2	**32**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		6	4	2	4	**48**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area G																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural	Any construction related activity resulting in destruction, clearing, degradation	10	5	3	4	**72**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat,	8	5	3	2	**32**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme

	Grassland habitat types	or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc							particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors								
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		8	4	3	3	**45**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area H																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors	10	5	2	2	**34**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		10	5	2	4	**68**	-	**H**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area I																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction	8	5	2	2	**30**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive	Wetland habitat types (Unchannelled valley		10	5	2	4	**68**	-	**H**		8	5	2	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien

habitat types	bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc								activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors								and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		8	5	3	4	**64**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

9.10.2 Operational Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
OPERATIONAL PHASE ACTIVITIES																		
Area A																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	3	51	-	M	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	6	5	2	2	26	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	5	2	3	39	-	M		4	5	2	2	22	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	4	3	3	45	-	M		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area B																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities,	10	5	3	4	72	-	H	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational	8	5	3	2	32	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat, Natural grassland habitat types		8	5	3	4	64	-	H		8	5	3	2	32	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	4	3	4	60	-	M		8	4	3	2	30	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and

		etc								impacts, contamination, etc.								integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		6	4	2	4	48	-	M		8	5	2	2	30	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area C																		
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pan)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	4	2	2	28	-	L	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	6	4	2	1	12	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pan)		6	4	2	1	12	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pan)		6	4	2	2	24	-	L		4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	24	-	L		4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area D																		
Direct impacts on flora species of conservation importance	None	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	4	2	2	28	-	L	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	6	4	2	1	12	-	L	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	None		6	4	2	1	12	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Degraded Grassland		6	4	2	2	24	-	L		4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	24	-	L		4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

Area E																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	3	**51**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	5	2	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	3	**51**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	3	**42**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area F																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	3	**42**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		4	4	2	3	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area G																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural	Any operational related activity resulting in destruction,	8	5	3	4	**64**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat,	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and

	Grassland habitat types	degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc							particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.								integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		8	4	3	3	**45**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area H																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	10	5	2	2	**34**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		10	5	2	3	**51**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area I																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure,	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones.	8	5	2	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of	Wetland habitat types		10	5	2	4	**68**	-	**H**	Minimising operational	8	5	2	3	**45**	-	**M**	Biodiversity monitoring programme,

natural vegetation/ sensitive habitat types	(Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc								footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.									erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		8	5	3	4	**64**	-	**H**		8	5	2	4	**60**	-	**M**		Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**		Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

9.10.3 Closure & Decommissioning

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
DECOMMISSIONING AND CLOSURE PHASE ACTIVITIES: 1. REMOVAL OF INFRASTRUCTURE 2. ACTIVE SURFACE REHABILITATION OF DISTURBED AREAS																		
Area A																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	3	1	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	4	2	2	**24**	-	**L**		6	3	1	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	3	1	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		4	4	2	2	**20**	-	**L**		4	3	1	2	**16**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Area B																		
Direct impacts on flora species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat, Natural grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management

																		programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		4	4	2	2	**20**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area C																		
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pan)	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	4	1	1	**11**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pan)		6	4	2	2	**24**	-	**L**		4	4	1	1	**9**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pan)		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		4	4	2	2	**20**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area D																		
Direct impacts on flora species of conservation importance	None	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	4	2	1	**12**	-	**L**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme, seedharvesting, germination and storage programme
Loss or degradation of natural vegetation/ sensitive habitat types	None		6	4	2	1	**12**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Degraded Grassland		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

Area E																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	10	5	2	3	**51**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	5	2	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	3	**51**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	3	**42**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area F																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		4	4	2	2	**20**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area G																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural	Removal of mining infrastructures, decommissioning of linear infrastructure,	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species,	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and

	Grassland habitat types	rehabilitation and revegetating of affected areas where surface disturbances resulted								including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features								integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area H																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		6	4	3	2	**26**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Area I																			
Direct impacts on flora species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Loss or degradation of	Wetland habitat types		8	4	2	3	**42**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme,

natural vegetation/ sensitive habitat types	(Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	resulted								topographical features								erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		6	4	3	3	**39**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		6	4	2	3	**36**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme

9.10.4 Residual Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
RESIDUAL IMPACTS																		
Area A																		
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M	
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M	
Area B																		
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M	
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M	
Area C																		
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M	
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M	
Area D																		
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem			4	5	2	4	44	-	M		4	5	2	4	44	-	M	

functioning		structure, areas of surface subsidence								herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features									
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M		
Area E																			
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme	
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M		
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M		
Area F																			
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme	
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M		
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M		
Area G																			
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme	
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M		
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M		
Area H																			
Loss or degradation of natural vegetation/ sensitive habitat types	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme	
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	44	-	M		4	5	2	4	44	-	M		
Residual impacts of pollution and habitat degradation			4	5	2	3	33	-	M		4	5	2	3	33	-	M		
Area I																			
Loss or degradation of natural vegetation/ sensitive	All affected areas and immediate surrounds	Altered topographical conditions, altered	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a	6	5	2	4	52	-	M	Biodiversity monitoring programme, erosion management programme, alien	

habitat types		hydrological regimes, altered botanical composition and structure, areas of surface subsidence							suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features								and invasive plant control & management programme, revegetation and rehabilitation programme
Impacts on ecological connectivity & ecosystem functioning			4	5	2	4	**44**	-	**M**		4	5	2	4	**44**	-	**M**	
Residual impacts of pollution and habitat degradation			4	5	2	3	**33**	-	**M**		4	5	2	3	**33**	-	**M**	

9.10.5 Cumulative Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CUMULATIVE IMPACTS: IMPACTS CONSIDERED ON A REGIONAL SCALE																		
Area A																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	2	4	52	-	M	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Increase in local and regional fragmentation/ isolation of habitat			4	5	2	4	44	-	M		4	4	2	3	30	-	M	
Area B																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	56	-	M	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	4	2	3	36	-	M	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	48	-	M		4	5	2	3	33	-	M	
Area C																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	4	4	2	2	20	-	L	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	3	3	2	1	8	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Increase in local and regional fragmentation/ isolation of habitat			4	4	2	2	20	-	L		4	3	2	1	9	-	L	
Area D																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	4	4	2	2	20	-	L	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	3	3	2	1	8	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Increase in local and regional fragmentation/ isolation of habitat			4	4	2	2	20	-	L		4	3	2	1	9	-	L	
Area E																		
Impacts on SA's	All mining areas where	Mining and mining	6	5	3	4	56	-	M	Minimize development	6	4	2	3	36	-	M	Biodiversity monitoring programme,

conservation obligations & targets	surface disturbances/ deterioration resulted caused by mining or mining related activities	related activities that resulted in deterioration and destruction of remaining natural habitat								footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities										erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	3	**33**	-	**M**			
Area F																				
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	4	4	3	3	**33**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme	
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	4	3	3	**33**	-	**M**			
Area G																				
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme	
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	3	**33**	-	**M**			
Area H																				
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	4	2	4	**48**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme	
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	4	**44**	-	**M**			
Area I																				
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	4	2	4	**48**	-	**M**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, hydrological functionality and integrity management programme	
Increase in local and regional fragmentation/ isolation of habitat			6	5	3	4	**56**	-	**M**		4	5	2	4	**44**	-	**M**			

9.11 DISCUSSION

While extensive parts of the study area comprehend transformed and degraded habitat that does not exhibit any inherent floristic attributes of sensitivity, remaining areas of natural terrestrial grassland and wetland habitat types are regarded representative of the regional ecological types, and therefore sensitive. The high sensitivity ascribed to these parts is not only the result of a relative high probability conservation important plants occurring within these areas, but also because of the high conservation value that is ascribed to the regional vegetation types (Endangered, Vulnerable – VEGMAP, 2006). The loss of natural habitat would therefore represent a significant cumulative impact on the conservation status of the regional vegetation types. The potential loss, or degradation, of approximately 8,400 ha of natural habitat in the study area is likely to have a significant effect on the regional vegetation.

The status of terrestrial natural grassland, vary greatly across the study area. Considering the extent of habitat transformation on a local and regional scale, the high floristic importance ascribed to remaining natural grassland does not only reflect the national status (Endangered), but also the effect of fragmentation, isolation factors and general degradation that results from land use, particularly cultivation and inappropriate grazing strategies. It is also critical to note that the extent of remaining natural habitat of the Eastern Highveld Grassland, as indicated in VEGMAP data, and on which the 'Endangered' status is based, is likely to be slightly inaccurate, as data used to establish the conservation status does not indicate recent land use changes resulting from agriculture and mining and, importantly, does not consider local degradation effects. Results from this assessment substantiate this statement as numerous areas of transformed habitat is not accurately reflected on aerial images as recent as 2007, while portions of 'natural grassland' were found to be in a poor status and is unlikely to recover to a prime status. The conservation of natural grasslands of the area should therefore be prioritised. The floristic diversity of pristine grasslands is significantly higher than that of degraded grassland. This might not be immediately visible from data presented in the report, but a closer inspection reveals that an artificial high diversity of degraded habitat results due to the presence of numerous weeds and opportunistic species that are not associated with the natural grasslands. When these species are not taken into account, it is evident that the diversity of degraded areas is particularly poor.

Similarly, wetland habitat types are generally accepted as sensitive for numerous reasons other than only vegetation, or biodiversity. Results of this assessment confirmed the high sensitivity and, in spite of the high utilisation factor that is noted across the study area, most areas were found to be relatively pristine. Reference is made to the three perennial streams occurring in the study area. These areas are regarded high in floristic diversity and are visually attractive. Particular reference is made to the Vaalbankspruit situated in the southern part of the study area (Area I). This area is regarded a prime example of the regional vegetation, comprising a concomitance of habitat types that result in an exceptionally high local diversity. In addition to the drainage lines and ephemeral grasslands that typify the study area, the presence of numerous endorheic pans contributes to the importance of the wetland habitat type. While the status of these areas is not pristine because of severe effects of grazing by cattle and nearby agriculture, their importance and contribution to the local and regional diversity cannot be overestimated.

A low sensitivity is ascribed to transformed and degraded areas, but these areas do play an important role as buffers around areas of natural/ sensitive habitat. The importance of these areas as buffers will be amplified during the proposed development. Strong recommendations for i) the exclusion of all areas of high sensitivity, and ii) the inclusion of buffers (consisting of areas of low sensitivity), will form part of the recommended mitigation measures of this report that will ultimately be incorporated in the EMP for the development. The estimated sensitivity of certain portions were therefore adapted to allow for protection of

nearby sensitive areas, in spite of a low floristic importance that these portions might hold on a local or regional scale.

The significance of impacts associated with the proposed stooping operations is directly related to the floristic sensitivity ascribed to the study area. The large extent of planned mining operations in the study area will undoubtedly result in significant impacts on the floristic environment. These impacts, largely, will result from habitat destruction associated with surface operations. The exclusion of all areas of natural and sensitive habitat will therefore be advocated as the most important mitigation measure. Impacts associated with stooping are likely to be severe on a different scale since the vegetation are not affected directly, implying destruction through surface clearance activities. However, surface changes (topographical alteration) are likely to affect the moisture balances of the top part of the soil and long-term species changes will result.

These effects are regarded particularly important in the case of lower landscapes and depressions (wetlands). Vegetation of these habitat types are strongly zonal and has been established within extremely narrow environmental parameters that include soil types, moisture levels, dependence on adjacent grasslands, topographical aspects, etc. Changes to the flow directions, moisture regimes, or any other definitive factor, are likely to result in severe and permanent damage to these areas. The exclusion of all wetland habitats will form the basis of mitigation of impacts within this habitat type.

Mitigation of direct impacts resulting from mining activities is largely restricted to the exclusion of sensitive areas. Direct impacts on vegetation are irreversible, even with the application of detailed rehabilitation procedures. Furthermore, the inherent dependence of various grassland habitat types (upland/ lowland interface) on each other limits the blanket approach of excluding only sensitive areas from a development of this nature. The creation of buffer zones and connective corridors is critical to avert peripheral (indirect) impacts from affecting the status of grassland and wetland habitat types on the long term. Generic mitigation measures, which are detailed in a later section of this report, will form the basis of protection from indirect, direct and peripheral impacts, but must be strongly controlled and monitored.

Biodiversity offsite interventions are strongly recommended in cases where unavoidable impacts will result in areas of high floristic sensitivity. The inclusion of sensitive areas in local conservation and management strategies will benefit the diversity on a regional scale.

9.12 GENERIC MITIGATION MEASURES

9.12.1 Site Specific Mitigation Measures

Mitigation Measure 1 - Exclude all areas of the sensitive habitat from the proposed development;

Mitigation Measure 2 - Implement a suitable buffer zone (at least 30 m) between the edge of these areas habitat and any type of development or surface disturbance;

Mitigation Measure 3 - Exclude as much of the wetland and endorheic pans from the development as possible, particularly the larger portions. Cognisance of the wetland ecologist/ specialist is regarded imperative in this regard. This should be done during the planning phase;

Mitigation Measure 4 - Implement a suitable buffer zone around the sensitive habitat types, taking cognisance of recommendations from the wetland report;

Mitigation Measure 5 - Prevent all and any influx of water into the natural grassland, wetlands and endorheic pans;

Mitigation Measure 6 - Prevent contamination of natural grassland, wetland and endorheic pans from nearby stockpiling, conveyor lines, water treatment facilities or any other source of pollution;

Mitigation Measure 7 - Remove and relocate all plant species of conservation importance that are present within development areas.

9.12.2 General Aspects

Mitigation Measure 8 - Appoint an Environmental Control Officer (ECO) prior to commencement of construction. Responsibilities should include, but not necessarily be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 9 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Biodiversity monitoring should be conducted at least twice per year (Summer, Winter) in order to assess the status of conservation areas;

9.12.3 Environmental Control Officer

Mitigation Measure 10 - Have overall responsibility for the implementation of the EMP;

Mitigation Measure 11 - Ensure that Exxaro and all contractors are aware of specifications, legal constraints and Exxaro standards and procedures pertaining to the project specifically with regards to the environment;

Mitigation Measure 12 - Ensure that all stipulations within the EMP are communicated and adhered to by Exxaro and its contractors;

Mitigation Measure 13 - Monitor the implementation of the EMP throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes;

Mitigation Measure 14 - Be fully conversant with the Environmental Impact Assessment for the project, the conditions of the RoD, all relevant environmental legislation and with the EMP;

Mitigation Measure 15 - Ensure that periodic environmental performance audits are undertaken on the project implementation;

Mitigation Measure 16 - Convey the contents of the EMP to the site staff and discuss the contents in detail with the Project Manager and Contractors;

Mitigation Measure 17 - Take appropriate action if the specifications contained in the EMP are not followed;

Mitigation Measure 18 - Monitor and verify that environmental impacts are kept to a minimum, as far as possible;

Mitigation Measure 19 - Compile progress reports on a regular basis, with input from the Site Manager, for submission to the Project Manager, including a final post-construction audit carried out by an independent auditor/consultant.

9.12.4 Fences & Demarcation

Mitigation Measure 20 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

Mitigation Measure 21 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

Mitigation Measure 22 - Fencing should allow adequate movement of small mammals between areas of natural habitat;

9.12.5 Fire

Mitigation Measure 23 - The Project team will compile a Fire Management Plan (FMP) and Contractors directed by the ECO will submit a FMP. The Project FMP shall be approved by local Fire Protection Association, and shall include *inter alia* aspects such as relevant training, equipment on site, prevention, response, rehabilitation and compliance to the National Veld and Forest Fire Act, Act No. 101 1998;

Mitigation Measure 24 - Prevent all open fires;

Mitigation Measure 25 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

Mitigation Measure 26 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

Mitigation Measure 27 - The irresponsible use of welding equipment, oxy-acetylene torches and other naked flames, which could result in veld fires, or constitute a hazard and should be guided by safe practice guidelines;

Mitigation Measure 28 - The use of fire as a management tool in ecologically sensitive areas should be guided and instructed by a qualified ecologist;

Mitigation Measure 29 - Use of plants occurring within ecologically sensitive areas for fire making purposes is strictly prohibited;

9.12.6 Roads & Access

Mitigation Measure 30 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 31 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 32 - Dust control on all roads should be prioritised;

Mitigation Measure 33 - No roads should be allowed within ecologically sensitive areas.

9.12.7 Workers & Personnel

Mitigation Measure 34 - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 35 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

9.12.8 Vegetation Clearance & Operations

Mitigation Measure 36 - The landowner must immediately take steps to remove alien vegetation as per Conservation of Agricultural Resource Act, namely:

- Uprooting, felling or cutting;
- Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer;
- The application of control measures regarding the utilisation and protection of veld in terms of regulation 9 of the Act;
- The application of control measures regarding livestock reduction or removal of animals in terms of regulations 10 and 11 of the Act;
- Any other method or strategy that may be applicable and that is specified by the executive officer by means of a directive.
- According to the Conservation of Agricultural Resource Act (No. 43 of 1983) as amended, the person applying herbicide must be adequately qualified and certified as well as registered with the appropriate authority to apply herbicides.

Mitigation Measure 37 - The size of areas subjected to land clearance will be kept to a minimum;

Mitigation Measure 38 - Only areas as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 39 - Cleared vegetation and debris that has not been utilised will be collected and disposed of to a suitable waste disposal site. It will not be burned on site;

Mitigation Measure 40 - No vegetation will be cut or collected off construction sites for burning or for any other purpose without the prior permission of the Site Manager;

Mitigation Measure 41 - All vegetation not required to be removed will be protected against damage;

Mitigation Measure 42 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 43 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and vice versa and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act (No 43 of 1983) and must be addressed on a continual basis, through an alien vegetation control and monitoring programme;

Mitigation Measure 44 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area;

Mitigation Measure 45 - Stored topsoil will be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds, which would adversely affect its suitability for planting;

Mitigation Measure 46 - No spoil material will be dumped outside the defined site;

Mitigation Measure 47 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 48 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 49 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 50 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 51 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 52 - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 53 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 54 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 55 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

9.12.9 Waste

Mitigation Measure 56 - As far as possible, waste should be avoided, reduced, re-used and/or recycled. Where this is not feasible, all waste (general and hazardous) generated during the construction of the power station may only be disposed of at appropriately licensed waste disposal sites (in terms of Section 20 of the Environment Conservation Act, No 73 of 1989 and in accordance with the new waste act: National Environmental Waste Management Act 2008);

Mitigation Measure 57 - Prevent and advocate against the indiscriminate disposal of rubbish, litter or rubble;

Mitigation Measure 58 - The burning of general waste material under any circumstances is not to be allowed;

Mitigation Measure 59 - The use of small on-site incinerators for waste burning should be investigated, and if found feasible, be implemented;

Mitigation Measure 60 - Waste will be sorted at source (i.e. the separation of tins, glass, paper etc); recycled waste of this sort will be collected by an accredited waste removal contractor;

Mitigation Measure 61 - A stormwater management plan will be compiled that will address, inter alia, capturing and storage of stormwater;

Mitigation Measure 62 - All runoff water from fuel deposits, workshops, vehicles washing areas and other equipment must be collected and directed through oil traps to settlement ponds. These ponds must be suitably lined and should be cleaned as soon as practicable, and the sludge disposed off at a suitable waste site;

Mitigation Measure 63 - No wastewater or water containing any chemical or pollutant should be released from, or escape as effluent, from the site.

10 FAUNAL ASSESSMENT

Please take note that the faunal assessment in this document excludes avifauna as it presented as a separate assessment in Section 11 of this report.

10.1 REGIONAL FAUNAL DIVERSITY

The study area is located within the regional vegetation community of Eastern Highveld Grassland (Mesic Highveld Grassland Bioregion: Grassland Biome – VegMap, 2006). The Eastern Highveld Grassland is listed as Endangered (only 56 % remains untransformed). The Grassland Biome (or ecoregion) of South Africa is found in all nine provinces of the country, covering 26 % of the country and includes six major regions comprising 14 vegetation types. Grasslands are the habitat of large herds of antelope, as well as many smaller animals. The grassland biome is one of the most threatened in South Africa; the development of the forestry, mining and development industries have irreversibly transformed 60-80 % of grasslands in South Africa, with only 2 % formally conserved. Grasslands are characterised by high levels of species richness and endemism:

- Mammals: 89 species (18 endemic, 9 threatened);
- Reptiles: 84 species (17 endemic, 4 threatened);
- Amphibians: 36 species (18 endemic, 2 threatened); and
- Invertebrates: unknown (? endemic, 16 threatened).

It is important to view the study area on an ecologically relevant scale; consequently, all sensitive animal species (specific faunal groups) known from Mpumalanga are included in this assessment. Detailed regional and scientific data on all faunal groups are lacking (notably for most of the invertebrate groups) and as a result only data sets on specific faunal groups allow for habitat sensitivity analyses based on the presence/ absence of sensitive faunal species (Red Data species) and their specific habitat requirements. The following faunal groups were included in these analyses:

- Butterflies (Invertebrata: Insecta: Lepidoptera – Nymphalidae, Lycaenidae, Hesperiidae, Pieridae and Papilionidae). References used include the IUCN Red List (2011) – http://www.iucnredlist.org and the South African Butterfly Conservation Assessment (SABCA, 2011) – http://sabca.adu.org.za;
- Frogs (Amphibia: Anura). References used include the Atlas and Red Data Book of the South Africa, Lesotho and Swaziland, the Giant Bullfrog Conservation Group (2011) – http://www.up.ac.za/bullfrog and a Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009);
- Reptiles (Reptilia: Testudines and Squamata). References used include the IUCN Red List (2011) and the South African Reptile Conservation Assessment (SARCA, 2011) – http://sarca.adu.org.za; and
- Terrestrial Mammals (Mammalia: Insectivora, Chiroptera, Primates, Lagomorpha, Pholidota, Rodentia, Carnivora, Tubulidentata, Proboscidea, Hyracoidea, Perissodactyla and Artiodactyla). References used include the Red Data Book of the Mammals of South Africa: A Conservation Assessment (Endangered Wildlife Trust - 2004).

As more data become available, additional faunal groups are likely to be added to these assessments. Dragonflies and Damselflies (Invertebrata: Insecta: Odonata) are some examples of future inclusions.

Animals known to be present in the Q-grids 2628BD, 2629AA and 2629AC were considered potential inhabitants of the study area (all species known from Mpumalanga were included in the assessment to limit the known effects of sampling bias).

10.2 FAUNAL DIVERSITY OF THE SITE

The study area is located in the southwestern part of Mpumalanga. During the field investigations, conducted during July, 2011 (dry season) and January, 2012 (wet season), a total of 61 animals were recorded in the study area (refer **Table 16**). This diversity includes one spider, one centipede, one tick, two damselflies, two dragonflies, one termite, one cricket, one bug, nine beetles, twelve butterflies, one fly, one bee, four frogs, two reptiles and twenty-one mammals. Three of the mammals recorded in the study area represent introduced (alien) species (refer **Table 16** – blue) and one species is listed as red data (refer **Table 16** – red). In addition, invertebrates from 36 families were recorded in the study area (refer **Table 17**), due to various reasons these invertebrates could not be identified to genus or species level at the time of the surveys.

Animals recorded in the study area during the two faunal site investigations represent typical grassland-wetland faunal communities of the fragmented landscape of the southwestern Mpumalanga Province (*pers. obs.*).

Table 16: Animal species recorded in the study area

Class	*Order*	*Family*	*Biological Name*	*English Name*
Arachnida	Araneae	Araneidae	*Neoscona sp*	Hairy Field Spider
Chilopoda	Scolopendromorpha	?	*Scolopendra sp*	Red-footed Centipede
	Acariformes	Ixodidae	*Rhipicephalus sp*	Brown Tick
Insecta	Odonata	Coenagrionidae	*Ischnura senegalensis*	Marsh Bluetail
			Africallagma glaucum	Swamp Bluet
		Libellulidae	*Trithemis arteriosa*	Red-veined Dropwing
			Orthetrum julia	Julia Skimmer
		Aeshnidae	*Anax imperator*	Blue Emperor
	Isoptera	Termitidae	*Trinervitermes sp*	Snouted Harvester Termite
	Orthoptera	Gryllidae	*Platygryllus sp*	Common Cricket
	Hemiptera	Lygaeidae	*Spilostethus pandurus*	Milkweed Bug
	Coleoptera	Cicindelidae	*Lophyra brevicollis*	Common Tiger Beetle
		Tenebrionidae	*Lagria sp*	Hairy Darkling Beetle
		Meloidae	*Decapotoma sp*	Blister Beetle
		Melyridae	*Astylus atromaculatus*	Spotted Maize Beetle
		Coccinellidae	*Cheilomenes lunata*	Lunate Ladybird
			Exochomus flavipes	Black Mealy Bug Predator
		Scarabaeidae	*Anisorrhinia umbonata*	Flower-loving Fruit Chafer
			Pedinorrhina plana	Yellow-belted Fruit Chafer
			Popillia biguttata	Yellow Shining Leaf Chafer
	Lepidoptera	Nymphalidae	*Danaus chryssipus*	African Monarch
			Junonia hierta	Yellow Pansy
			Telchinia rahira	Marsh Acraea
			Vanessa cardui	Painted Lady
		Lycaenidae	*Cacyreus marshalli*	Common Geranium Bronze
			Freyeria trochylus	Grass Jewel Blue
			Lycaena clarki	Eastern Sorrel Copper
			Zizula hylax	Gaika Blue
		Pieridae	*Belenois aurota*	Brown-veined White
			Pontia helice	Meadow White
		Papilionidae	*Papilio demodocus*	Citrus Swallowtail
		Hesperiidae	*Kedestes wallengrenii*	Wallengren's Ranger
	Diptera	Bombyliidae	*Bombomyia discoidea*	Pied Bee Fly
	Hymenoptera	Apidae	*Apis mellifera*	Honey bee

Table 16: Animal species recorded in the study area				
Class	***Order***	***Family***	***Biological Name***	***English Name***
Amphibia	Anura	Pipidae	*Xenopus laevis*	Common Platanna
		Bufonidae	*Amietophrynus rangeri*	Raucous Toad
		Pyxicephalidae	*Amietia angolensis*	Common River Frog
			Cacosternum boettgeri	Boettger's Caco
Reptiles	Squamata	Elapidae	*Hemachatus haemachatus*	Rinkhals
		Varanidae	*Varanus niloticus*	Water Monitor
Mammalia	Tubulidentata	Orycteropodidae	*Orycteropus afer*	Aardvark
	Lagomorpha	Leporidae	*Lepus saxatilis*	Scrub Hare
	Rodentia	Bathyergidae	*Cryptomys hottentotus*	Common Mole-rat
		Hystricidae	*Hystrix africaeaustralis*	Porcupine
		Muridae	*Tatera brantsii*	Highveld Gerbil
			Mus minutoides	Pygmy Mouse
			Otomys irroratus	Vlei Rat
	Carnivora	Felidae	*Leptailurus serval*	Serval
		Viverridae	*Genetta genetta*	Common Genet
		Herpestidae	*Atilax paludinosus*	Marsh Mongoose
			Cynictis penicillata	Yellow Mongoose
			Galerella sanguinea	Common Slender Mongoose
		Canidae	*Canis mesomelas*	Black-backed Jackal
			Vulpes chama	Cape Fox
		Mustelidae	*Aonyx capensis*	African Clawless Otter
	Artiodactyla	Suidae	*Phacochoerus africanus*	Common Warthog
		Cervidae	*Dama dama*	Common Fallow Deer
		Bovidae	*Raphicerus campestris*	Steenbok
			Antidorcas marsupialis	Cape Springbok
			Damaliscus phillipsi	Blesbok
			Sylvicapra grimmia	Bush Duiker

Table 17: Invertebrate families recorded in the study area			
Class	***Order***	***Family***	***English Name***
Arachnida	Araneae	Thomisidae	Crap Spiders
Insecta	Odonata	Libellulidae	Skimmers
	Blattodea	Blattellidae	Small Cockroaches
		Blaberidae	Sluggish Cockroaches
	Isoptera	Termitidae	Common Termites
	Dermaptera	Labiduridae	Long-horned Earwigs
	Orthoptera	Tettigoniidae	Katydids
		Lentulidae	Wingless Grasshoppers
		Acrididae	Short-horned Grasshoppers
	Hemiptera	Tingidae	Lace Bugs
		Reduviidae	Assassin Bugs
		Lygaeidae	Seed Bugs
		Scutteleridae	Shield-backed Bugs
		Pentatomidae	Stink Bugs
		Gerridae	Water Striders
		Issidae	Dumpy Planthoppers
		Cicadellidae	Leaf Hoppers
	Thysanoptera	Thripidae	Common Thrips
	Coleoptera	Dytiscidae	Water Beetles
		Gyrinidae	Whirligig Beetles
		Silphidae	Carrion Beetles
		Scarabaeidae	Scarab Beetles
		Melyridae	Soft-winged Flower Beetles
		Coccinellidae	Ladybirds
		Meloidae	Blister Beetles
		Chrysomelidae	Leaf Beetles
	Diptera	Tipulidae	Craneflies
		Chironomidae	Midges
		Culicidae	Mosquitoes
		Tabanidae	Horseflies
		Syrphidae	Hover Flies
		Muscidae	House Flies
		Calliphoridae	Bluebottles
	Lepidoptera	Geometridae	Loopers
	Hymenoptera	Sphecidae	Sand Wasps
		Formicidae	Ants

10.3 RED DATA FAUNA ASSESSMENT

Red Data species that were not observed in the study area during the field assessment were assessed by implementing the following criteria:

- the size of the study area;
- the location and connectivity of the study area with regards to other natural faunal habitats; and,
- the presence/absence, status and diversity of natural faunal habitats within the study area.

Above-mentioned criteria are used in partnership with the known distribution of Red Data species as well as their known habitat requirements to estimate their likelihood of occurring in the study area.

A total of 88 conservation important animals are known to occur in the Mpumalanga (butterflies, frogs, reptiles and mammals), indicated in **Table 18**. This includes 26 listed as Data Deficient (DD), 31 as Near Threatened (NT), 20 as Vulnerable (VU), 8 as Endangered (EN) and 3 as Critically Endangered (CR). It is estimated that 69 of these animals have a low probability of occurring in the study area, 10 have a moderate-low probability, 6 a moderate probability and 2 were attributed a high probability of occurring in the study area. One species was confirmed to be present in the study area, namely Cerval.

Table 18: Red Data Fauna assessment for the study area

Species Details			***Probability***
Biological Name	***English Name***	***RD Status***	
Butterflies			
Aloeides barbarae	Barbara's Copper	EN	low
Aloeides merces	Wakkerstroom Copper	VU	low
Aloeides nubilus	Cloud Copper	VU	low
Aloeides rossouwi	Rossouw's Copper	VU	low
Chrysoritis aureus	Heidelberg Opal	VU	low
Chrysoritis phosphor borealis	Scarce Scarlet	DD	low
Lepidochrysops irvingi	Irving's Blue	EN	low
Lepidochrysops jefferyi	Jeffrey's Blue	EN	low
Lepidochrysops swanepoeli	Swanepoel's Blue	VU	low
Metisella meninx	Marsh Sylph	VU	high
Frogs			
Breviceps sopranus	Whistling Rain Frog	DD	low
Breviceps sylvestris	Northern Forest Rain Frog	EN	low
Hemisus guttatus	Spotted Shovel-nosed Frog	VU	low
Pyxicephalus adspersus	Giant Bullfrog	NT	moderate-low
Strongylopus wageri	Plain Stream Frog	NT	low
Reptiles			
Acontias breviceps	Short-headed Legless Skink	NT	moderate-low
Afroedura major	Swazi Flat Gecko	NT	low
Chamaesaura aenea	Coppery Grass Lizard	NT	moderate-low
Chamaesaura macrolepis	Large-scaled Grass Lizard	NT	moderate-low
Crocodylus niloticus	Nile Crocodile	VU	low
Homoroselaps dorsalis	Striped Harlequin Snake	NT	moderate-low
Kinixys natalensis	Natal Hinged Tortoise	NT	low
Lamprophis fuscus	Yellow-bellied House Snake	NT	low
Smaug giganteus	Giant Girdled Lizard	VU	low
Tetradactylus breyeri	Breyer's Long-tailed Seps	VU	low
Mammals			
Acinonyx jubatus	Cheetah	VU	low

Amblysomus hottentotus	Hottentot's Golden Mole	DD	low
Amblysomus robustus	Robust Golden Mole	VU	low
Amblysomus septentrionalis	Higveld Golden Mole	NT	low
Atelerix frontalis	South African Hedgehog	NT	moderate-low
Canis adustus	Side-striped Jackal	NT	low
Cercopithecus mitis	Samango Monkey	VU	low
Chrysospalax villosus	Rough-haired Golden Mole	CR	low
Cloeotis percivali	Short-eared Trident Bat	CR	low
Crocidura cyanea	Reddish-grey Musk Shrew	DD	moderate
Crocidura flavescens	Greater Musk Shrew	DD	moderate-low
Crocidura fuscomurina	Tiny Musk Shrew	DD	moderate-low
Crocidura hirta	Lesser Red Musk Shrew	DD	moderate-low
Crocidura maquassiensis	Maquassie Musk Shrew	VU	low
Crocidura mariquensis	Swamp Musk Shrew	DD	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	DD	moderate-low
Crocuta crocuta	Spotted Hyaena	NT	low
Damaliscus lunatus lunatus	Tsessebe	EN	low
Dasymys incomtus	Water Rat	NT	low
Diceros bicornis minor	Black Rhinoceros	CR	low
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	DD	low
Epomophorus gambianus	Gambian Epauletted Fruit Bat	DD	low
Grammomys dolichurus	Woodland Mouse	DD	low
Graphiurus platyops	Rock Dormouse	DD	low
Hipposideros caffer	Sundevall's Leaf-nosed Bat	DD	low
Hippotragus equinus	Roan Antelope	VU	low
Hippotragus niger niger	Sable Antelope	VU	low
Hyaena brunnea	Brown Hyaena	NT	moderate
Kerivoula lanosa	Lesser Woolly Bat	NT	low
Lemniscomys rosalia	Single-striped Mouse	DD	moderate
Leptailurus serval	**Serval**	**NT**	**confirmed**
Hydrictis maculicollis	Spotted-necked Otter	NT	low
Lycaon pictus	African Wild Dog	EN	low
Manis temminckii	Pangolin	VU	low
Mellivora capensis	Honey Badger	NT	moderate
Miniopterus fraterculus	Lesser Long-fingered Bat	NT	low
Miniopterus schreibersii	Schreiber's Long-fingered Bat	NT	moderate
Myosorex cafer	Dark-footed Forest Shrew	DD	low
Myosorex varius	Forest Shrew	DD	high
Myotis bocagei	Rufous Hairy Bat	DD	low
Myotis tricolor	Temminck's Hairy Bat	NT	low
Myotis welwitschii	Welwitsch's Hairy Bat	NT	low
Mystromys albicaudatus	White-tailed Rat	EN	low
Neamblysomus juliane	Juliana's Golden Mole	VU	low
Otomys slogetti	Sloggett's Rat	DD	low
Ourebia ourebi	Oribi	EN	low
Panthera leo	Lion	VU	low
Paracynictis selousi	Selous' Mongoose	DD	low
Pipistrellus anchietae	Anchieta's Pipistrelle	NT	low
Pipistrellus rusticus	Rusty Bat	NT	low
Poecilogale albinucha	African Weasel	DD	moderate
Raphicerus sharpei	Sharp's Grysbok	NT	low
Rhinolophus blasii	Peak-saddle Horseshoe Bat	VU	low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT	low
Rhinolophus darlingi	Darling's Horseshoe Bat	NT	low

Rhinolophus fumigatus	Ruppel's Horseshoe Bat	NT	low
Rhinolophus hildebrantii	Hildebrant's Horseshoe Bat	NT	low
Rhinolophus landeri	Lander's Horseshoe Bat	NT	low
Rhynchogale melleri	Meller's Mongoose	DD	low
Suncus infinitesimus	Least Dwarf Shrew	DD	low
Suncus lixus	Greater Dwarf Shrew	DD	low
Suncus varilla	Lesser Dwarf Shrew	DD	low
Tatera leucogaster	Bushveld Gerbil	DD	low

10.4 FAUNAL HABITAT TYPES

The close relationship between vegetation units and specific faunal composition has been noted in several scientific studies. For the purpose of this investigation, floristic units are therefore considered representative of the faunal habitat types (refer **Figure 13**). The following habitat types (vegetation units or ecological units are indicated:

- Agricultural fields;
- Buildings, homesteads, infrastructure and existing development;
- Channelled valley bottoms;
- Cultivated fields;
- Artificial dams and impoundments;
- Natural dams and impoundments;
- Degraded grassland;
- Endorheic pans;
- Excavations;
- Exotic stands;
- Hillslope seepage;
- Mining areas;
- Natural grassland;
- Roads and other linear infrastructure; and
- Unchannelled valley bottoms.

Two distinct groups of natural faunal habitats exist in the study area, namely terrestrial grasslands, including cultivated fields, degraded grassland and natural grassland, and wetland habitat types, including channelled valley bottoms, artificial dams, natural dams, endorheic pans, hillslope seepage and unchannelled valley bottoms. Both of these groups of habitats have unique ecological characteristics that influence the faunal communities, assemblages and species that are associated with it.

10.4.1 Grasslands

- Food provision for grassland specialist butterflies, reptiles and small mammals such as rodents.
- In a severely fragmented landscape, the remaining grassland fragments provide refuge to grassland specialist species.
- The grasslands found in the region of the study area are mostly restricted to areas that are not easily ploughed (i.e. for crop agriculture) – these areas are usually either rocky (outcrops, ledges, surface rock etc.) or wet; consequently these grassland often include unique habitat characteristics that might be of service to sensitive and/or threatened faunal taxa. However, this was not particularly evident in the study area.

10.4.2 Wetlands

- The wetlands of the study area include some unique habitat characteristics (wetland-related habitat characteristics) that are absent from the grassland habitat found in the study area.
- The wetlands found in the study area are fully functioning ecological systems likely to host a full complement of wetland animal assemblages; animals such as frogs, wetland mammals and some butterflies.
- Although not specifically covered in this assessment, these wetlands also host a myriad of wetland invertebrates that cannot survive in terrestrial habitats.
- The Endorheic pans, dams, drainage lines and associated vegetation of the study area is also the only natural habitat likely to host red data faunal species – both the Marsh Sylph and Forest Shrew (both estimated to have a high probability of occurring in the study area) are wetland-associated and will occur in these areas if found to be present.

10.5 FAUNAL HABITAT SENSITIVITY ASSESSMENT

During the field assessment, the study area was investigated and assessed in terms of the following biodiversity attributes:

- Habitat status: level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity: the number of different faunal habitat types (both on micro- and macro-scale) found within the proposed site and bordering areas;
- Habitat linkage: the degree to which the faunal habitat of the proposed site is linked to other natural areas enabling movement of animals to and from the habitat found on site;
- Red Data species: the degree to which suitable habitat for the red data species likely to be found in the study area (larger study area) is located on each site; and
- Sensitive faunal habitat: the relative presence of faunal sensitive habitat type elements such as surface rock associated with outcrops and hills as well as wetland elements.

Faunal habitat sensitivities are grouped into sensitivity classes (Table 20) based on the calculated averages:

- Low - 0-20 %
- Medium-low - 20-40 %
- Medium - 40-60 %
- Medium-high - 60-80 %
- High - 80-100 %

Table 19: Faunal Habitat Sensitivities for the study area

Habitat Type	*Status*	*Diversity*	*Linkage*	*Red Data*	*Sens*	*Ave*	*Sens Class*
Agricultural fields	2	3	3	2	2	24 %	medium-low
Buildings, etc.	1	1	1	1	1	10 %	low
Channelled valley bottoms	7	6	9	7	8	74 %	medium-high
Cultivated fields	4	4	5	3	3	38 %	medium-low
Artificial dams	5	6	6	6	6	58 %	medium
Natural dams	7	8	8	8	8	78 %	medium-high
Degraded grassland	6	6	6	4	7	58 %	medium
Endorheic pans	8	9	8	9	9	86 %	high
Excavations	1	2	1	1	1	12 %	low
Exotic stands	2	3	5	2	2	28 %	medium-low
Hillslope seepage	8	7	7	8	8	76 %	medium-high
Mining areas	1	2	1	1	1	12 %	low

Table 19: Faunal Habitat Sensitivities for the study area							
Habitat Type	***Status***	***Diversity***	***Linkage***	***Red Data***	***Sens***	***Ave***	***Sens Class***
Natural grassland	9	8	7	8	8	80 %	high
Linear infrastructure	1	2	1	1	1	12 %	low
Unchannelled valley bottoms	8	7	9	8	9	82 %	high

These estimations are used to ascribe a sensitivity index value to units of the respective variations, illustrated in **Figure 15**. Additional aspects that are taken into consideration include surrounding habitat sensitivity, conservation potential, fragmentation and habitat isolation factors. Therefore, different units of a habitat might be ascribed a relative wide range of faunal sensitivities.

10.6 DISCUSSION

Extensive parts of the study area have been transformed and degraded. Most of the study area is characterized by existing impacts associated with commercial crop agriculture (agricultural fields, homesteads and farming infrastructure) and coal mining (mining areas, excavations, artificial impoundments and linear infrastructure such as pipelines, conveyors and roads). These areas are all considered to be transformed faunal habitat and contain, at best, only trace elements of the original ecological characteristics of the region (terrestrial and wetland-associated). Remaining untransformed faunal habitats include terrestrial grassland (natural grassland and degraded grassland) and wetland-associated habitat (channelled valley bottoms, endorheic pans, hillslope seepage and unchannelled valley bottoms).

Grasslands and the wetlands of the study area exhibit high species richness, species diversity, biodiversity value, effective ecological functionality, are well linked and act as refuges for many animal species, including a significant number of threatened taxa. Two Red Data wetland animals are estimated to have a high probability of occurring in the study area, namely the Forest Shrew (*Myosorex varius*) and the Marsh Sylph (*Metisella meninx*). Both these species are well known from the region in which the study area is located and all of their habitat requirements are met within the study area's boundaries (pers. obs.). One wetland red data species were confirmed to occur in the study area, namely the Serval.

10.6.1 Annotations on Serval (Leptailurus serval)

Serval occupies almost all types of grasslands and savannas in Africa. Their distribution is closely tied to water and associated vegetation, reed beds and marshes. The species use medium and tall grasslands and reedbeds as rest sites, although in areas with greater disturbance from people and livestock frequently retreat to patches of woody vegetation during the day. The species is listed on CITES (Appendix II) and on the IUCN Red List as a species of Least Concern. Locally, Serval is listed as Near Threatened (EWT 2004). This species is widely distributed in grasslands south of the Sahara but are declining in number in the west and extreme south of Africa.

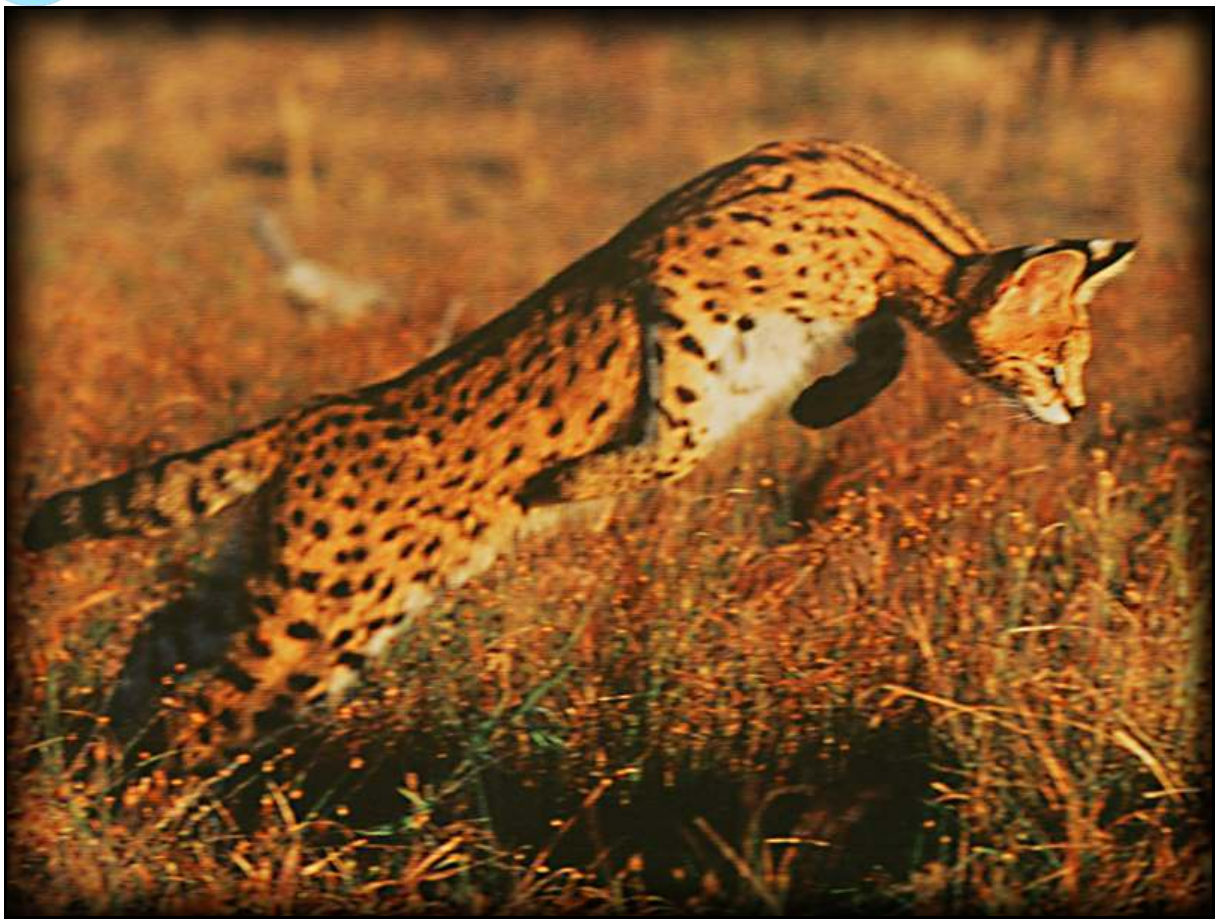
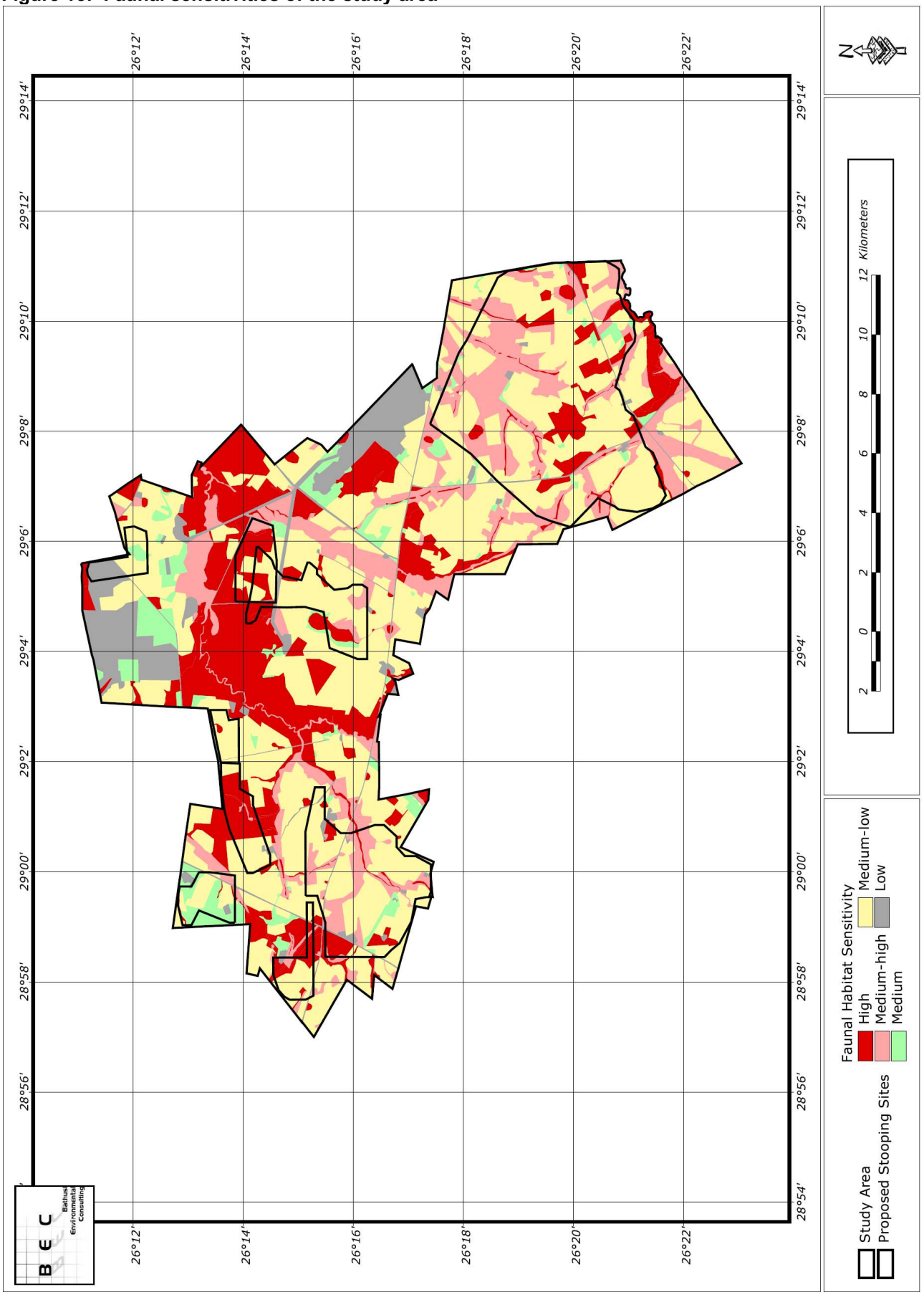


Photo 1: Image of Serval

Figure 15: Faunal sensitivities of the study area



10.7 FAUNAL IMPACT ASSESSMENT

The following impacts resulting from the proposed development are expected to affect the faunal attributes of the study area:

- Direct impacts on Red Data fauna species;
- Loss or Degradation of natural faunal habitat & in surrounding areas;
- The disruption of ecological connectivity and migration routes of larger, flightless animals as well as territorial infringement; and
- Direct impacts on common fauna species & interactions with structures & personnel.

10.7.1 Direct impacts on Red Data Fauna Species

Threatened animals contribute significantly to the ecological diversity of a region since their presence usually provides an indication of a relatively pristine environment. Although regarded as a direct and significant impact, developments such as this are unlikely to affect these animals directly since they are generally mobile and will ultimately be able to migrate away from impacts that result from the proposed development. Significantly, however, the loss of suitable habitat that is available to them represents a significant impact on the status of these animals. Aspects of these animals that will also be affected include migration patterns and suitable habitat for breeding and foraging purposes. Since these requirements are frequently stricter than most generalist species, impacts on their habitat are likely to be more significant than for most other, common fauna species.

Although only a low number of Red Data species were observed during the survey period, the Red Data assessment of this report indicates that several Red Data fauna species are likely to occupy suitable areas within the study area. The status of these areas is relative pristine and the possibility that some fauna species simply were not observed during the limited time available cannot be excluded (due to customary limitations in the search of these species).

Potential Mitigation: Implement a biodiversity-offset programme that will target nearby habitat and of which the aim would be to improve the status of these areas. In addition, contamination of any kind should be prevented.

10.7.2 Loss or Degradation of Natural Faunal Habitat & in Surrounding Areas

Natural habitat of the study area as well as surrounding areas will likely be affected adversely by direct impacts resulting from construction and operational activities. Particular reference is made to the loss of habitat resulting from surface clearing activities, the construction of infrastructure as well as less obvious impacts such as leaching of chemicals into the groundwater and surface water, generation of huge amounts of dust and spillages. Also of importance is the loss of habitat that are not necessarily considered suitable for Red Data species, but where a high diversity of animals are likely to occupy the area. Extensive areas that exhibit low fragmentation and isolation factors are included in this category. This impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;

- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, *e.g.* increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

Changes to the natural habitat may lead to a reduction in the resilience of ecological communities and ecosystems and changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the wetland habitat types, is particularly important. A high conservation value is generally ascribed to floristic faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region.

Potential Mitigation: Implement a biodiversity offsite interventions that will target nearby habitat and of which the aim would be to improve the status of these areas. Ensure that the loss of faunal habitat is restricted to the development site itself. Infrastructure and related activities must be confined to the development site and not allowed to spread to nearby sensitive areas. Fences must be erected prior to construction and all personnel and contractors should be instructed as to the physical boundaries pertaining to their respective disciplines and measures set in place to ensure that they keep to these boundaries. In addition, erosion control measures must be put in place from the commencement of construction to ensure that artificial erosion associated with the activities of the project (construction, operation and decommissioning) does not degrade the natural ecological state of the faunal habitats bordering the study area and the various areas of activity.

10.7.3 The Disruption of Ecological Connectivity & Migration Routes

The region is characterised by highly transformed and fragmented grassland habitat types. Evidence of previous investigations has confirmed this and it is therefore reasonable to assume that animals that utilises the existing areas of natural habitat will migrate extensively across the region. Foraging, available water, food sources, breeding patterns and seasonal/ climate changes include some of the more obvious explanations for migration patterns of animals.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors, 'stepping stones' or habitat. Loss of current migration routes or connectivity areas (stepping stones) within the study area will likely affect the migration pattern of some species. While larger animals are not likely to be affected significantly, smaller animals might not be able to cross or avoid certain types of development/ infrastructures. Particular reference is made to the disruption of migration patterns of flightless animals.

Potential Mitigation: All impacts must be limited to the site only – no land use changes or otherwise disturbances of animals outside of the study area should be allowed; vehicles should yield to larger animals on access roads. Wherever linear structures (roads and pipelines) bisect natural areas of untransformed faunal habitat measures should be put in place to ensure continued movement of all faunal groups needing to cross these manmade barriers.

10.7.4 Impacts on Common Fauna & Interactions with Structures & Personnel

Activities that are known to transpire from human–animal conflicts are likely to affect animals that utilise surrounding areas. Unwanted activities might include poaching, snaring, killing by accidental contact, capturing, effects of domesticated cats and dogs, roadkills, etc. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from the area of impact, some species would not able to relocate, such as ground living and small species.

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. An aspect that is of concern is the presence of vehicles on access and infrastructure roads, leading to road kills, particularly amongst nocturnal animals that are likely to occur in the region.

The presence of personnel within the development area during construction and operational phases will inevitably result in some contact with animals. Therefore, encounters with dangerous animals (such as snakes) remain likely. In addition, the presence of domestic dogs and cats is generally associated with humans. These animals are frequently accountable for killing of natural fauna. It is also regarded moderately likely that the natural faunal component might be attracted to the artificial water source that is created by the development. The establishment of human abodes generally result in the presence of foraging rodents, which is likely to attract smaller predators, raptors, owls, and snakes. The lack of understanding from personnel frequently results in the unnecessary killing of these animals.

Potential Mitigation: Frequent policing of fences and areas bordering the mining area must be implemented with severe penalties to offenders that kill animals. Sensitizing personnel to the presence and handling of animals must form part of the induction. The construction of fences around all areas related to the project where personnel have daily access (construction, operation and decommission) is of the utmost importance. Regular inspection of these fences to ensure the fences' integrity and patrol of the borders and surrounding areas next to the site for the presence of snares etc. will limit the impact of poaching and snaring. Communication with farmers whose property border the operational areas to create awareness of potential poaching problems in the area is important.

10.8 FAUNAL IMPACT RATING TABLES

10.8.1 Construction Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CONSTRUCTION PHASE ACTIVITIES																		
Area A																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	3	45	-	M	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	8	5	2	1	15	-	L	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme.
Loss or degradation of natural and sensitive faunal habitats	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	5	2	2	26	-	L		4	5	2	1	11	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	5	3	3	48	-	M		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types		6	4	2	4	48	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area B																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities,	10	5	2	4	68	-	H	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check	8	5	2	2	30	-	M	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat, Natural grassland habitat types		8	5	2	4	60	-	M		6	5	2	2	26	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	5	3	3	48	-	M		6	4	3	2	26	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types	etc	6	4	2	4	48	-	M	fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area C																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Endorheic pan)	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	6	5	2	2	26	-	L	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	5	2	1	11	-	L	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Endorheic pan)		6	5	2	2	26	-	L		4	5	2	1	11	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pan)		6	5	3	2	28	-	L		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area D																			
Direct impacts on fauna species of conservation importance	None	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	6	5	2	2	26	-	L	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	6	5	2	1	13	-	L	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	None		6	5	2	2	26	-	L		4	5	2	1	11	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Degraded Grassland		6	5	3	2	28	-	L		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area E																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural	8	5	2	4	60	-	M	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat	6	5	2	3	39	-	M	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme

Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	**60**	-	**M**	types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	5	2	3	**33**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area F																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	8	5	2	2	**30**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		6	5	2	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	3	**48**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area G																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads,	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined	8	5	2	2	**30**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological	Wetland habitat types		8	5	3	3	**48**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme,

connectivity and local/regional migration routes	(Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland	conveyor sections, pollution control dams, coal storage facilities, etc								corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.									erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area H																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	10	5	2	2	**34**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		10	5	2	4	**68**	-	**H**		10	5	2	4	**68**	-	**H**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area I																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	10	5	2	4	**68**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	8	5	2	2	**30**	-	**M**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges		10	5	2	4	**68**	-	**H**		8	5	2	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages,		8	5	3	4	**64**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

	Endorheic pans), Natural Grassland, Degraded Grassland, Ridges																		
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	2	4	**56**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

10.8.2 Operational Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
OPERATIONAL PHASE ACTIVITIES																		
Area A																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	6	5	2	2	26	-	L	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	5	2	2	22	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	5	2	2	26	-	L		4	5	2	2	22	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	5	3	3	48	-	M		8	4	3	3	45	-	M	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area B																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	60	-	M	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy	6	5	2	2	26	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat, Natural grassland habitat types		8	5	2	4	60	-	M		6	5	2	2	26	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	5	3	3	48	-	M		8	4	3	3	45	-	M	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types		6	4	2	4	48	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity

										penalties for offenders.							management programme
Area C																		
Direct impacts on fauna species of conservation importance	Wetland habitat types (Endorheic pan)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	6	5	2	2	**26**	-	**L**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	5	2	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Endorheic pan)		6	5	2	2	**26**	-	**L**		4	5	2	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pan)		6	5	3	2	**28**	-	**L**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area D																		
Direct impacts on fauna species of conservation importance	None	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	6	5	2	2	**26**	-	**L**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	4	5	2	1	**11**	-	**L**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	None		6	5	2	2	**26**	-	**L**		4	5	2	1	**11**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Degraded Grassland		6	5	3	2	**28**	-	**L**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area E																		
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure,	6	5	2	4	**52**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance	4	5	2	4	**44**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope		6	5	2	4	**52**	-	**M**		4	5	2	4	**44**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity

	seepages), Natural Grassland habitat types	offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc								footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.								management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	3	**48**	-	**M**		8	4	3	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area F																		
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	6	5	2	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	3	**48**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area G																		
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams,	8	5	2	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear	6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural		8	5	3	3	**48**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

	Grassland habitat types, Degraded Grassland	coal storage facilities, etc								infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.								
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	3	**36**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area H																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	5	3	4	**64**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		6	4	2	4	**48**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Area I																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haulroads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors, allow for animal movement above/under/around linear infrastructure, check fence lines and surrounding areas for snares etc. and ensure heavy penalties for offenders.	6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges		8	5	2	4	**60**	-	**M**		6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		8	5	3	4	**64**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	2	4	**56**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme

10.8.3 Closure & Decommissioning

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
DECOMMISSIONING AND CLOSURE PHASE ACTIVITIES: 1. REMOVAL OF INFRASTRUCTURE 2. ACTIVE SURFACE REHABILITATION OF DISTURBED AREAS																		
Area A																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	6	5	2	2	**26**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	4	5	2	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	5	2	2	**26**	-	**L**		4	5	2	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		4	5	3	2	**24**	-	**L**		4	2	3	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types		4	3	2	2	**18**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area B																		
Direct impacts on fauna species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat, Natural grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	5	3	2	**28**	-	**L**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat, Natural grassland habitat types		4	3	2	2	**18**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area C																		
Direct impacts on fauna species of conservation	Wetland habitat types (Endorheic pan)	Removal of mining infrastructures,	6	5	2	2	**26**	-	**L**	Ensure proper rehabilitation of affected areas, establish a	4	5	2	1	**11**	-	**L**	Biodiversity monitoring programme, erosion management programme,

importance		decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted							suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features								revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Endorheic pan)		6	5	2	2	**26**	-	**L**		4	5	2	1	**11**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pan)		6	5	3	2	**28**	-	**L**		4	2	3	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		4	3	2	2	**18**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area D																			
Direct impacts on fauna species of conservation importance	None	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	6	5	2	2	**26**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	4	5	2	1	**11**	-	**L**	Pre-development walkthrough, rescue & relocation programme, biodiversity monitoring programme
Loss or degradation of natural and sensitive faunal habitats	None		6	5	2	2	**26**	-	**L**		4	5	2	1	**11**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Degraded Grassland		6	5	3	2	**28**	-	**L**		4	2	3	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Natural Grassland habitat types		4	3	2	2	**18**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area E																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	6	5	2	4	**52**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	4	5	2	4	**44**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		4	5	2	4	**44**	-	**M**		4	5	2	4	**44**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	3	3	**48**	-	**M**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	3	2	3	**33**	-	**M**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area F																			

Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	5	2	4	**52**	-	**M**		6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	5	3	2	**28**	-	**L**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		4	3	2	2	**18**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area G																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		6	5	3	2	**28**	-	**L**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	3	2	2	**22**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area H																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of	Wetland habitat types		8	5	2	4	**60**	-	**M**		6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme,

natural and sensitive faunal habitats	(Endorheic pans, Hillslope seepages), Natural Grassland habitat types	revegetating of affected areas where surface disturbances resulted								herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features									erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		6	5	3	2	**28**	-	**L**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		6	3	2	2	**22**	-	**L**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Area I																			
Direct impacts on fauna species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Loss or degradation of natural and sensitive faunal habitats	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges		8	5	2	4	**60**	-	**M**		6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Disruption of ecological connectivity and local/regional migration routes	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		6	5	3	3	**42**	-	**M**		6	2	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme
Impacts on common fauna and interactions with structures and personnel	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		6	3	2	3	**33**	-	**M**		4	1	2	1	**7**	-	**L**	Biodiversity monitoring programme, erosion management programme, revegetation and rehabilitation programme

10.8.4 Residual Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
RESIDUAL IMPACTS																		
Area A																		
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	8	5	2	4	60	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	4	1	2	22	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			8	5	2	4	60	-	M		6	4	1	2	22	-	L	
Disruption of ecological connectivity and local/regional migration routes			8	5	3	3	48	-	M		6	2	1	2	18	-	L	
Area B																		
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	10	5	2	4	68	-	H	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	26	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			10	5	2	4	68	-	H		8	4	1	2	26	-	L	
Disruption of ecological connectivity and local/regional migration routes			10	5	3	3	54	-	M		8	2	1	2	22	-	L	
Area C																		
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			6	5	2	4	52	-	M		4	4	1	2	18	-	L	
Disruption of ecological connectivity and local/regional migration routes			6	5	3	3	42	-	M		4	2	1	2	14	-	L	
Area D																		
Residual impacts on fauna species of conservation	All affected areas and immediate surrounds	Altered topographical conditions, altered	6	5	2	4	52	-	M	Ensure proper rehabilitation of affected areas, establish a	4	4	1	2	18	-	L	Biodiversity monitoring programme, erosion management programme, alien

importance		hydrological regimes, altered botanical composition and structure, areas of surface subsidence							suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features								and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			6	5	2	4	**52**	-	**M**		4	4	1	2	**18**	-	**L**	
Disruption of ecological connectivity and local/regional migration routes			6	5	3	3	**42**	-	**M**		4	2	1	2	**14**	-	**L**	
Area E																			
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			8	5	2	4	**60**	-	**M**		6	4	1	2	**22**	-	**L**	
Disruption of ecological connectivity and local/regional migration routes			6	5	3	3	**42**	-	**M**		6	2	1	2	**18**	-	**L**	
Area F																			
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	10	5	2	4	**68**	-	**H**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			10	5	2	4	**68**	-	**H**		8	4	1	2	**26**	-	**L**	
Disruption of ecological connectivity and local/regional migration routes			10	5	3	3	**54**	-	**M**		8	2	1	2	**22**	-	**L**	
Area G																			
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	10	5	2	4	**68**	-	**H**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			10	5	2	4	**68**	-	**H**		8	4	1	2	**26**	-	**L**	
Disruption of ecological connectivity and local/regional migration routes			10	5	3	3	**54**	-	**M**		8	2	1	2	**22**	-	**L**	
Area H																			
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical	10	5	2	4	**68**	-	**H**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species,	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation
Residual loss or degradation			10	5	2	4	**68**	-	**H**		8	4	1	2	**26**	-	**L**	

of natural and sensitive faunal habitats		composition and structure, areas of surface subsidence								including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features								programme
Disruption of ecological connectivity and local/regional migration routes			10	5	3	3	**54**	-	**M**		8	2	1	2	**22**	-	**L**	
Area I																		
Residual impacts on fauna species of conservation importance	All affected areas and immediate surrounds	Altered topographical conditions, altered hydrological regimes, altered botanical composition and structure, areas of surface subsidence	10	5	2	4	**68**	-	**H**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	1	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, alien and invasive plant control & management programme, revegetation and rehabilitation programme
Residual loss or degradation of natural and sensitive faunal habitats			10	5	2	4	**68**	-	**H**		8	4	1	2	**26**	-	**L**	
Disruption of ecological connectivity and local/regional migration routes			10	5	3	3	**54**	-	**M**		8	2	1	2	**22**	-	**L**	

10.8.5 Cumulative Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CUMULATIVE IMPACTS: IMPACTS CONSIDERED ON A REGIONAL SCALE																		
Area A																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	8	5	3	4	**64**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	5	3	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			8	5	3	4	**64**	-	**H**		6	5	3	2	**28**	-	**L**	
Area B																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	10	5	3	4	**72**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			10	5	3	4	**72**	-	**H**		8	5	3	2	**32**	-	**M**	
Area C																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	4	5	3	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			6	5	3	4	**56**	-	**M**		4	5	3	2	**24**	-	**L**	
Area D																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	4	5	3	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			6	5	3	4	**56**	-	**M**		4	5	3	2	**24**	-	**L**	
Area E																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/	Mining and mining related activities that	8	5	3	4	**64**	-	**H**	Minimize development footprint, compensate for loss	6	5	3	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme,

Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity	deterioration resulted caused by mining or mining related activities	resulted in deterioration and destruction of remaining natural habitat	8	5	3	4	**64**	-	**H**	of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	6	5	3	2	**28**	-	**L**	hydrological functionality and integrity management programme
Area F																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	10	5	3	4	**72**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			10	5	3	4	**72**	-	**H**		8	5	3	2	**32**	-	**M**	
Area G																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	10	5	3	4	**72**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			10	5	3	4	**72**	-	**H**		8	5	3	2	**32**	-	**M**	
Area H																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	10	5	3	4	**72**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			10	5	3	4	**72**	-	**H**		8	5	3	2	**32**	-	**M**	
Area I																		
Cumulative loss of sensitive faunal habitat	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	10	5	3	4	**72**	-	**H**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, hydrological functionality and integrity management programme
Cumulative isolation and fragmentation of natural faunal habitats and loss of ecological connectivity			10	5	3	4	**72**	-	**H**		8	5	3	2	**32**	-	**M**	

10.9 RECOMMENDED MITIGATION MEASURES

10.9.1 Site Specific Mitigation Measures

Mitigation Measure 1 - Exclude all areas of the sensitive habitat from the proposed development;

Mitigation Measure 2 - Implement a suitable buffer zone (at least 30 m) between the edge of these areas habitat and any type of development or surface disturbance;

Mitigation Measure 3 - Exclude as much of the wetland and endorheic pans from the development as possible, particularly the larger portions. Cognisance of the wetland ecologist/ specialist is regarded imperative in this regard. This should be done during the planning phase;

Mitigation Measure 4 - Implement a suitable buffer zone around the pans, take cognisance of recommendations from the wetland report;

Mitigation Measure 5 - Prevent contamination of natural grassland, wetland and endorheic pans from nearby stockpiling, conveyor lines, water treatment facilities or any other source of pollution;

10.9.2 Roads & Access

Mitigation Measure 6 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 7 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 8 - No roads should be allowed within ecologically sensitive areas. The use of roads around ecologically sensitive areas for the purpose of buffers should be done with circumspect particularly in view of accidental killing of animals;

10.9.3 Animals

Mitigation Measure 9 - No animal may be hunted, trapped, snared or killed for any purpose whatsoever. Fences and boundaries should be patrolled weekly in order to ensure the removal of snares;

Mitigation Measure 10 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 11 - Dangerous animals should be handled by a competent person;

Mitigation Measure 12 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction;

Mitigation Measure 13 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

10.10 INFORMATION GAPS

Significant information gaps exist concerning animal species, their habitat requirements, current geographical ranges and consequently their status and sensitivity towards mining developments (such as the proposed project) on local, regional and even national and international scales. Some animal groups have been studied in relative depth and much is known about their ecological requirements; other such as some reptiles (notably the red data species *Homoroselaps dorsalis*) and most invertebrate groups are poorly studied and very little known is about their ecology or status. Many invertebrate groups are usually ignored during EIA assessments since usable information (sensitivities, statuses etc.) is not available and these groups are consequently not included in sensitivity analyses.

In the Red Data Fauna analysis all species listed in the various red data lists (IUCN Red List, EWT Mammal Red Data Assessment for South Africa, Red Data Book, SARCA, etc.) are used to compare the area investigated to other areas in region (based on available desktop information and personal experience and observations) and the different faunal habitats occurring within the study area. Red Data species confirmed or considered likely to be found in the study area are used as indicators of sensitive faunal habitat. However, many of the "unknowns" (i.e. either poorly studied species, families or orders or species yet to be found and described) may turn out to shift our estimates about specific habitat sensitivity and conservation aims. Therefore, although all due care is applied during the Red Data assessment, it is based on information with a high paucity that could potentially indicate a skewed representation of true species' and habitat sensitivities.

Time and budget constraints are crucial factors that limit the extent of any field investigation. The more time and sampling effort spend within a study area, the higher the species' count and consequently the level of detailed, relevant information obtained used during assessments of sensitivity and, in the end, impact assessments and mitigation proposals. Unfortunately, it is not within the scope of environmental impact assessments to spend significantly long periods in the field and obtain large amounts of ecological information relevant to the study area. The field investigator was therefore selective in terms of habitat and animal group focus (i.e. rather focus on areas "known" to be sensitive and search for species "known" to be at risk) in order to maximise the time available in during the field investigation. The field investigation conducted for this project is deemed to include acceptable levels of detailed information obtained; the ecological data accumulated during the two field investigations (wet and dry season) provided an adequate picture of the faunal communities of the study area within the scope of acceptable impact assessment studies.

However, the field investigations were hampered by the exclusion of some the farms within the study area – access to these areas were denied to the field investigator by the landowners of these properties at the time of the surveys.

11 AVIFAUNAL ASSESSMENT

11.1 GENERALISED HABITAT DESCRIPTION, LAND USE & LANDSCAPE PERSPECTIVE

11.1.1 Local Context

The study site is characterised by four broad habitat types that range from (1) natural grassland (comprising of primary undulating grassland and secondary grazed grassland), (2) wetland-associated landscape features (i.e. endorheic pans, manmade impoundments and drainage lines), (3) agricultural land to (4) exotic plantations (refer **Figures 12 & 13 -** Habitat Types & Variations, Photographic collages – **Figure 16**). Agricultural land covers the largest combined surface area on the study site (*c*. 54 %), and is mainly used for the production of *Zea mays* (maize). The remaining extent is dominated by natural grassland (*c*. 34 %) that is predominantly used for grazing purposes. High stocking rates and overgrazing are largely responsible for the widespread dominance of secondary and degraded graminoid compositions (*e.g. Eragrostis plana* and *E. curvula*) and poor floristic richness (refer **Tables 9 & 10, Section 9.7**). Nevertheless, approximately 7 % of the study site is occupied by wetland features of which 75 % is represented by natural entities (*e.g.* drainage lines and endorheic pans) while the remaining 25 % consists of artificial dams.

In addition, the largest surface area of natural habitat features (mainly natural grassland) occurs on Area B, G and I (refer **Table 20**), while Area F, H and I represent the largest surface area of wetland features. It is especially Area F, H and I (including Area C) which support endorheic pans. In contrast, Area D was found to host the largest surface area of degraded and transformed habitat. Although large areas of degraded habitat were present in Area F and H, these areas are important for waterbirds based on the occurrence of pans (refer **Table 21**).

The importance of the study area, especially from an avifaunal perspective, is confined to the endorheic pans. These features are of great interest based on recent anecdotal observations:

- Many waterbird species tend to congregate (or moult) on the pans during winter due to the non-perennial nature of the vleis and palustrine wetlands that occur in the region;
- Some of the pans provide important breeding platforms for a diversity of Anatid taxa. These function as important source areas for the nearby impoundments through population recruitment, thereby maintaining population viability;
- Some of the pans (on **Area H and Area I**) provide ephemeral foraging habitat for "near-threatened' species, in particular flamingo species (genus *Phoenicopterus*) and Maccoa Duck (*Oxyura maccoa*) (e.g. the pan system on the Farm Grootpan and the pans on the Farm Vaalpan and Bakenlaagte); and
- The drainage lines are also daily flyways for a variety of bird species, especially in a landscape affected by intense agricultural activities. These features were especially dominant on Area F and Area I.

Table 20: The surface area (ha) of each habitat type in relation to the proposed study site		
Habitat Type	**Surface area (ha)**	**Percentage (%)**
Agricultural land (& cultivated fields)	**9683.85 ha**	**45.89 %**
Wetland features	4391 ha	20.81 %
Natural grassland	5053.28 ha	23.94 %
Exotic plantations	240.44 ha	1.14 %
Other (transformed)	1735.65 ha	8.22 %
Total	**21104.23 ha**	**91.78 %**
Wetland features	**Surface area (ha)**	**Percentage (%)**
Dams	246.93 ha	5.62 %
Drainage lines	344.94 ha	7.86 %
Hillslope seeps & unchannelled valley bottoms (vleis)	**3552.04 ha**	**80.89 %**
Endorheic Pans	247.09 ha	5.63 %
Total	**4391 ha**	**100.00 %**
Grassland (excluding cultivated land)	**Surface area (ha)**	**Percentage (%)**
Natural	4046.81 ha	80.08 %
Degraded	1006.47 ha	19.92 %
Total	**5053.28 ha**	**100.00 %**

Table 21: Surface area (ha) of each habitat type in relation to each stooping area																		
Area	**A**		**B**		**C**		**D**		**E**		**F**		**G**		**H**		**I**	
Habitat Type	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**
Agricultural land (& cultivated fields)	102.68	43.04%	87.87	30.23%	106.6	89.07%	89.02	50.52%	113.8	58.68%	819.56	61.65%	121.9	40.60%	386.8	64.89%	2166.2	52.78%
Wetland features	18.1	7.59%	28.42	9.78%	13.08	10.93%		0.00%	18.23	9.40%	320.64	**24.12%**	26.75	8.91%	96.97	**16.27%**	1299.5	**31.66%**
Natural grassland	103.99	43.59%	170.8	58.76%			23.5	13.34%	56.35	29.05%	137.49	10.34%	148.2	49.37%	90.71	15.22%	478.36	11.65%
Exotic plantations											3.06	0.23%		0.00%	5.68	0.95%	121.66	2.96%
Other (transformed)	13.81	5.79%	3.57	1.23%			63.67	36.14%	5.57	2.87%	48.6	3.66%	3.36	1.12%	15.91	2.67%	38.68	0.94%
Total	**238.59**	**100.00%**	**290.6**	**100.00%**	**119.7**	**100.00%**	**176.2**	**100.00%**	**194**	**100.00%**	**1329.4**	**100.00%**	**300.2**	**100.00%**	**596**	**100.00%**	**4104.4**	**100.00%**
Wetland features	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**
Dams			1.06						6.77		9.38		0.19				39.41	
Drainage lines	3.51		3.07														10.19	
Hillslope seeps & unchannelled valley bottoms (vleis)	14.59		24.29		8.28				11.46		307.96		26.55		54.28		1205.4	
Endorheic Pans					4.8						3.31				42.68		44.53	
Total	**18.1**	**7.59%**	**28.42**	**9.78%**	**13.08**	**10.93%**	**0**	**0.00%**	**18.23**	**9.40%**	**320.64**	**24.12%**	**26.75**	**8.91%**	**96.97**	**16.27%**	**1299.5**	**31.66%**
Grassland (excluding cultivated land)	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**
Natural	122.1	51.17%	199.2	**68.54%**	13.08	10.93%	23.5	13.34%	74.58	38.45%	458.14	34.46%	174.9	**58.28%**	187.7	31.49%	1777.8	**43.32%**
Degraded	116.49	48.83%	91.44	31.46%	106.6	89.07%	152.7	**86.66%**	119.4	61.55%	871.22	**65.54%**	125.2	41.72%	408.4	**68.51%**	2326.5	56.68%
Total	**102.68**	**43.04%**	**87.87**	**30.23%**	**106.6**	**89.07%**	**89.02**	**50.52%**	**113.8**	**58.68%**	**819.56**	**61.65%**	**121.9**	**40.60%**	**386.8**	**64.89%**	**2166.2**	**52.78%**

11.1.2 Regional Context

The study site corresponds to the Grassland Biome and more particularly to the Mesic Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as the Eastern Highveld Grassland (refer **Figure 10, Section 9.1**).

This grassland type is restricted to the undulating plains and includes a number of low hills and pan depressions. The pan depressions, as mentioned above, are an important consideration since they provide critical important foraging habitat for two "near-threatened" flamingo species. The vegetation pertaining to the Eastern Highveld Grassland is short and dominated by graminoid species of the genera *Themeda, Aristida, Agrostis* and *Eragrostis*. The only good examples of primary Eastern Highveld Grassland were observed along the Vaalbankspruit in the southern part of the study area. This grassland sere was earmarked by a high richness of grass species and a sloping topography that provides suitable habitat for endemic grassland bird species (*e.g.* Blue Korhaan *Eupodotis caerulescens* and Botha's Lark *Spizocorys fringillaris*).

Nearly 44 % of the Eastern Highveld Grassland is transformed by cultivation, coal mining activities and the creation of artificial impoundments. Although the latter has contributed to the regional waterfowl diversity, severe transformation by opencast mining activities in the region has resulted in large-scale displacement and habitat loss of many threatened bird taxa that historically occupied the area.

Figure 16: A collage of images illustrating the habitat features on the study site

Legend: (a-b) endorheic pans, (c-d) perennial streams confined to a valley bottom, (e) an artificial impoundment, (f) species-rich undulating grassland, (g) species-poor secondary (grazed) grassland and (h) an *Eragrostis curvula* pasture.

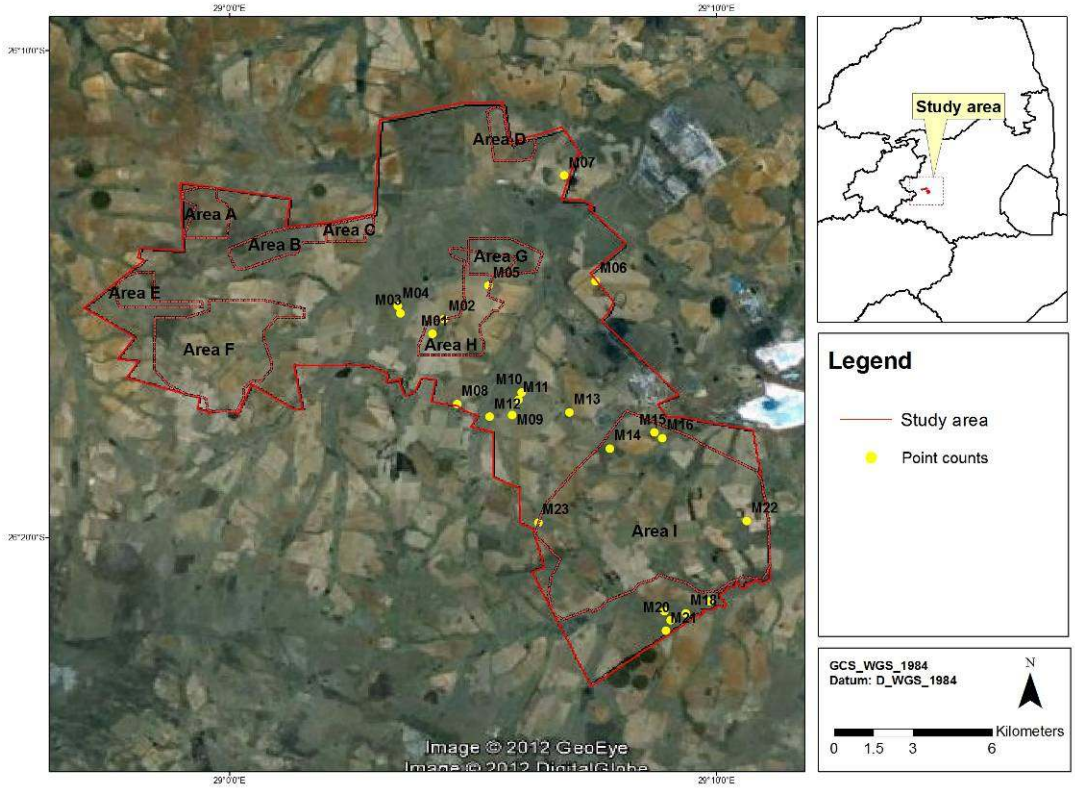
11.2 MPUMALANGA CONSERVATION PLAN

According to Lötter & Ferrar (2006), approximately 65 % of the study area is zoned as "No natural habitat remaining" and 23 % considered being of "Least concern" (refer **Figures 8 & 9**). It emphasises the transformed nature of the terrestrial habitat units on the stooping areas due to agricultural intensification and livestock grazing (refer **Figures 2 & 3**). However, less than 12 % of the habitat types on the study area are classified as "Highly significant" or "Important and necessary". These areas are characterised by endorheic pans and extensive grassland (often on undulating topographies). In addition, areas classified as "Highly significant" are only located on Area G and Area I, while extensive habitat classified as "Important and necessary" are located on Area A, B, E G and I. With the exception of the endorheic pans, the appreciated conservation value suggests that current grazing regimes and cultivation have undoubtedly contributed to the observed ecological state of the study site.

11.3 RESULTS & DISCUSSION

A total of 23 point counts were compiled in the study area, illustrated in **Figure 17**.

Figure 17: The geographic placement of 23 point counts on the study site.

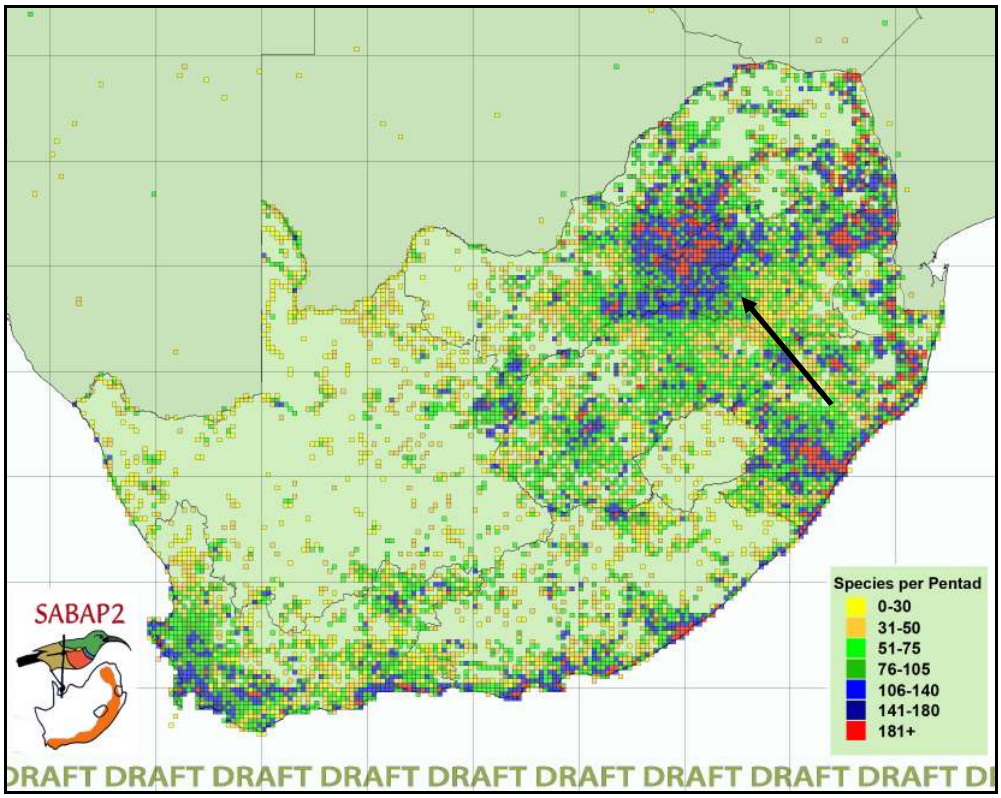


11.3.2 Richness & dominant composition

According to the South African Bird Atlas Project (SABAP1: Harrison *et al*., 1997), an average of 197.8 bird species have been recorded from the study region based on four quarter degree squares that are sympatric to the study site (2629AA = 195 spp., 2628BD = 196 spp., 2628BB = 201 spp. & 2629AC = 199 spp.). This equates to 21 % of the approximate 951 species listed for the southern African subregion[13]. However, the SABAP2 database suggests that study area is more likely to sustain an average 71.4 species (www.sabap2.adu.org.za). Nevertheless, 128 bird species were recorded during the site visits (representing a dry and wet season survey) of which six are considered to be of global and regional conservation concern (refer **Table 22**). The SABAP2 statistic was obtained from nine pentad grids. On a national scale, the species richness on the study site is considered low-moderate (refer **Figure 18**).

[13] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).

Figure 18: The bird species richness per pentad grid in comparison to the study area



Note: (see arrow for study area) (map courtesy of SABAP2 and the Animal Demography Unit). According to the SABAP2 database, the study area hosts between 51-75 species.

Table 22: *A summary table of the total number of species (based on SABAP1), Red listed species (according to Barnes, 2000 and the IUCN, 2011), endemics and biome-restricted species (Barnes, 1998) expected and observed on the study site. Values in brackets refer to derived totals compared against the southern African subregion (expected) and the SABAP1 (and SABAP2) database (observed).*

Table 22: A summary table of the total number of bird species		
Comment	**Expected**	**Observed**
Total number of species	197.8 (21 %)	128 (65 %)
Number of Red listed species (Barnes, 2000 & IUCN, 2011)	22 (17 %)	6 (27 %)
Number of biome-restricted species (Barnes, 1998 – Afrotropical Highlands)	2 (6 %)	0 (0 %)
Number of endemics (Hockey *et al*., 2005)	16 (16 %)	7 (44 %)
Number of near-endemics (Hockey *et al*., 2005)	4 (6.5 %)	3 (75 %)

Note: Red listed species (according to Barnes, 2000 and the IUCN, 2011), endemics and biome-restricted species (Barnes, 1998) expected and observed on the study site. Values in brackets refer to derived totals compared against the southern African subregion (expected) and the SABAP1 (and SABAP2) database (observed).

The observed totals are within the limit (> 50 %) of the number of species likely to occur and provide a realistic indication of the thoroughness and general coverage of the study site. Despite the fact the study

site is dominated by grassland species, it was poorly represented by biome-restricted[14] and endemic bird species (*e.g.* Southern Bald Ibis *Geronticus calvus* & Botha's Lark *Spizocorys fringillaris*) unlike the compositions expected from the eastern Mpumalanga highlands and escarpment.

An analysis of bird data generated from the point counts showed that the Zitting Cisticola (*Cisticola juncidis*), a species confined to moist grassland areas and pastures, was the most dominant species on the study site. Other prominent taxa include the Black-smith Lapwing (*Vanellus armatus*), Red-knobbed Coot (*Fulica cristata*) and the Egyptian Goose (*Alopochen aegyptiacus*) (**Table 23** summarises the 10 typical species observed on the study area). Examination of the dominant taxa shows a prominent wetland-dependant and grassland composition dominated by members of the Cisticolidae, Anatidae and Ploceidae.

Table 23: The ten most dominant bird species recorded on the study area

Species	Consistency	Percentage
Zitting Cisticola	0.53	13.02 %
Black-smith Lapwing	0.47	13.01 %
Red-knobbed Coot	0.43	8.35 %
Egyptian Goose	0.42	7.62 %
Long-tailed Widowbird	0.34	7.33 %
Cloud Cisticola	0.29	6.89 %
Reed Cormorant	0.32	4.61 %
African Pipit	0.27	4.3 %
Yellow-billed Duck	0.38	4.19 %
Red-billed Teal	0.28	3.75 %

The study site is represented by two distinct avifaunal communities (refer **Appendix 2**):

1. A community confined to Highveld grassland seres. Typical members include cryptic taxa including a high diversity of cisticolas (including Cloud Cisticola *Cisticola textrix,* Wing-snapping Cisticola *C. ayresi* and Levaillant's Cisticola *C. tinniens*), Long-tailed Widowbird (*Ploceus progne*), African Pipit (*Anthus cinnamomeus*) and Cape Longclaw (*Macronyx capensis*); and
2. A species-rich and diverse community restricted to areas of open surface water and associated shoreline habitat. Typical species include waterfowl and wader taxa such as the Red-knobbed Coot (*Fulica cristata*), Black-smith Lapwing (*Vanellus armatus*), Yellow-billed Duck (*Anas undulata*), Red-billed Teal (*Anas erythrorhyncha*) and Reed Cormorant (*Phalacrocorax africanus*).

[14] A species with a breeding distribution confined to one biome. Many biome-restricted species are also endemic to southern Africa.

11.3.3 *Waterbird richness and diversity: Importance of the wetland features on the study site*

A comparison between the grassland and wetland counts showed increased species numbers of more than 50 % on wetland features (refer **Table 24**). It clearly indicates that the various wetland features are more diverse than the surrounding grasslands. The wetland features also sustained higher numerical abundances when compared to the grassland seres.

Table 24: Diversity measures obtained from bird counts on wetland features and grassland seres

Broad Habitat Type	Number of species (S)	Av. num of individuals	H'(log_e)*
Wetland Features	61	176.85	2.6
Grasslands (irrespective of ecological condition)	33	13.6	3.06

Note: * - Shannon-Weaver Diversity index

A comparison between rarefied curves of the different wetland features revealed that the endorheic pans are more diverse than the other features (refer **Figure 19**). These features were confined to stooping Area C, F, H and I. Further examination of the rarefied curves also shows that bird numbers on the pans rarely reach saturation, which explains the high turnover of species experienced by the endorheic pans. Despite showing high numbers of species, the pans also appear to sustain high abundance values (refer **Figure 20**).

Figure 19: Rarefaction curves obtained for selected wetland features on the study site.

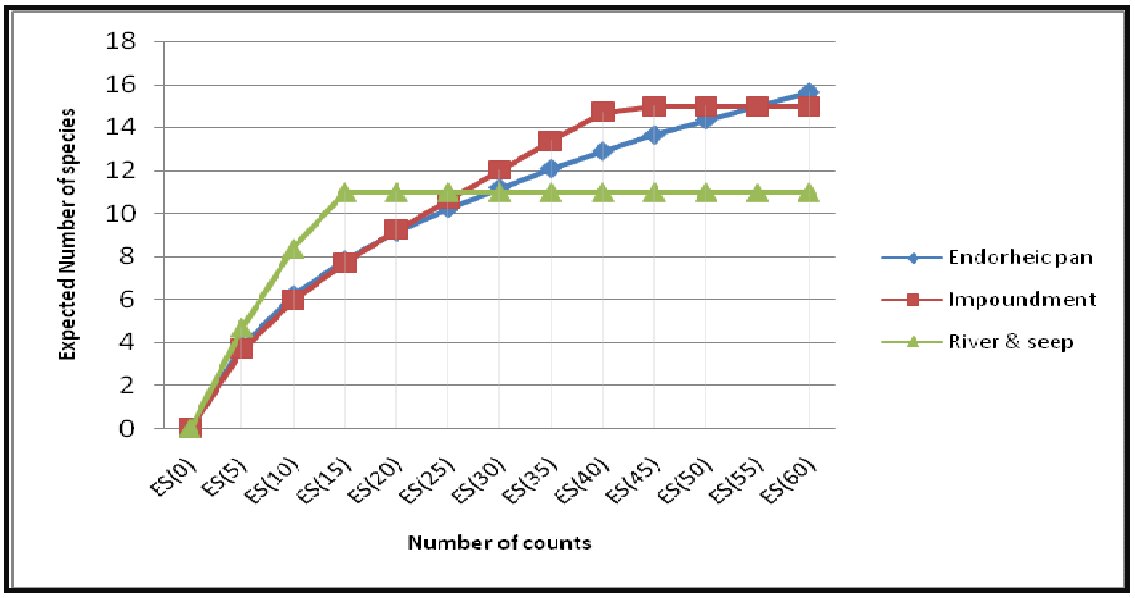
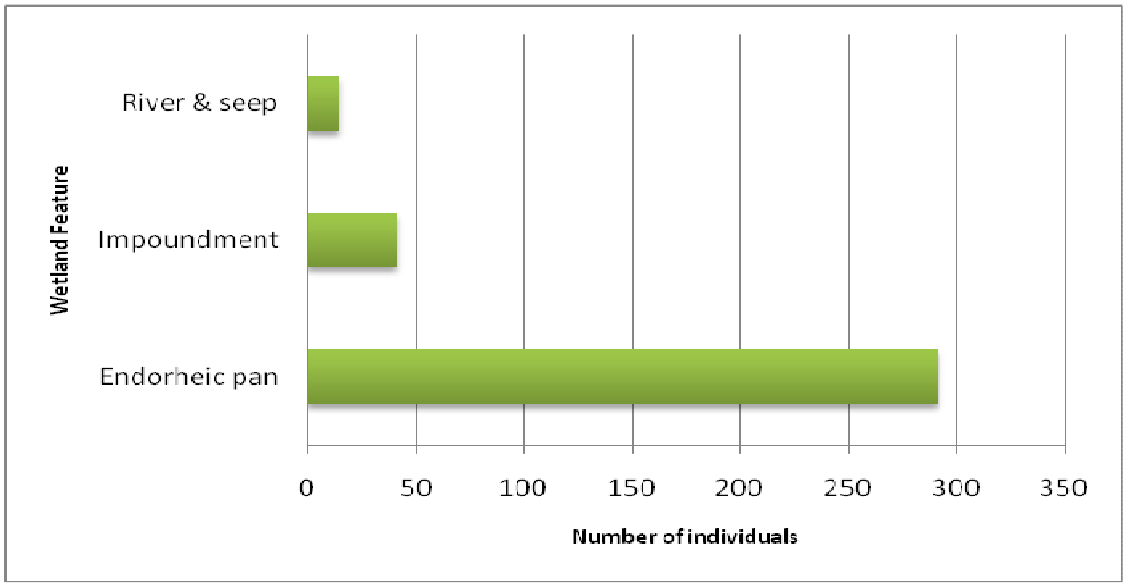


Figure 20: The average number of individuals recorded from each wetland feature.



From **Figure 21,** it is evident that endorheic pans 1, 2, 5, 6 and 14 supports high numbers of species. The first three of these pans are concentrated on Area H, while pan 14 is located on the northern part of Area I. Similarly, these endorheic pans support more than 200 waterbird individuals (#1, 2 & 9) with more than 400 individuals recorded from # 2 and 5 (**Figure 22**). It is evident that the wetland habitat on Area H and the northern parts of Area I are critical for sustaining waterbird richness and high densities of waterbirds on the study area.

Figure 21: The total number of waterbird species (S) recorded from 17 wetland features.

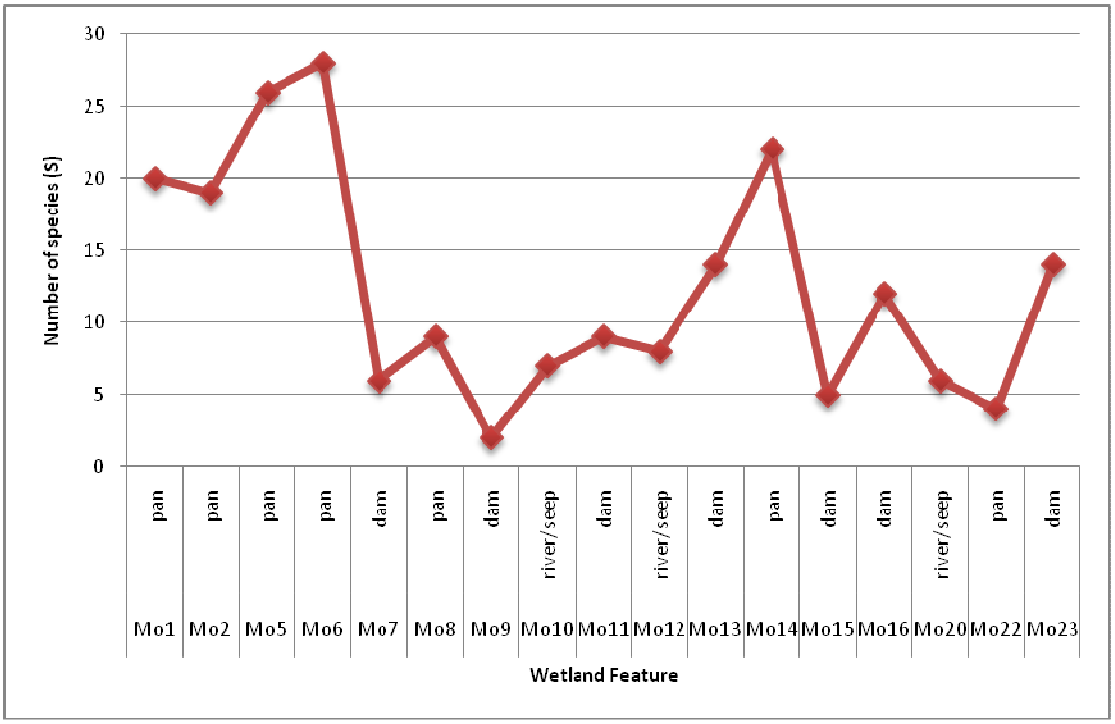
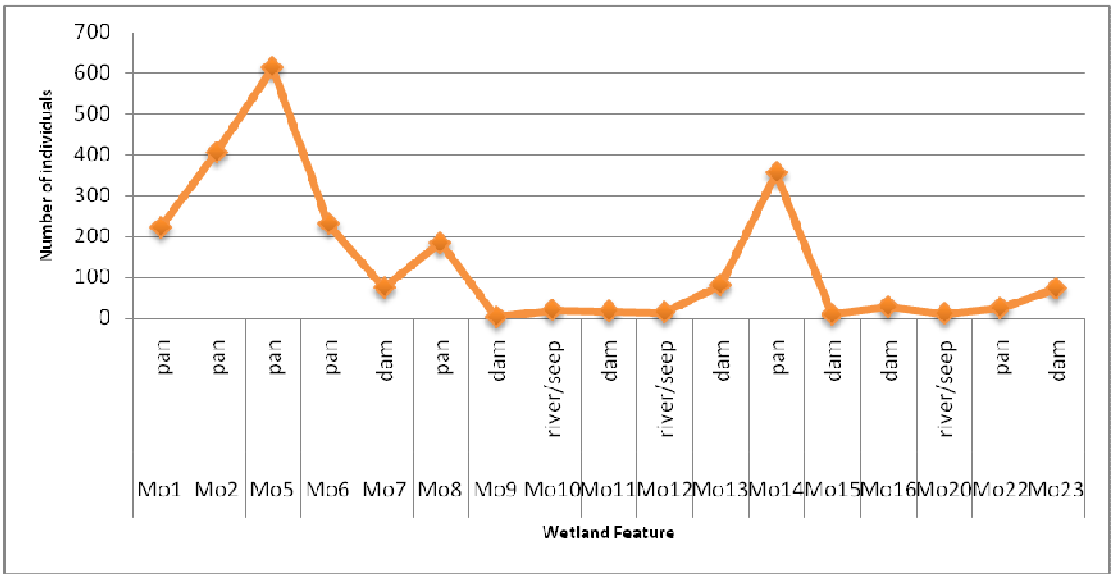
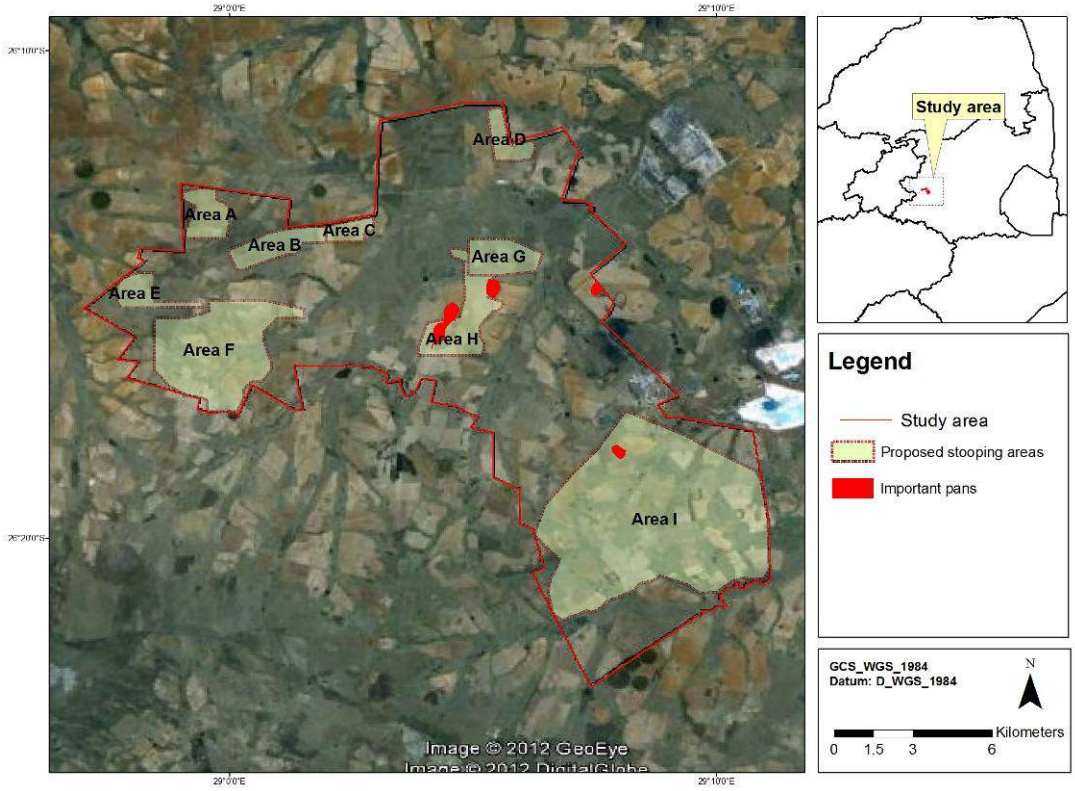


Figure 22: The number of waterbird individuals counted from 17 wetland features.



In summary, there seems to be two areas in South Africa where waterbirds tend to concentrate. One area corresponds to the winter-rainfall area of the Western Cape and the other to the Highveld plateau (Taylor *et al*., 1999). It is the latter area that is known for its high concentration of pans. It appears that many waterbird species migrate annually from the one area to the other based on the amount of rainfall and inundation received by these pans. Interestingly, none of South Africa's waterbirds are actually pan specialists, although the ephemeral nature of these pans (due to high cycling of nutrients) makes it possible for these systems to sustain high bird densities and numbers. Furthermore, they are also the main breeding grounds for ducks and geese. Consequently, these pans (as emphasised by the results illustrated in **Figure 23**) are highly dynamic systems that tend to be unpredictable, thereby attracting large numbers of species during unfavourable environmental conditions when nearby smaller pans and dams are either non-functional (dry) or lacking concentrated food resources. Nevertheless, it evident that some of these pans overlap with the proposed stooping areas (refer **Figure 23**) and would require intervention of some kind.

Figure 23: Spatial position of 5 endorheic pans sustaining high waterbird diversities and numbers



11.3.4 Species of Conservation Concern: Threatened & "Near-threatened" Taxa

Table 25 provides a summary of bird species of conservation concern previously recorded in the study region[15] based on their known distribution range and the presence of suitable habitat. The only species of conservation concern recorded during the site visit was the globally "near-threatened" Maccoa Duck (*Oxyura maccoa*) (BirdLife International, 2008). *O. maccoa* was represented by small rafts (numbering 1-4 individuals) of post-breeding birds, and was confirmed from the pan located northeast of the study site. However, this pan, as well as the larger pan southeast of site, provide ephemeral foraging habitat for two national "near-threatened' flamingo species (Greater *Phoenicopterus ruber* & Lesser Flamingo *P. minor*) (Barnes, 2000).

[15] The study region has reference to an area that is larger than the study site itself. It incorporates external habitat types that are bordering the study site. Many bird species, especially large terrestrial species exhibit large home ranges and will move over large distances in search of food or mating partners. Therefore, the area of occupancy of some species is determined by changing environmental conditions.

Table 25: Bird species of special conservation concern that could utilize the study area

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Anthropoides paradiseus (Blue Crane)	Vulnerable	Vulnerable	Yes	Yes	Prefers open grasslands. Also forages in wetlands, pastures and agricultural land.	Medium, regarded as an uncommon visitor on the study site. It is a regular (winter) visitor on the grasslands and cultivated fields south of the study site (Kinross – Bethal area).
Bugeranus carunculatus (Wattled Crane)	Vulnerable	Critically Endangered	Yes	No	Restricted to extensive upland sponges in montane grassland (in South Africa).	Unlikely to occur.
Ciconia nigra (Black Stork)	-	Near-threatened	Yes	No	Forages in and around large permanent wetlands and roost and breed in remote mountainous areas (*e.g.* cliffs).	Low, vagrant on the study site.
Circus macrourus (Pallid Harrier)	-	Near-threatened	Yes	Yes	Open grassland, valley bottom seeps and pastures.	Medium, an erratic (and unpredictable) summer visitor on the site.
Circus maurus (Black Harrier)	Near-threatened	Near-threatened	Yes	No	Generally confined to the clay grasslands on the south-western part of Mpumalanga.	Medium, an uncommon winter visitor on the study site.
Circus ranivorus (African Marsh Harrier)	-	Vulnerable	Yes	No	Restricted to permanent wetlands with extensive reedbeds.	Confirmed, an uncommon foraging visitor to extensive palustrine wetlands.
Charadrius pallidus (Chestnut-banded Plover)	-	Near-threatened	Yes	No	Natural and artificial saltpans	Vagrant.
Eupodotis senegalensis (White-bellied Korhaan)	-	Vulnerable	Yes	No	Prefers transitional habitat between grassland and savanna (*e.g.* Bankenveld).	Unlikely to occur.
Eupodotis caerulescens (Blue Korhaan)	Near-threatened	Near-threatened	Yes	No	Prefers extensive open short grassland and cultivated land.	Confirmed, resident on certain grassland seres (southern and central parts of the study site – southern extent of Farms Onverwaght 97 & Vierfontein 61 IS).
Falco biarmicus (Lanner Falcon)	-	Near-threatened	Yes	No	Varied, but prefers to breed in mountainous areas	Confirmed, occasional foraging visitor on the study site (observations based on individuals that presumably breed at the nearby void at Kriel Power Station

Table 25: Bird species of special conservation concern that could utilize the study area

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Falco naumanni (Lesser Kestrel)	Recently delisted	Vulnerable	Yes	No	The open grassland patches provide foraging habitat.	Medium-High, a fairly common summer visitor on the study site.
Falco vespertinus (Red-footed Falcon)	Near-threatened	-	Yes	No	Open arid savanna and grassland. Often joins flocks of Amur Falcons.	An uncommon summer foraging visitor.
Glareola nordmanni (Black-winged Pratincole)	Near-threatened	Near-threatened	Yes	No	A species preferring extensive open grassland, usually near wetlands. Often forages over agricultural land and pastures.	An uncommon summer visitor on the study site.
Geronticus calvus (Southern Bald Ibis)*	Vulnerable	Vulnerable	Yes	No	A species restricted to montane grassland (especially when burned) and breed/nest on steep cliffs.	Possible, uncommon foraging visitor on the study site (observations pertain to solitary birds that roost/breed in the nearby void system adjacent to the Kriel Power Station - Farm Onverwacht 70 IS).
Mycteria ibis (Yellow-billed Stork)	-	Near-threatened	Yes	No	Prefers shoreline habitat bordering large impoundments and extensive wetland systems.	Medium, an uncommon foraging visitor on the study site.
Neotis denhami (Denham's Bustard)	Near-threatened	Vulnerable	Yes	No	Prefers extensive undulating grassland and open renosterveld (usually at high altitudes).	Unlikely to occur.
Oxyura maccoa (Maccoa Duck)	Near-threatened	-	Yes	Yes	Large saline pans and shallow impoundments.	Confirmed, a common post-breeding visitor on the endorheic pans (confirmed from three prominent endorheic systems).
Phoenicopterus minor (Lesser Flamingo)	Near-threatened	Near-threatened	Yes	No	Restricted to large alkaline pans and other inland water bodies.	Medium-High, an irregular visitor on the endorheic pans.
Phoenicopterus ruber (Greater Flamingo)	-	Near-threatened	Yes	Yes	Restricted to large saline pans and other inland water bodies.	High, a regular visitor to the endorheic pans, especially the large pan system on Grootpan 86 IS
Sagittarius serpentarius (Secretarybird)	Vulnerable	Near-threatened	Yes	Yes	Prefers open grassland or lightly wooded habitat.	Medium-High, regarded as an uncommon foraging visitor on the study site. It is probably a regular visitor on the grasslands pertaining to the Farm Onverwacht 97.

Table 25: Bird species of special conservation concern that could utilize the study area

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Spizocorys fringillaris (Botha's Lark)	Endangered	Endangered	Yes	No	Upland grazed grassland, preferable clay grassland coinciding with the Vaal catchment.	Likely to occur. Suitable habitat observed from sloping grassland on the Farm Onverwacht 97. Nearest known population occurs 30 km southeast of the study site (near Bethal; pers. obs.)
Tyto capensis (African Grass Owl)	-	Vulnerable	Yes	No	Prefers rank moist grassland that borders drainage lines or wetlands.	Medium, the wetland areas with *Imperata cylindrica* grassland provide suitable breeding and roosting habitat. Unfortunately large areas of suitable habitat were transformed by grazing regimes and trampling.

Note: Bird species of special conservation concern that could utilize the study area based on their known distribution range and the presence of suitable habitat. Species with a high likelihood of occurrence are highlighted in grey. Red list categories were chosen according to the IUCN (2011)* and Barnes (2000)**.

11.4 ANNOTATED ACCOUNT OF HIGH PROBABILITY SPECIES

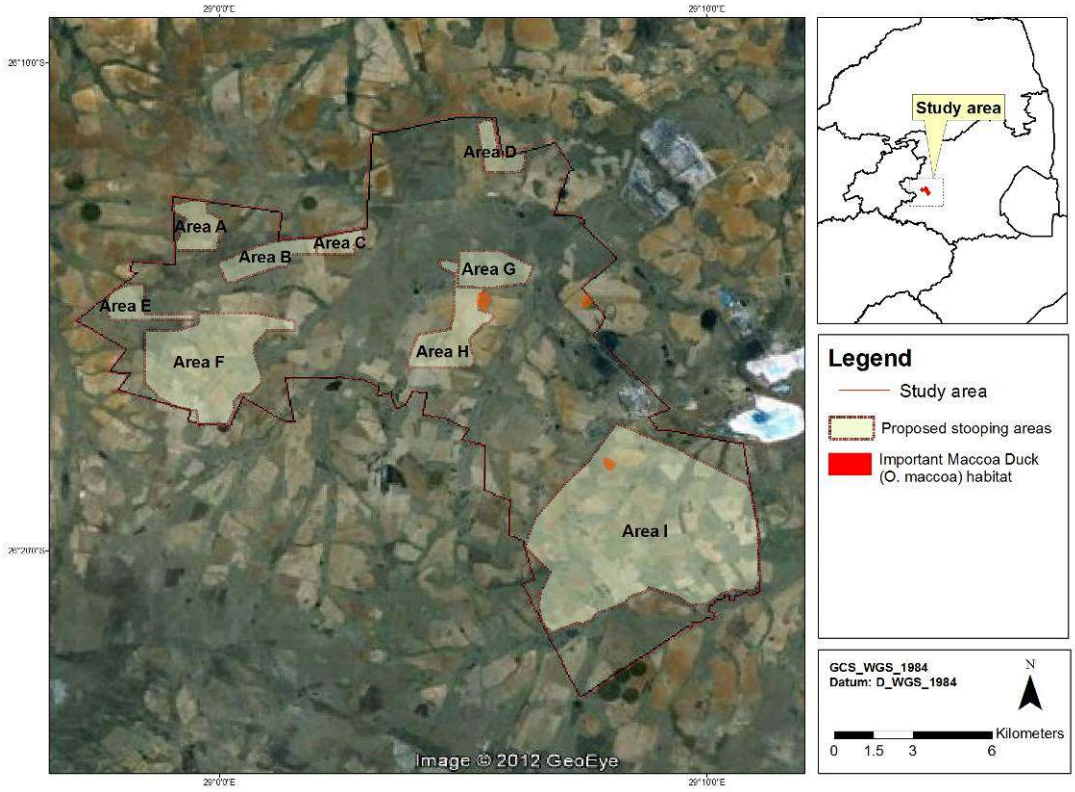
11.4.1 Maccoa Duck (Oxyura maccoa)

O. maccoa was recently classified by the IUCN as "near-threatened" owing to its small global population size and ongoing declines resulting from a number of unrelated threats (BirdLife International, 2008). Important threats appear to be water pollution and habitat alteration. It feeds almost exclusively on benthic invertebrates, which makes it susceptible to bio-accumulation of pollutants.

Nevertheless, it is endemic to sub-Saharan Africa, of which South Africa supports the largest population with approximately 4,500 – 5,500 individuals (BirdLife International, 2008). Unfortunately, only 20 % of the South African population occurs in protected areas, making this species extremely vulnerable to further habitat alteration. They are entirely aquatic and dependant on permanent wetlands with high concentrations of benthic invertebrates (Colahan, 2005).

Small rafts of between 10 to 22 individuals were observed on three pan systems, corresponding to Area H and the northern section of Area I (refer **Figure 24**). The pans are regarded as important post-breeding habitat for this species in the region.

Figure 24: Suitability of the area for the occurrence of Maccoa Duck (*Oxyura maccoa*)

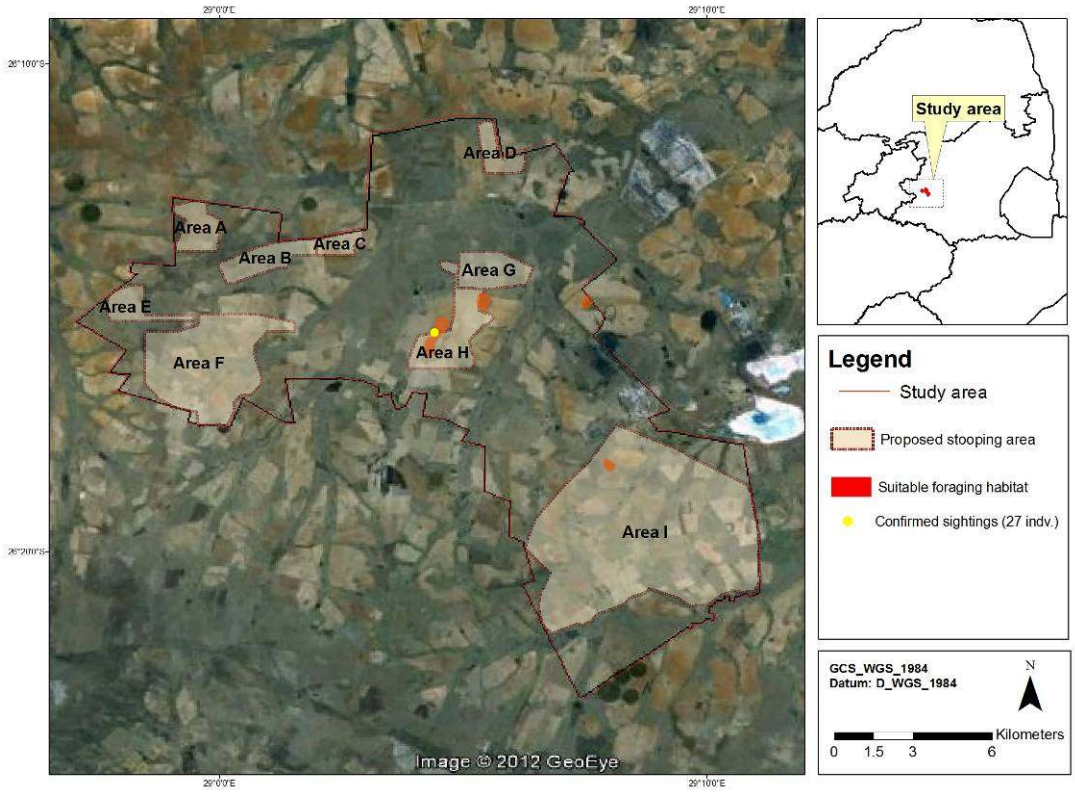


11.4.2 *Greater Flamingo (Phoenicopterus ruber)*

P. ruber is highly nomadic and thus unpredictable in occurrence. However, it prefers to congregate on large shallow impoundments and lakes, especially alkaline pans with pH values as much as 10.5 that hold high densities of brine shrimps and diatoms (del Hoyo et. al, 1992; Simmons, 2005). Based on mandible morphology, the Greater Flamingo with its shallow-keeled bill prefers to feed on *Artemia* (brine shrimps), chironomids, copepods, diatoms, the chrysalis of *Ephydra* flies and certain snails (*Cerithidea & Cerithium*). *P. ruber* doesn't breed in the Mpumalanga Province, and it seems that most of the wetlands in the province are unsuitable and does not meet its breeding demands.

It is known to utilise the large pans in the area and its occurrence on the Grootpan system (Area H on the Farm Grootpan 86 IS; n=27 individuals) is punctuated by the high reporting rates obtained during the SABAP1 period. Therefore, the pans on the study area (shown in **Figure 25**) qualify as potential suitable foraging habitat for the Greater Flamingo.

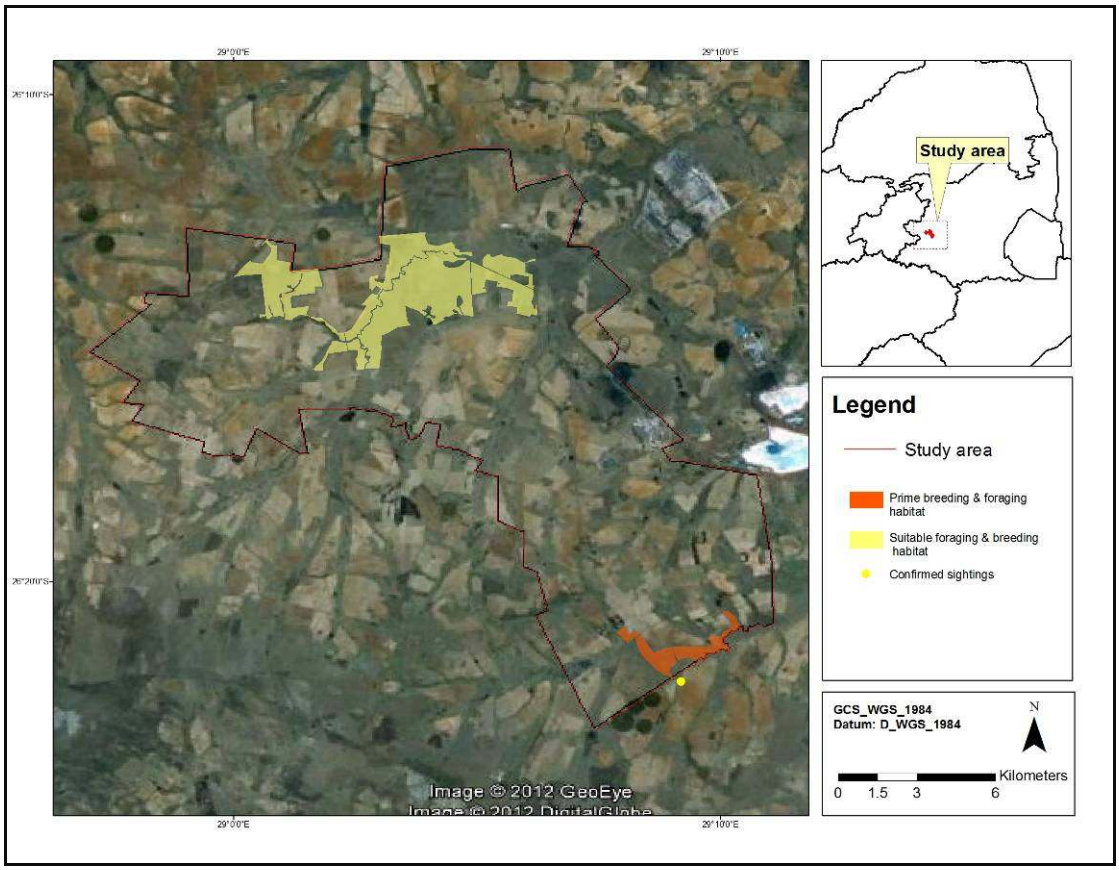
Figure 25: Suitability of the study site for the occurrence of Greater Flamingo (*Phoenicopterus ruber*)



11.4.3 Blue Korhaan (*Eupodotis caerulescens*)

E. caerulescens frequents short grassland (Harrison et al., 1997) and is endemic to South Africa. It is globally a restricted-range species (BirdLife International, 2008), which is responsible for placing it in the globally "near-threatened" category. It was confirmed from the primary undulating grassland units on the southern part of the study area (on the Farm Onverwacht 97 IS), but is also predicted to occur on the extensive central grasslands on Area B and Area G (corresponding to the Farm Vierfontein 61 IS; refer **Figure 26**). However, the South African population has stabilised over the last 10 years and was subsequently delisted (according to Taylor, 2014).

Figure 26: Suitability of the study site for the occurrence of the "near-threatened" Blue Korhaan (*Eupodotis caerulescens*)

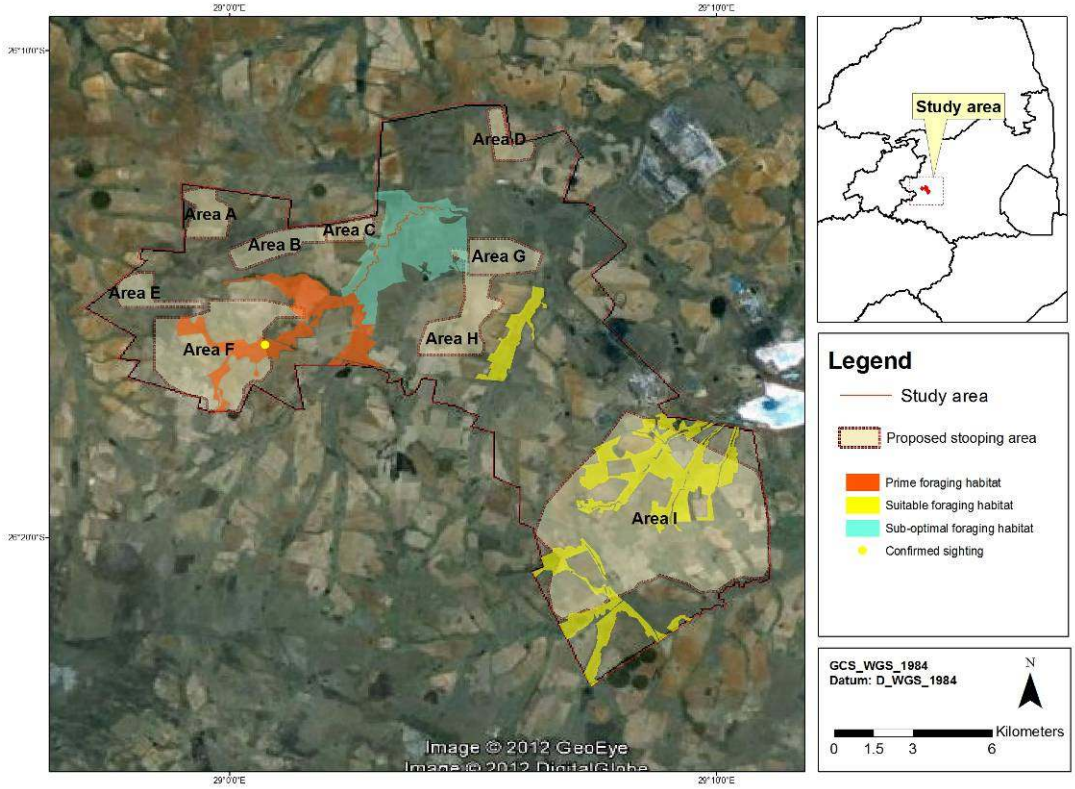


11.4.4 African Marsh Harrier (*Circus ranivorus*)

The African Marsh Harrier requires extensive permanent wetlands with reedbeds to satisfy its breeding requirements, but will often utilise smaller wetlands while foraging (Barnes, 2000). At present, it is considerably localised and the South African population displays a highly fragmented distribution range which was responsible for the recent upgrading of its conservation status from "vulnerable" to "endangered" (Taylor, 2014). The breeding success of this species is highly dependent on the spatial scale of wetland systems, and breeding attempts are seldom successful if suitable habitat is less than 100 ha in extent (Tarboton & Allen, 1984). In addition, it prefers to nest in dense reedbeds placed over water.

Suitable foraging habitat was observed from various wetland features on the study area (refer **Figure 27**) including Area F and Area I. In addition, it was only confirmed from the upper catchment of the Rietspruit (on Farms Moedverloren 88 IS and Vierfontein 61 IS) corresponding to Area F.

Figure 27: Suitability of the study site for the occurrence of the "Vulnerable" African Marsh Harrier (*Circus ranivorus*)

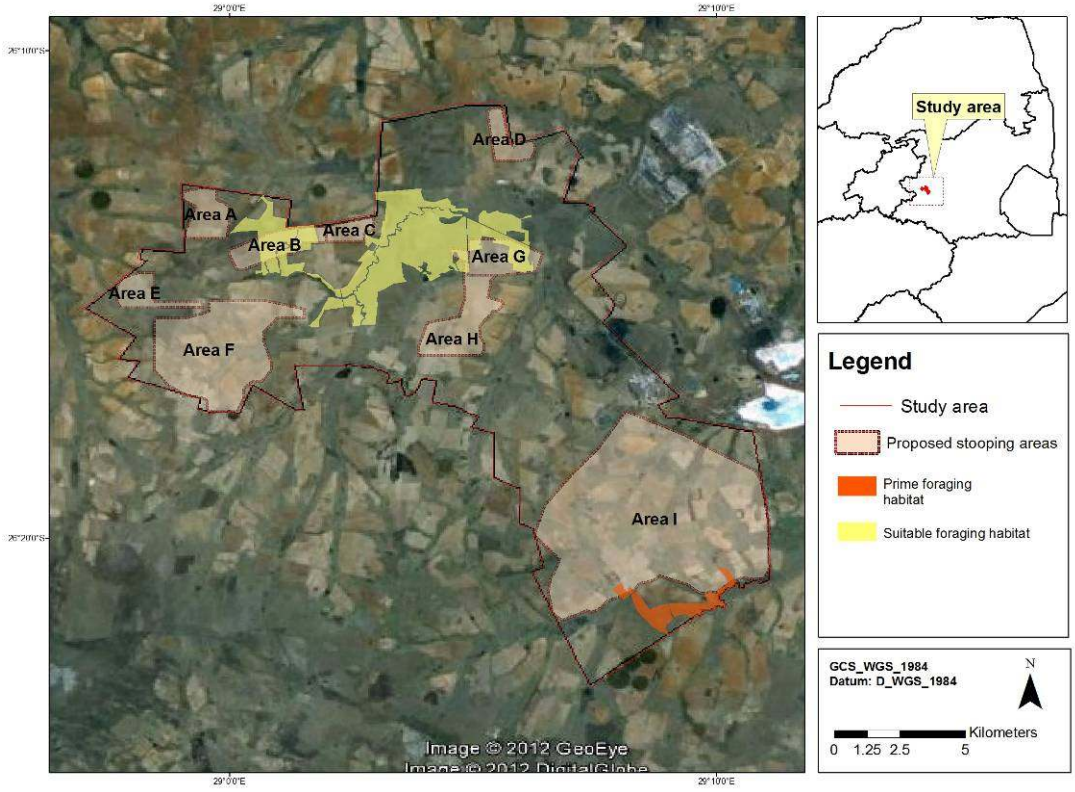


11.4.5 Secretarybird (Sagittarius serpentarius)

This species was recently upgraded from "Least Concern" to "Vulnerable" since recent evidence suggests that is has experienced rapid declines across its entire range due to habitat loss, anthropogenic disturbances and intensive grazing (BirdLife International, 2011). Secretarybirds are widespread in Africa south of the Sahara, but have declined over most of their geographic distribution range. Based on reporting rates, they appear to be more common in large conservation and rural areas, and this explains why reporting rates are relatively low (or even absent) on areas that are not statutorily conserved. Secretarybirds prefer open areas, in particular open savanna and grassland, and avoid areas of dense bush or very rocky areas.

It was not confirmed on the study area although the extensive patches of grassland on the central (Area B and Area G) and southern parts (Area I) of the study area provides suitable foraging habitat (refer **Figure 28**). However, it was recorded from grassland seres on neighbouring farms, and could for this reason occur on the study area. The main reason why this species could utilise the study area is two-tiered and probably (1) a function of habitat loss that occurred elsewhere in the region and (2) the presence of extensive, intact grassland. Many terrestrial bird species show widespread declines in numbers, primarily due to large-scale loss of habitat. It is postulated that this steady decline of suitable habitat has "forced" this species to utilise other "sub-optimal" areas, many being closely associated with human settlements, where it is often confronted or threatened by human activities.

Figure 28: Suitability of the study site for the occurrence of the "Vulnerable" Secretarybird (*Sagittarius serpentarius*)



11.4.6 Lanner Falcon (Falco biarmicus)

F. biarmicus is a fairly common species within its global distribution range, and occurs from south-eastern Europe to the Middle East, south-west Asia and across most of Africa (Jenkins, 2005). The global population consists of more than 30,000 breeding pairs with approximately 1,400 pairs confined to the eastern parts of South Africa (Tarboton & Allen, 1984). Its conservation status was recently upgraded from "near-threatened" to "vulnerable" in South Africa since the national population is continuing to experience declines owing to persistent transformation of open habitat to make way for agricultural land.

This species breeds mainly in mountainous areas and prefers deep ravines and sheer cliffs for nesting purposes. However, it is regarded as an occasional foraging visitor on the various grassland (natural and degraded) units and pastures on the study site. It prefers to forage over open terrain and will hunt indiscriminately on almost any open area with suitable prey (mainly other terrestrial birds such as francolins and lapwings). The observations are probably related to individuals that breed/roost in the old void system at the Kriel Power Station.

11.4.7 African Grass-owl (Tyto capensis)

The African Grass-owl is known to occur on the study area with one breeding pair residing along the Rietspruit system coinciding with Area F (currently part of a monitoring programme conducted by EWT). However, other suitable breeding and roosting areas were also observed on the central and southern parts of the study area (e.g. Area I) consisting of tall, dense patches of *Imperata cylindrica*.

Please note that a full-scale Grass-owl survey is planned to take place during the end of November (2014) by a team of specialists. Results emanating from the survey will be documented in the final draft of this report.

B. The following species are included due to the presence of suitable habitat on the study area and the occurrence of nearby breeding populations:

11.4.8 Southern Bald Ibis (Geronticus calvus)

This species is included due to the presence of suitable habitat on the study site and the occurrence of nearby breeding populations.

The Southern Bald Ibis is endemic to the northeastern parts of South Africa, Lesotho and western Swaziland, with the core of its distribution located in the northeastern Free State, the Mpumalanga escarpment and the KwaZulu-Natal Drakensberg (BirdLife International, 2008). It is currently listed as "Vulnerable" due to its small global population size, which is believed to be declining owing to habitat transformation and degradation. The global population is approximately 8,000 – 10,000 individuals (Allen, 1997; Barnes, 2000) with an estimated 1,500 breeding pairs in South Africa (BirdLife International, 2008). The Mpumalanga and Limpopo population stands at approximately 2,250 individuals (Allen, 1985).

It is threatened by human interference at breeding localities and habitat loss due to afforestation, opencast mining activities and agricultural intensification (BirdLife International, 2008). It prefers to breed on vertical cliffs, while high-altitude grassland, especially when recently burned, is its preferred foraging habitat. It also utilises cultivated land, pastures and tilled land during foraging bouts (pers. obs.). It will also attempt to breed on the vertical sides of old opencast void systems (*e.g.* near the Kriel Onverwacht mine and on Ikwezi-Doornkop mine near Newcastle).

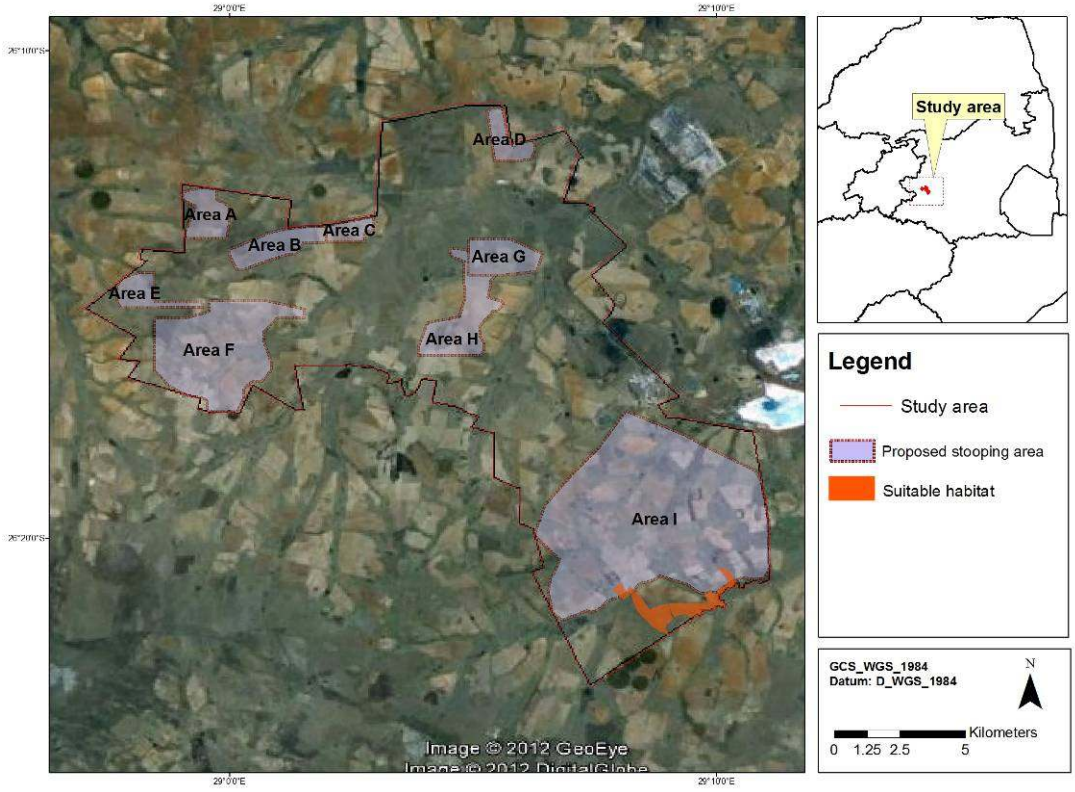
All observations of *G. calvus* on the study site will include individuals from the nearby population that roosts at the Kriel - Onverwacht void. It is regarded as an uncommon foraging visitor to the various grassland units on the site.

11.4.9 Botha's Lark (Spizocorys fringillaris)

The Botha's Lark is an endemic resident of South Africa with a very restricted distribution centred on the Mpumalanga Highveld and eastern Free State. It is listed as "endangered" since it experienced a very rapid population decline due to habitat destruction (*e.g.* agricultural intensification) (BirdLife International, 2008). The global population is estimated at 1,500 – 5,000 individuals.

It is restricted to well-grazed, high altitude grassland on clay soils. The nearest breeding population occurs south (approx. 30 km) of the study site near Bethal (pers. obs.), which prompted the likelihood that this species could occur on the southern part of the study site (refer **Figure 29**). The undulating grasslands on the Farm Onverwacht 97 IS provides suitable habitat for this species to occur.

Figure 29: Suitability of the study site for the occurrence of the "Endangered" Botha's Lark (*Spizocorys fringillaris*)



11.5 AVIFAUNAL IMPORTANCE & PRELIMINARY SENSITIVITY ANALYSIS

11.5.1 Areas of high avifaunal importance: Wetland features & extensive grassland patches

- The endorheic pans facilitate moulting of waterfowl (when many individuals have lost their ability to fly) (refer **Figure 30**);
- The endorheic pans is responsible for > 50 % of the observed avifaunal diversity and support high numbers of waterbird species;
- The endorheic pans conform to an interconnected pan system with high variability amongst each other in terms of depth, salinity and water levels. Therefore, based on seasonality, these systems are highly dynamic and experience a frequent turnover of bird species. In addition, they provide foraging habitat for the globally '"near-threatened' Maccoa Duck (*O. maccoa*) and the "near-threatened" Greater Flamingo (*Phoenicopterus ruber*) (# 1, 2, 4, 6 and 14 - refer **Figure 17**);
- Some of the endorheic pan systems show extensive areas of mudflats which are important foraging habitat for small *Charadrius* plovers (*e.g.* Common Ringed Plover *Charadrius hiaticula*) and Palaearctic migrants, *e.g.* scolopacid shorebirds (up to 400 and 130 Little Stints *Calidris minuta* and Ruffs *Philomachus pugnax* counted respectively) - # 1, 2 and 5 - refer **Figure 17**;
- The large manmade impoundments provide roosting and breeding habitat (trees) for certain aquatic bird species (*e.g.* Black-headed Heron *Ardea melanocephala* & White-breasted Cormorant *Phalacrocorax lucidus*);
- The hillsslope seeps, perennial streams, valley bottom seeps and their associated grassland seres represent local flyways and dispersal networks for wading birds and waterfowl (mainly herons, cormorants, ibises, ducks and geese) – any development within these areas will have a definite and

significant impact on the avifaunal diversity of the area. These areas also provide suitable foraging habitat for the "vulnerable" African Marsh Harrier (*Circus ranivorus*); and

- The southern and central grassland patches (especially on the Farms Onverwacht 97 and Vierfontein 61 IS corresponding to Areas B, G and I) represent large corridors of foraging habitat for declining terrestrial bird species such as the Secretarybird (*Sagittarius serpentarius*), Blue Korhaan (*Eupodotis caerulescens*) and possibly Botha's Lark (*Spizocorys fringillaris*).

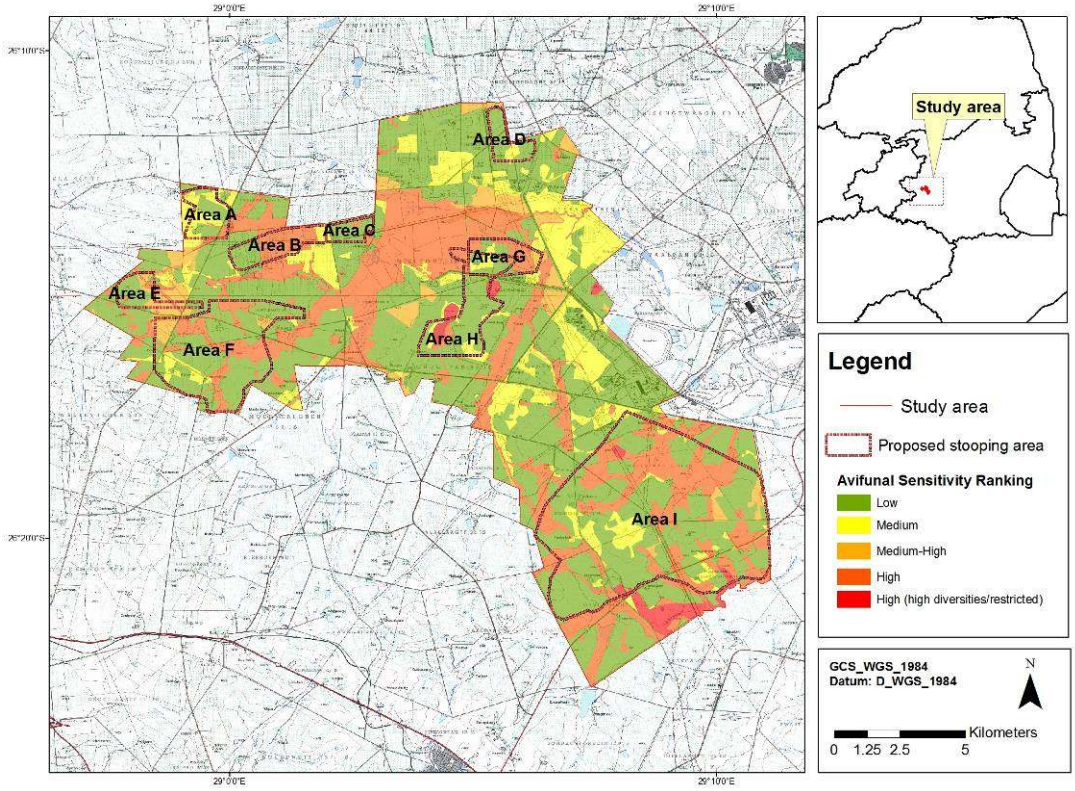
11.5.2 Areas of medium & medium-high avifaunal importance: Degraded grassland

- These grassland patches, although of secondary composition provide ephemeral foraging habitat for the Secretarybird (*Sagittarius serpentarius*) and Blue Korhaan (*Eupodotis caerulescens*) while maintaining high ecological connectivity with adjacent grassland units (refer **Figure 30**).

11.5.3 Areas of medium-low & low avifaunal importance: Natural grassland (in part), exotic plantations and agricultural land

- These include grassland patches surrounded by agricultural fields and are fragmented (isolated) - they provide ephemeral foraging habitat for unspecialised bird taxa;
- Many of these areas were historically disturbed (*e.g.* overgrazed) and are composed of pioneer or increaser grass species that contribute little towards local biodiversity; and
- Some of these habitat types correspond to areas where severe disturbances took place (*e.g.* tilling).

Figure 30: A sensitivity map illustrating the avifaunal importance & ecological function



It was evident from the sensitivity analysis that the following proposed stooping areas represent habitat features that are of high avifaunal sensitivity:

- **Area F, H & I**: Presence of large endorheic systems holding high waterbird richness and densities;
- **Area B, G & I**: Presence of extensive natural grassland which provide foraging habitat for large terrestrial bird species; and
- **Area F & H**: Presence of extensive hillslope seeps and channelled valley bottom wetland systems, including the Rietspruit system which provide habitat for the "endangered" African Marsh Harrier (*C. ranivorus*).

11.6 AVIFAUNAL IMPACT ASSESSMENT, MITIGATION & RECOMMENDATIONS

5.1 Background

Coal mining is probably one the most important industries in the world, especially in South Africa that contributes towards economic development and power generation (Tiwary, 2001). However, it is also an industry that imparts substantial pollution and a wide variety of environmental impacts depending on the extent of the mining operations and the pre-mining condition of the area.

The proposed surface infrastructure that will be required during the stooping activities will invariably result in the loss of agricultural land and natural grassland. According to the sensitivity map (refer **Figure 30**), highly sensitive or critical important avifaunal habitat that are anticipated to be impacted in a direct way (*e.g.* the loss of habitat or displacement of birds) are the endorheic pans on the Farm Grootpan. Likewise, stooping activities that are coincidental to the various wetland features could easily disrupt the water balance (the groundwater-surface water interaction).

Proposed construction activities will include:

- Footprint clearance;
- Establishment of infrastructure;
- Establishment of box-cuts; and
- Waste Handling.

Proposed operational activities will include:

- Opencast mining of coal;
- Stooping activities (underground mining of coal);
- Coal product stockpiling;
- Conveyer belts (transporting of coal);
- Coal product crushing;
- Pollution control dams;
- Waste generation and handling; and
- Hydrocarbon storage.

Proposed decommissioning/closure activities will include:

- Removal of infrastructure;
- Rehabilitation; and
- Residual impacts post closure.

Based on the provisional layout, major bird impacts associated with the construction, operational and decommissioning phases will include:

- Long-term loss of waterbird habitat caused by mining activities (open-cast mining) and displacement of bird species occupying adjacent grassland areas;
- Indirect, long-term impacts associated with the acidification of soils and surface water (acid mine drainage), thereby affecting avifaunal reproduction and mortality, as well as accidental spillage of dirty/wastewater into nearby endorheic/wetland systems; and
- Possible skewed bird compositions and increased competition due to the creation of artificial habitat (pollution control dams) and waste handling facilities.

11.7 CONSTRUCTION IMPACTS

11.7.1 Loss of habitat & habitat transformation

Construction of the proposed infrastructure (including the construction of linear infrastructure) will result in the clearance of vegetation and the loss of low to medium important avifaunal habitat (only if coincidental to the agricultural lands and degraded grassland).

However, the two proposed opencast pits coincide with two of the most important endorheic pans for waterbirds on the study site (on the Farm Grootpan). Therefore, any loss of habitat beit surface water loss or shoreline habitat will subsequently alter the waterbird composition and abundance. In addition, loss of linear habitat types, for example seeps and drainage lines could affect the daily migration routes of many waterbird taxa. Nevertheless, impacts associated with the opencast activities are believed to be more acute in comparison to the underground stooping activities. During the latter, it is anticipated that smaller areas will be cleared to accommodate the surface infrastructure.

11.7.2 Displacement of bird taxa

Construction activities go hand in hand with high ambient noise levels. Many of the larger terrestrial species, including wading birds and waterfowl will vacate the study site during the construction phase. It is also possible that waterbird taxa will be displaced from their preferred moulting sites. This impact is considered significant and will result in the loss of endorheic pan habitat.

11.7.3 Changes in the community structure (during waste handling)

It is possible that stored waste, especially if left for extended periods on the site will attract cosmopolitan (or feral) species (*e.g.* Greyheaded Gull *Larus cirrocephalus* and Pied Crow *Corvus albus*) in densities that will displace the natural occurring taxa. Many of these species are inherently aggressive and will compete with those species that occur naturally on the study site.

11.7.4 Displacement of threatened, "near-threatened" & conservation important taxa

Due to the placement of the endorheic pans in relation to the proposed opencast pits, it is inevitable that the Greater Flamingo and Maccoa Duck will be displaced. However, displacement of threatened species, especially large terrestrial species (*e.g.* Secretarybird & Blue Korhaan) caused by stooping activities will be limited to the physical placement of the surface infrastructure. Displacement of threatened bird species could effectively be minimised by avoid placing infrastructure on intact grasslands on the central and southern part of the study site, and by allocating "no-go" buffer zones to the endorheic pans.

11.8 OPERATIONAL IMPACTS

11.8.1 Displacement of waterbirds & large terrestrial bird taxa

Opencast mining activities are proximal to two regionally important endorheic pans. Therefore, it is anticipated that noise generated by the mining activities (*e.g.* blasting) will displace the waterbird taxa from the pans.

On the other hand, stooping activities are confined to the underground mining, thereby resulting in less intrusive noise generation. Noise regimes will be limited to surface infrastructure (*e.g.* hauling, offices and crushing plants), which is predictable and constant over time and often induce a learning response to birds that is very similar to habituation. Therefore, it is predicted that the displacement of terrestrial taxa during stooping activities will be of temporary nature.

11.8.2 Changes in the community structure

It is possible that stored waste, especially if left for extended periods on the site will attract cosmopolitan (or feral) species (*e.g.* Greyheaded Gull *Larus cirrocephalus* and Pied Crow *Corvus albus*) in densities that could displace the natural occurring taxa. Many of these species are inherently aggressive and will compete with those species that occur naturally on the study site.

In addition, the proposed pollution control dams provide an alternative environment for certain waterfowl species to colonise. Although considered as a positive impact (*e.g.* increasing local species richness and diversity), it is regarded as an "artificial" assemblage of species that will be dominated by generalist taxa with widespread distribution patterns (*e.g.* Red-knobbed Coot & Yellow-billed Duck).

11.8.3 Water pollution caused by dirty/waste water and hydrocarbon spillage

Accidental spillages of dirty water emanating from the water pollution treatment plant could ultimately end up in the nearby endorheic pans and drainage lines. Spilled pollutants will alter the water chemistry, thereby causing a chain-reaction of events that could eventually modify the distribution and abundance of the benthic and diatom community. This in turn will affect the availability of aquatic food resources for wetland-dependant waterfowl, which can lead to local declines of waterfowl numbers, either directly (affecting adult mortality) or indirectly (affecting the reproductive success of certain species).

The proximal position of the opencast pits to the endorheic pans increases the risk of an overspill of stored hydrocarbons and oil-related products, thereby increasing the risk for chronic oil pollution in waterbirds. The feathers of waterbirds are a physiological adaptation to insulate and waterproof the individual. However, when feathers become oiled, it loses its thermoregulatory and waterproofing ability. Oiled birds then risk hypothermia and could even drown (oiled birds cannot fly) (Erasmus, *et al.*, 1981). In extreme cases, birds that suffer from hypothermia will mobilise their fat reserves, will lose weight and eventually die from starvation. When oil is ingested, *e.g.* during preening, a range of physiological abnormalities are produced such as ulceration of the mouthparts and digestive system leading to loss of blood and anemia (Kerley & Erasmus, 1987). Oiled birds are also susceptible to other diseases such as pneumonia. When the eyes are exposed to oil, the blindness may occur due to ulceration of the cornea.

11.8.4 Water pollution caused acid mine drainage (AMD)

Water pollution is probably one of the biggest problems that face the coal mining industry. In fact, water pollution caused by coal mining has a regional effect since pollutants are carried away in groundwater, streams and during precipitation events. However, AMD is probably the most common mining related source of water pollution, and the severity depends on the sulphur content of the coal (the higher the sulphur content of the pyrites in the coal, the more acidic the water becomes).

Coal mining activities near drainage systems and pans are likely to alter the chemistry and specifically the pH of the surface water of such systems. This in turn will affect the availability of aquatic food resources for wetland-dependant fauna. Leaching of pollutants from stockpiles (especially those with high pyrite content) can lead to increased ground water acidification during rainfall events. The long-term effects of acid deposition during rainfall events (acid rain) could lead to significant declines in bird populations. Acid deposition causes egg-shell thinning and lowering of reproductive success due to a depletion of calcium in the soil (Green, 1998; Hames *et al*., 2002).

11.8.5 Conveyer belts & transportation of coal

The transportation of coal invariably involves the construction of linear structures (in this case conveyer belts and haul roads) that often requires the crossing of wetland system and drainage lines. Crossing of wetland systems by means of roads and conveyer belts could disrupt the daily movement corridors of birds. Similarly, an increased road network could cumulatively enhance surface-runoff and lead to unpredictable floods and erosion during peak rainfall events. Ultimately, increased erosion could promote siltation, thereby affecting the availability of prey for bird species that typify the higher trophic levels of the food chain (*e.g.* piscivorous species).

11.8.6 Increased settling of airborne pollutants (coal dust)

The anticipated increase in haul traffic and opencast mining operations (especially after blasting events) will lead to increased settling of dust on adjacent vegetation. Dust settling on vegetation could affect the breeding "fitness" of phytophagous invertebrate species (*e.g.* host plant selection) and their larval development, which will cycle down the food chain affecting the resource allocation for insectivorous bird species.

11.9 DECOMMISSIONING IMPACTS

- *Water pollution*: It is anticipated that the removal of the waste water treatment facility and latent pollution resulting from acid mine drainage could alter the natural waterbird composition on the nearby pans;
- *Increased anthropogenic encroachment*: The proposed mining activities will provide a means of "job-creation" for the local community as well as people from abroad. Unfortunately, such an activity will impact negatively on the surrounding habitat types by facilitating "urban-sprawl" and consequential plundering of natural resources; and
- *Changes in the avifaunal community structure during rehabilitation events*: It is likely that the bird species composition will shift, due to an anticipated loss in habitat area during opencast mining. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study site when natural grasslands are being converted to mining pits. In addition, rehabilitation will

attract bird species with unspecialised and generalist life-histories. It is predicted that these will persist for many years before conditions become suitable for succession to progress.

11.10 AVIFAUNAL IMPACT RATING TABLES

11.10.1 Construction Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CONSTRUCTION PHASE ACTIVITIES																		
Area A																		
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	8	5	2	3	45	-	M	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	6	5	2	2	26	-	L	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and grassland units		6	4	2	2	24	-	L		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community composition	Transformation of Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Mainly wetland habitat and degraded grassland		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Area B																		
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and grassland units	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections,	10	5	3	4	72	-	H	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing	8	5	3	3	48	-	M	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and grassland units		10	4	3	4	68	-	H		8	4	3	2	30	-	M	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community	Transformation of Wetland habitat, and Natural		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor

composition	Grassland habitat types	pollution control dams, coal storage facilities, etc)								infrastructure on linear habitat features.								bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Natural grassland (providing habitat for Secretarybirds and Blue Korhaan)		10	4	3	4	68	-	H		8	4	3	4	60	-	M	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Area C																		
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and pan	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	8	5	2	4	60	-	M	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	6	4	3	1	13	-	L	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and pan		8	4	2	3	42	-	M		6	4	2	3	36	-	M	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community composition	Transformation of Wetland habitat and pan habitat types		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Mainly pan and wetland habitat		8	4	2	3	42	-	M		6	4	2	3	36	-	M	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Area D																		
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and degraded grassland	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	8	4	2	2	28	-	L	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	6	4	2	1	12	-	L	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and degraded grassland units		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community composition	Transformation of Wetland habitat and Degraded Grassland		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of	Mainly wetland habitat and degraded grassland		6	4	2	2	24	-	L		4	4	2	1	10	-	L	Biodiversity monitoring programme, erosion management programme, monitor

species of conservation concern																		bird distribution and abundance patterns, hydrological functionality and integrity management programme
Area E																		
Direct impacts on the loss of habitat & habitat transformation	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	8	5	2	4	**60**	-	**M**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones, walkthrough prior to commencement of construction activities and during optimal growing season in order to identify and relocate plants of conservation importance from construction areas. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors.	6	5	2	3	**39**	-	**M**	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Impacts resulting in changes in the avifaunal community composition	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Area F																		
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), moist grassland and pans	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	10	5	3	5	**90**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	8	5	3	4	**64**	-	**H**	Monitor bird distribution and abundance patterns
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), moist grassland and pans		10	4	3	4	**68**	-	**H**		8	4	3	4	**60**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Impacts resulting in changes in the avifaunal community composition	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), moist grassland and pans		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Impacts resulting in the displacement or loss of species of conservation concern	Mainly wetland habitat and associated grassland (African Marsh Harrier and African Grass-owl)		10	4	3	4	**68**	-	**H**		8	4	3	4	**60**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme

Area G																			
Direct impacts on the loss of habitat & habitat transformation	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and natural grassland	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	10	5	3	4	**72**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	8	5	3	3	**48**	-	**M**	Monitor bird distribution and abundance patterns
Direct impacts on the displacement of bird taxa	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and natural grassland		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Impacts resulting in changes in the avifaunal community composition	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages) and natural grassland		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme
Impacts resulting in the displacement or loss of species of conservation concern	Mainly natural grassland units (foraging habitat of Secretarybird and Blue Korhaan)		8	4	3	3	**45**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Area H																			
Direct impacts on the loss of habitat & habitat transformation	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)	10	5	3	4	**72**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.	10	5	3	3	**54**	-	**M**	Monitor bird distribution and abundance patterns.
Direct impacts on the displacement of bird taxa	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types		10	5	3	4	**72**	-	**H**		10	5	3	3	**54**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community composition	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types		10	5	3	4	**72**	-	**H**		10	5	3	3	**54**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Area I																			
Direct impacts on the loss of habitat & habitat transformation	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types	Any construction related activity resulting in destruction, clearing, degradation or alteration of natural	10	5	3	5	**90**	-	**H**	Exclude areas of high sensitivity from construction activities that will result in destruction of natural habitat, particularly wetland habitat	10	5	3	4	**72**	-	**H**	Monitor bird distribution and abundance patterns.
Direct impacts on the	Wetland habitat types		10	5	3	4	**72**	-	**H**		10	5	3	3	**54**	-	**M**	Biodiversity monitoring programme,

displacement of bird taxa	(**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types	habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc)							types, implementation of suitable buffer zones. Minimising clearance footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Avoid placing infrastructure on linear habitat features.									erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in changes in the avifaunal community composition	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.
Impacts resulting in the displacement or loss of species of conservation concern	Wetland habitat types (**Endorheic pans**, Hillslope seepages), Natural Grassland habitat types		10	5	3	4	**72**	-	**H**		10	5	3	3	**54**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme.

11.10.2 Operational Phase

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
OPERATIONAL PHASE ACTIVITIES																		
Area A																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	6	4	2	3	36	-	M	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Degraded Grassland		6	4	2	3	36	-	M		4	4	2	2	20	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		8	4	3	3	45	-	M		4	4	3	2	22	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat		8	4	2	3	42	-	M		6	4	2	2	24	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area B																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of	8	5	3	3	48	-	M	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types,	6	5	3	2	28	-	L	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat, Natural grassland habitat types	ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	10	5	3	4	**72**	-	**H**	implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	5	3	2	**32**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat and Natural Grassland habitat types		8	5	3	3	**48**	-	**M**		6	5	3	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat		8	4	2	3	**42**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area C																			
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Endorheic pan)	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	8	4	3	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pan)		6	4	2	3	**36**	-	**M**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	3	2	**26**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term

																		waterbirds counts
Area D																		
Direct impacts on the displacement of bird taxa - waterbirds	None	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	6	4	2	2	**24**	-	**L**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Degraded Grassland		6	4	2	2	**24**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Degraded Grassland		6	4	2	2	**24**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Degraded Grassland		6	4	3	2	**26**	-	**L**		4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area E																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	8	4	2	4	**56**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope		8	4	3	4	**60**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns,

	seepages), Natural Grassland habitat types									impacts, contamination, etc.								hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area F																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	10	4	2	4	**64**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		10	4	3	4	**68**	-	**H**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		8	4	2	3	**42**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area G																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of	8	4	3	4	**60**	-	**M**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types,	6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	8	4	3	4	**60**	-	**M**	implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		8	4	3	4	**60**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	3	3	**39**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area H																				
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc.)	10	4	3	4	**68**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		8	4	2	4	**56**	-	**M**		6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term

																		waterbirds counts
Area I																		
Direct impacts on the displacement of bird taxa - waterbirds	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Any operational related activity resulting in destruction, degradation or alteration of natural habitat (construction of ancillary infrastructure, offices, workshops, hydrocarbon storage facilities, electrical supply, haul roads, conveyor sections, pollution control dams, coal storage facilities, etc	10	4	3	4	**68**	-	**H**	Exclude areas of high sensitivity from operational activities that will result in destruction of natural habitat, particularly wetland habitat types and ecologically functional grassland types, implementation of suitable buffer zones. Minimising operational footprints, limiting linear infrastructure, placing linear infrastructure to combined corridors. Implementation of management and preventative guidelines in order to avoid dispersing of operational impacts, contamination, etc.	8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Direct impacts on the displacement of bird taxa - grassland-associated birds	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges		10	4	3	4	**68**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		10	4	3	4	**68**	-	**H**		8	4	3	3	**45**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

11.10.3 *Closure & Decommissioning*

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
DECOMMISSIONING AND CLOSURE PHASE ACTIVITIES: 1. REMOVAL OF INFRASTRUCTURE 2. ACTIVE SURFACE REHABILITATION OF DISTURBED AREAS																		
Area A																		
Direct impacts on bird species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	3	1	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages)		6	4	2	2	**24**	-	**L**		6	3	1	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	3	1	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		4	4	2	2	**20**	-	**L**		4	3	1	2	**16**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area B																		
Direct impacts on bird species of conservation importance	Wetland Habitat (Unchannelled valley bottoms, channelled valley bottoms, hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat, Natural grassland habitat types	surface disturbances resulted	8	4	2	3	**42**	-	**M**	facilitate suitable slopes and topographical features	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat, Degraded Grassland, Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat, Natural grassland habitat types		6	4	3	3	**39**	-	**M**		4	4	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area C																		
Direct impacts on bird species of conservation importance	Wetland habitat types (Endorheic pan)	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pan)		6	4	2	2	**24**	-	**L**		4	4	1	1	**9**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pan)		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	3	3	**39**	-	**M**		4	4	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term

																		waterbirds counts
Area D																		
Direct impacts on bird species of conservation importance	None	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	2	**28**	-	**L**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	6	4	2	1	**12**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	None		6	4	2	1	**12**	-	**L**		4	4	2	1	**10**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Degraded Grassland		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		4	4	1	2	**18**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area E																		
Direct impacts on bird species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	3	**42**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope		8	4	2	3	**42**	-	**M**		6	4	2	2	**24**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns,

	seepages), Natural Grassland habitat types																	hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	3	3	**39**	-	**M**		4	4	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area F																		
Direct impacts on bird species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		8	4	2	3	**42**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area G																		
Direct impacts on bird species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where	8	4	2	3	**42**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types	surface disturbances resulted	8	4	2	3	**42**	-	**M**	facilitate suitable slopes and topographical features	8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types, Degraded Grassland		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Hillslope seepages), Natural Grassland habitat types		6	4	3	3	**39**	-	**M**		4	4	3	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Area H																			
Direct impacts on bird species of conservation importance	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	3	3	**45**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	3	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		6	4	2	2	**24**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Endorheic pans, Hillslope seepages), Natural Grassland habitat types		6	4	3	2	**26**	-	**L**		6	4	1	2	**22**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Endorheic pans, Hillslope seepages, Channelled valley bottoms), Natural Grassland habitat types		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term

																		waterbirds counts
Area I																		
Direct impacts on bird species of conservation importance	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges	Removal of mining infrastructures, decommissioning of linear infrastructure, rehabilitation and revegetating of affected areas where surface disturbances resulted	8	4	3	3	**45**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species of the region, including a grass and herbaceous cover, prevent erosion, reslope areas to facilitate suitable slopes and topographical features	8	4	3	2	**30**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Loss or degradation of natural vegetation/ sensitive habitat types	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges		8	4	2	3	**42**	-	**M**		8	4	2	2	**28**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Impacts on ecological connectivity & ecosystem functioning	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland, Degraded Grassland, Ridges		6	4	3	3	**39**	-	**M**		6	4	3	2	**26**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Indirect impacts (loss/ degradation/ pollution) on surrounding habitat	Wetland habitat types (Unchannelled valley bottoms, Channelled valley bottoms, Hillslope seepages, Endorheic pans), Natural Grassland habitat types, Ridges habitat		8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts

11.10.4 Residual Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
RESIDUAL IMPACTS																		
Area A																		
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	
Area B																		
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	
Area C																		
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	

Area D																				
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	
Area E																				
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	
Area F																				
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**	
Area G																				
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			6	4	3	3	**39**	-	**M**		4	4	3	3	**33**	-	**M**	

										ecological sensitivity								
Area H																			
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**		
Area I																			
Increased anthropogenic encroachment	All affected areas and immediate surrounds	Altered hydrological regimes and chemical composition, altered avifaunal composition and structure, possible poaching and plundering of natural resources	8	5	2	4	**60**	-	**M**	Ensure proper rehabilitation of affected areas, establish a suitable ground cover of representative plant species, including a grass and herbaceous cover, prevent erosion, remediate chemical imbalances of the water chemistry composition. Limit urban sprawl to areas of low ecological sensitivity	6	5	2	4	**52**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Residual impacts of pollution and habitat degradation			8	4	3	4	**60**	-	**M**		6	4	3	3	**39**	-	**M**		

11.10.5 Cumulative Impacts

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE MINE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							ACTION PLAN
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP	
CUMULATIVE IMPACTS: IMPACTS CONSIDERED ON A REGIONAL SCALE																		
Area A																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	2	4	**52**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	4	4	2	2	**20**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ increased isolation of habitat			4	5	2	4	**44**	-	**M**		4	4	2	3	**30**	-	**M**	
Area B																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	3	**33**	-	**M**	
Area C																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	4	4	2	2	**20**	-	**L**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity	3	3	2	1	**8**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			4	4	2	2	**20**	-	**L**		4	3	2	1	**9**	-	**L**	

										guidelines									
Area D																			
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	4	4	2	2	**20**	-	**L**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	3	3	2	1	**8**	-	**L**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			4	4	2	2	**20**	-	**L**		4	3	2	1	**9**	-	**L**		
Area E																			
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	3	**33**	-	**M**		
Area F																			
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	4	4	3	3	**33**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			8	5	3	4	**64**	-	**H**		6	5	2	4	**52**	-	**M**		
Area G																			
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the	6	4	2	3	**36**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			4	5	3	4	**48**	-	**M**		4	5	2	3	**33**	-	**M**		

									mining and biodiversity guidelines									
Area H																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	6	4	2	4	**48**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			8	5	3	4	**64**	-	**H**		6	5	2	4	**52**	-	**M**	
Area I																		
Impacts on SA's conservation obligations & targets	All mining areas where surface disturbances/ deterioration resulted caused by mining or mining related activities	Mining and mining related activities that resulted in deterioration and destruction of remaining natural habitat	6	5	3	4	**56**	-	**M**	Minimize development footprint, compensate for loss of natural habitat, ensure proper restoration and rehabilitation subsequent to mining activities. Apply guidance from Grassland ecosystem guidelines, Mpumalanga C-plan and the mining and biodiversity guidelines	6	4	2	4	**48**	-	**M**	Biodiversity monitoring programme, erosion management programme, monitor bird distribution and abundance patterns, hydrological functionality and integrity management programme. Monitor water chemistry and conduct long-term waterbirds counts
Increase in local and regional fragmentation/ isolation of habitat			8	5	3	4	**64**	-	**H**		6	5	2	4	**52**	-	**M**	

11.11 PROPOSED MITIGATION

The following mitigation measures and recommendations should form part of the Environmental Management Plan:

11.11.1 Loss of Habitat & Habitat Transformation

- Opencast activities and surface infrastructure should correspond to areas with ***low*** avifaunal sensitivities;
- Appropriate buffer zones must be implemented to sensitive features to alleviate the effect of habitat fragmentation and edge effects (to be negotiated with MPTA). In general, habitat fragmentation results in an increase in the proportion of edge effects in relation to the total area. Edges are habitat areas that are often unsuitable for some species to utilise, which subsequently becomes confined to an even smaller interior or core area of unchanged habitat. The following buffer areas are proposed:
  - All endorheic pans should be buffered by at least 500 m;
  - All tributaries, seeps and moist grassland units should be buffered by at least 200 m;
  - The buffer areas should be barricaded to restrict the movement of mining equipment. The fence should be perforated to allow for the free movement of animal species, albeit not livestock;
- Minimize the area cleared for construction activities. This includes the area used by personnel and labour. Laydown sites should be located on areas with ***low*** avifaunal sensitivities (*e.g.* agricultural land);
- Linear features (drainage lines and seeps) must be retained irrespective of their floristic condition or composition to facilitate the avifaunal dispersal when a high rate of natural disruption is expected;
- Building material should be located in a secure site. Care must be taken to prevent an overspill of construction activities into sensitive areas that are not part of the layout;
- Reinstate lost grassland and rehabilitate as a continual process – this will maximise the viability of the natural seed bank and prevent the unnecessary loss of topsoil during storage. Monitor rehabilitation success by comparing biological data (see below) from the rehabilitated areas with that of nearby natural grassland; and
- Opportunities should be sought to re-create lost waterbird habitat such as the creation of impoundments with the assistance of a qualified ornithologists. Please note that the opportunities exclude the artificial creation of endorheic pans since they are subject to complex inundation regimes, which is difficult to simulate.

11.11.2 Disturbance/Displacement of Waterbirds & Large Terrestrial Taxa

- Buffer/avoid mining in close proximity to endorheic pans - all endorheic pans should be buffered by at least 500 m or more;
- Limit construction activities to daytime;
- Minimize the use of earthmoving equipment that results in noise generation;
- Construction/mine personnel must be restricted to the construction/mine site and should not gain access to the endorheic pans or intact grassland;
- Provide adequate ablution facilities;
- Minimise the number of vehicles using access roads;
- All labour or staff should be advised (induction) by means of environmental awareness training on the avifaunal importance of the area; and

- Where possible, existing roads should be used.

11.11.3 Loss of Threatened & Near-Threatened Species

- Buffer all nearby endorheic pans;
- Maintain the ecological condition and composition of intact grassland (central and southern part of the study site):
  - Draft and implement a fire management plan;
  - Revise fire management plan on an annual base when necessary;
  - Monitor avifaunal diversity and composition by comparing data after burn trials with current baseline data. Monitoring should be conducted on a bi-annual basis;
  - Fence-off wetland systems to exclude cattle;
  - Implement a "camp" system and rotate cattle within camps depending on grassland status/trampling frequency;
  - Revise rotational system on an annual basis – depending on grassland status; and
- Implement a monitoring programme to monitor the presence/absence and abundance of the Maccoa Duck and Greater Flamingo population on endorheic pans.

11.11.4 Handling of Waste Products

- Waste should be removed from the study site as soon as possible; and
- If stored, it should be covered.

11.11.5 Water Pollution & Acid Mine Drainage

- To effectively quantify the effect of acid mine drainage in the area, it is proposed that a waterbird monitoring program be implemented for the area (see section dealing with monitoring below);
- Physical barriers and trenches must be constructed around fuel depots (storing hydrocarbons), stockpile yards and water treatment plants to prevent accidental spillages;
- Chemicals and equipment (bioremediation agents) for the treatment of fuel spillages must be available on site at all times; and
- Cover stockpiles with waterproof tarpaulins to prevent infiltration of contaminated water during precipitation events.

11.11.6 Dust

- All haul roads must be sprayed with "dust-off" to suppress dust;
- Minimise the number of vehicles using access roads; and
- Cover crushing plants to contain dust.

11.11.7 Human Encroachment: Plundering of Natural Resources

- All labour or staff should be advised (induction) by means of environmental awareness training on the avifaunal importance of the area; and

- Intentional killing of any animal species should be avoided. Any person found deliberately harassing any animal in any way should face disciplinary measures, following the possible dismissal from the site.

11.11.8 Lighting & Attraction of Migratory Species

- Reduce exterior lighting and implement operational strategies to reduce "spill light". Lightning, especially when placed near large waterbodies where birds tend to congregate, could attract night-migrating bird taxa and can result in collisions with buildings. If possible, outside lighting should make use of lights with blue or green hues rather than light that contains red wavelenghts. In addition, features should be illuminated (for security reasons) by using "down-lighting" rather than "up-lighting".

11.11.9 Road Construction

- Where possible, existing roads should be used;
- The width of roads should be kept to a minimum;
- Run-off control measures on either side of roads must be constructed to prevent erosion, and
- Crossing of wetland features and drainage lines should be minimised by means of re-routing.

11.12 MONITORING & RECOMMENDATIONS

11.12.1 Effects of water pollution caused by accidental spillage & acidification

To quantify the effect of accidental water pollution and acid mine drainage in the area it is proposed to monitor the bird population on the nearby endorheic pans, drainage lines and impoundments. Baseline bird counts and water samples must be collected before mining commences, and should include an analysis of the water chemistry composition.

Monitoring should be conducted seasonally (summer and winter) during the mining phase and for at least five years after decommissioning. Surveys should aim to duplicate the protocol used during the national coordinated waterbird counts (Taylor *et al*., 1999). Surveys shall consist of absolute counts of waterfowl, waders and wading birds on at least 20 wetland features to maintain statistical rigour and accuracy. All counts should be completed within a week during fair weather conditions (not during rainy or windy days). A water sample should also be taken from each water feature for chemical analysis.

11.12.2 Disturbance effects on species of conservation concern

It is unclear whether some of the threatened (and near-threatened) species (*e.g.* the Maccoa Duck and Greater Flamingo) are "resident" on the endorheic pan systems or whether their presence is highly seasonal. Consequently, a monitoring programme should be implemented to count Maccoa Duck and flamingo sightings on a bi-monthly basis. The rationale behind the monitoring programme is to obtain information, which is currently lacking, regarding construction and operational impacts on the behaviour and fecundity of bird populations on the South African Highveld.

11.12.3 Recommendations regarding Waste Water Treatment Plant

The most significant latent impact of coal mining arises from water pollution. Currently, the best way to control pollution run-off from mining activities is the construction of waste water treatment plants (WTP). However, these structures seldom contribute towards biological diversity and are seldom of any ecological value. The design of the WTP should not only deal with pollution run-off, but should also incorporate elements that will benefit faunal diversity, in particular waterbird taxa.

By creating an artificial flow-through wetland and introducing wetland plant species near the inlet of the WTP, it is possible to add value to the WTP from a functional and conservation point of view. It is recommended that different obligate and facultative wetland plant species be sourced and utilised for this purpose. Based on the growth form of the selected plant species, effluent near the inlet of the WTP will first pass through tall stands of *Phragmites australis*, followed by *Typha capensis* and lastly a diverse assemblage of Cyperoid - dominated vegetation (containing the genera *Cyperus, Eleocharis, Kyllinga* and *Schoenoplectus*). The plant diversity could further be enhanced, especially on shallow waterlogged areas along the shoreline of the WTP, by introducing *Leersia hexandra, Agrostis lachnantha* and *Juncus effuses*. It is also important to make provision for shallow, muddy areas that are particularly important in providing roosting areas for non-perching birds such as ducks and geese.

A secondary function of the proposed artificial wetland is to assist with the treatment of effluent. However, caution should be exercised if treatment of polluted water is the primary function of the WTP, since a survey in the United States showed that only 50 % of artificial wetlands result in significant reductions of heavy

metal concentrations (Wieder, 1989). In fact, the Wieder (1989) study found that some wetlands (approx. 11 %) actually increased metal concentrations. The design calls for expert collaborative advice during the construction phase from an ecologist and a specialist with knowledge in the chemical composition of mine-derived water.

It is also possible that some of the plant species will eventually develop into a "climax" terrestrial state (due to proliferation) and could jeopardize the function and structure of the wetland. The domination by plant and reed communities will limit the habitat heterogeneity and should therefore be managed in such way to prevent them from forming homogenous stands that exclude other species and habitat zones. The following strategy is proposed: Since the area is fairly small, there is no need to make use of chemical treatments. Reeds should rather be removed physically by means of cutting them at specific times of the year. Reeds should be cut in the beginning of the growing season below the water level.

11.12.4 Rehabilitation success

Rehabilitation effort should be assessed by comparing quantitative data from rehabilitated areas with that of nearby natural grassland types. It is proposed that sampling effort be limited bird density estimates using fixed point counts. Monitoring should be conducted during both seasons and at least five years after decommissioning.

11.13 KNOWLEDGE GAPS

In order to obtain a comprehensive understanding of the dynamics of terrestrial communities, as well as the status of endemic, rare or threatened species in any area, avifaunal assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and more often based on instantaneous sampling bouts.

It should be noted that certain parts of the Farms Bakenlaagte 84 IS and Vierfontein 61 IS could not be surveyed since access was denied.

12 APPENDIX 1: FLORISTIC DIVERSITY OF THE REGION

Including ¼-degree grids 2628BB, 2628BD, 2629AA and 2629AC (POSA, 2011)

Species	Family	Threat status	Growth forms
Aristida bipartita	Poaceae		Graminoid
Aristida diffusa subsp. *burkei*	Poaceae		Graminoid
Aeollanthus buchnerianus	Lamiaceae		Dwarf shrub
Aristida junciformis subsp. *junciformis*	Poaceae		Graminoid
Aloe ecklonis	Asphodelaceae		Herb
Acalypha angustata	Euphorbiaceae		Dwarf shrub
Alectra sessiliflora var. *sessiliflora*	Orobanchaceae		Herb
Albuca setosa	Hyacinthaceae		Geophyte
Alectra vogelii	Orobanchaceae		Herb
Alepidea peduncularis	**Apiaceae**	**Data Deficient**	**Herb**
Ammi majus var. *glaucifolium*	Apiaceae		Herb
Asclepias adscendens	Apocynaceae		Herb
Aspidoglossum interruptum	Apocynaceae		Herb
Boophone disticha	**Amaryllidaceae**	**Declining**	**Geophyte**
Brachiaria advena	Poaceae		Graminoid
Brachiaria eruciformis	Poaceae		Graminoid
Brachiaria serrata	Poaceae		Graminoid
Brachystelma pygmaeum subsp. *pygmaeum*	Apocynaceae		Geophyte
Bryum argenteum	Bryaceae		Bryophyte
Bulbostylis densa subsp. *afromontana*	Cyperaceae		Cyperoid
Bulbostylis hispidula subsp. *pyriformis*	Cyperaceae		Cyperoid
Calamagrostis epigejos var. *capensis*	Poaceae		Graminoid
Callilepis leptophylla	**Asteraceae**	**Declining**	**Herb**
Carex glomerabilis	Cyperaceae		Cyperoid
Catalepis gracilis	Poaceae		Graminoid
Chasmatophyllum musculinum	Mesembryanthemaceae		Succulent
Cineraria parvifolia	Asteraceae		Herb
Cirsium vulgare	Asteraceae		Herb
Citrullus lanatus	Cucurbitaceae		Climber
Colchicum striatum	Colchicaceae		Geophyte
Commelina africana var. *lancispatha*	Commelinaceae		Herb

Species	Family	Threat status	Growth forms
Commelina benghalensis	Commelinaceae		Herb
Commelina subulata	Commelinaceae		Helophyte
Conyza canadensis	Asteraceae		Herb
Crassula natans var. *natans*	Crassulaceae		Succulent
Crinum bulbispermum	**Amaryllidaceae**	**Declining**	**Geophyte**
Crinum graminicola	Amaryllidaceae		Geophyte
Cyanotis speciosa	Commelinaceae		Herb
Cyperus congestus	Cyperaceae		Cyperoid
Cyperus esculentus var. *esculentus*	Cyperaceae		Cyperoid
Cyperus longus var. *longus*	Cyperaceae		Cyperoid
Cyperus marginatus	Cyperaceae		Cyperoid
Cyperus rupestris var. *rupestris*	Cyperaceae		Cyperoid
Cyperus squarrosus	Cyperaceae		Cyperoid
Cyperus usitatus	Cyperaceae		Cyperoid
Digitaria eriantha	Poaceae		Graminoid
Digitaria sanguinalis	Poaceae		Graminoid
Digitaria ternata	Poaceae		Graminoid
Digitaria tricholaenoides	Poaceae		Graminoid
Dimorphotheca caulescens	Asteraceae		Herb
Drimia intricata	Hyacinthaceae		Geophyte
Echinochloa holubii	Poaceae		Graminoid
Echinochloa jubata	Poaceae		Graminoid
Eleocharis dregeana	Cyperaceae		Cyperoid
Eleocharis limosa	Cyperaceae		Cyperoid
Elephantorrhiza elephantina	Fabaceae		Dwarf shrub
Eleusine coracana i. africana	Poaceae		Graminoid
Eleusine multiflora	Poaceae		Graminoid
Eragrostis curvula	Poaceae		Graminoid
Eragrostis lappula	Poaceae		Graminoid
Eragrostis lehmanniana var. *lehmanniana*	Poaceae		Graminoid
Eragrostis mexicana subsp. *virescens*	Poaceae		Graminoid
Erica drakensbergensis	Ericaceae		Shrub
Eulophia welwitschii	Orchidaceae		Geophyte
Euryops transvaalensis subsp. *transvaalensis*	Asteraceae		Herb
Exormotheca holstii	Exormothecaceae		Bryophyte

Species	Family	Threat status	Growth forms
Festuca arundinacea	Poaceae		Graminoid
Fingerhuthia africana	Poaceae		Graminoid
Fingerhuthia sesleriiformis	Poaceae		Graminoid
Fuirena pachyrrhiza	Cyperaceae		Cyperoid
Fuirena pubescens var. *pubescens*	Cyperaceae		Cyperoid
Geranium multisectum	Geraniaceae		Herb
Gladiolus crassifolius	Iridaceae		Geophyte
Gladiolus papilio	Iridaceae		Geophyte
Gladiolus permeabilis subsp. *edulis*	Iridaceae		Geophyte
Gladiolus robertsoniae	**Iridaceae**	**Near Threatened**	**Geophyte**
Gladiolus sericeovillosus subsp. *calvatus*	Iridaceae		Geophyte
Gladiolus vinosomaculatus	Iridaceae		Geophyte
Gnidia phaeotricha	Thymelaeaceae		Dwarf shrub
Habenaria epipactidea	Orchidaceae		Geophyte
Habenaria filicornis	Orchidaceae		Geophyte
Harpochloa falx	Poaceae		Graminoid
Hebenstretia angolensis	Scrophulariaceae		Herb
Helichrysum difficile	Asteraceae		Herb
Helichrysum mixtum var. *mixtum*	Asteraceae		Herb
Helichrysum nudifolium var. *pilosellum*	Asteraceae		Herb
Helichrysum rugulosum	Asteraceae		Herb
Helichrysum stenopterum	Asteraceae		Herb
Helictotrichon turgidulum	Poaceae		Graminoid
Heteropogon contortus	Poaceae		Graminoid
Hibiscus aethiopicus var. *ovatus*	Malvaceae		Herb
Hyparrhenia anamesa	Poaceae		Graminoid
Hypochaeris radicata	Asteraceae		Herb
Hypoxis acuminata	Hypoxidaceae		Geophyte
Hypoxis hemerocallidea	**Hypoxidaceae**	**Declining**	**Geophyte**
Hypoxis rigidula var. *rigidula*	Hypoxidaceae		Geophyte
Indigastrum burkeanum	Fabaceae		Herb
Indigofera hedyantha	Fabaceae		Herb
Indigofera setiflora	Fabaceae		Herb
Ipomoea oblongata	Convolvulaceae		Herb
Ipomoea pellita	Convolvulaceae		Herb

Species	Family	Threat status	Growth forms
Isolepis setacea	Cyperaceae		Cyperoid
Jamesbrittenia stricta	Scrophulariaceae		Dwarf shrub
Juncus dregeanus subsp. *dregeanus*	Juncaceae		Helophyte
Juncus exsertus	Juncaceae		Helophyte
Juncus lomatophyllus	Juncaceae		Herb
Juncus oxycarpus	Juncaceae		Helophyte
Kniphofia typhoides	**Asphodelaceae**	**Near Threatened**	**Herb**
Kyllinga erecta var. *erecta*	Cyperaceae		Cyperoid
Lactuca inermis	Asteraceae		Herb
Lagarosiphon major	Hydrocharitaceae		Herb
Ledebouria cooperi	Hyacinthaceae		Geophyte
Ledebouria revoluta	Hyacinthaceae		Geophyte
Leersia hexandra	Poaceae		Graminoid
Leptochloa fusca	Poaceae		Graminoid
Lessertia depressa	Fabaceae		Dwarf shrub
Limosella longiflora	Scrophulariaceae		Herb
Medicago laciniata var. *laciniata*	Fabaceae		Herb
Mimulus gracilis	Scrophulariaceae		Helophyte
Monsonia angustifolia	Geraniaceae		Herb
Mossia intervallaris	Mesembryanthemaceae		Succulent
Nerine gracilis	**Amaryllidaceae**	**Near Threatened**	**Geophyte**
Nerine krigei	Amaryllidaceae		Geophyte
Nerine rehmannii	Amaryllidaceae		Geophyte
Nesaea schinzii	Lythraceae		Dwarf shrub
Oldenlandia herbacea var. *herbacea*	Rubiaceae		Herb
Ophioglossum polyphyllum	Ophioglossaceae		Geophyte
Ornithogalum flexuosum	Hyacinthaceae		Geophyte
Osteospermum muricatum subsp. *muricatum*	Asteraceae		Herb
Panicum schinzii	Poaceae		Graminoid
Parinari capensis subsp. *capensis*	Chrysobalanaceae		Dwarf shrub
Paspalum distichum	Poaceae		Graminoid
Pelargonium luridum	Geraniaceae		Geophyte
Pelargonium minimum	Geraniaceae		Herb
Pelargonium sidoides	**Geraniaceae**	**Declining**	**Dwarf shrub**
Periglossum angustifolium	Apocynaceae		Herb

Species	Family	Threat status	Growth forms
Persicaria decipiens	Polygonaceae		Helophyte
Persicaria limbata	Polygonaceae		Helophyte
Polygala africana	Polygalaceae		Herb
Polygala hottentotta	Polygalaceae		Dwarf shrub
Potamogeton pectinatus	Potamogetonaceae		Herb
Potamogeton richardii	Potamogetonaceae		Hydrophyte
Pseudognaphalium oligandrum	Asteraceae		Herb
Pulicaria scabra	Asteraceae		Herb
Ranunculus multifidus	Ranunculaceae		Herb
Rhynchosia adenodes	Fabaceae		Herb
Rhynchosia reptabunda	Fabaceae		Climber
Rhynchosia sordida	Fabaceae		Dwarf shrub
Riccia atropurpurea	Ricciaceae		Bryophyte
Riccia cupulifera	Ricciaceae		Bryophyte
Riccia nigrella	Ricciaceae		Bryophyte
Riccia okahandjana	Ricciaceae		Bryophyte
Riccia rosea	Ricciaceae		Bryophyte
Riccia stricta	Ricciaceae		Bryophyte
Riccia volkii	Ricciaceae		Bryophyte
Schistostephium crataegifolium	Asteraceae		Herb
Schoenoplectus brachyceras	Cyperaceae		Cyperoid
Schoenoplectus corymbosus	Cyperaceae		Cyperoid
Schoenoplectus decipiens	Cyperaceae		Cyperoid
Schoenoplectus leucanthus	Cyperaceae		Cyperoid
Schoenoplectus muriculatus	Cyperaceae		Cyperoid
Schoenoplectus pulchellus	Cyperaceae		Cyperoid
Searsia discolor	Anacardiaceae		Dwarf shrub
Searsia magalismontana subsp. *magalismontana*	Anacardiaceae		Dwarf shrub
Sebaea grandis	Gentianaceae		Herb
Selago densiflora	Scrophulariaceae		Herb
Seriphium plumosum	Asteraceae		Shrub
Setaria sphacelata var. *torta*	Poaceae		Graminoid
Striga asiatica	Orobanchaceae		Herb
Syncolostemon pretoriae	Lamiaceae		Herb
Tagetes minuta	Asteraceae		Herb

Species	Family	Threat status	Growth forms
Themeda triandra	Poaceae		Graminoid
Trachyandra reflexipilosa	Asphodelaceae		Geophyte
Trachyandra saltii var. *saltii*	Asphodelaceae		Geophyte
Trichodesma physaloides	Boraginaceae		Herb
Trichostomum brachydontium	Pottiaceae		Bryophyte
Trifolium africanum var. *africanum*	Fabaceae		Herb
Tristachya leucothrix	Poaceae		Graminoid
Vigna vexillata var. *vexillata*	Fabaceae		Climber
Wahlenbergia banksiana	Campanulaceae		Herb
Wahlenbergia undulata	Campanulaceae		Herb
Xyris capensis	Xyridaceae		Helophyte
Zornia linearis	Fabaceae		Herb

13 APPENDIX 2: RECORDED FLORISTIC DIVERSITY OF THE SITE

** - denotes declared invasive species

Species Name	*Family*	*Growth Form*	*Status/ Uses*	*Common Name*
Abildgaardia ovata	Cyperaceae	Sedge	None	--
Acalypha angustata	Euphorbiaceae	Forb	None	Copper leaf (e), Katpisbossie (a)
Agrostis eriantha	Poaceae	Grass	None, indicator of wet soils	Large panicle Agrostis (e), Groot-pluim-agrostis (a)
Agrostis lachnantha	Poaceae	Grass	Indicator of wet soils	South African Bent Grass (e) Vinkagrostis (a)
Ajuga ophrydis	Lamiaceae	Forb	None	--
Albuca species	Liliaceae	Geophyte	None	--
Amaranthus hybridus	Amaranthaceae	Forb	Naturalised exotic, edible parts	Pigweed (e), Misbredie (a)
Andropogon appendiculatus	Poaceae	Grass	Decreaser, palatable	Vlei bluestem (e), Vleiblougras (a)
Anthospermum rigidum	Rubiaceae	Forb	None	--
Aponogeton junceus	Aponogetonaceae	Hydrophilic	Indicator of moist conditions	--
Argemone ochroleuca	Papaveraceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Mexican poppy (e), Bloudissel (a)
Aristida bipartita	Poaceae	Grass	Unpalatable, indicator of degraded veld, Increaser IIC	Rolling grass (e), Grootrolgras (a)
Aristida junciformis	Poaceae	Grass	Thatching & weaving, unpalatable, Increaser IIC	Ngongoni three-awn (e), Ngongoni-steekgras (a)
Aristida meridionalis	Poaceae	Grass	Unpalatable, Increaser IIB	Giant three-awn (e), Langbeensteekgras (a)
Asclepias aurea	Apocynaceae	Forb	None	Golden Star Drops (e)
Asclepias eminens	Apocynaceae	Forb	None	Large Turret Flower (e)
Asclepias species	Apocynaceae	Forb	None	--
Asclepias stellifera	Apocynaceae	Forb	Poisonous latex	Spring Stars (e)
Aster species	Asteraceae	Forb	None	--
Berkheya insignis	Asteraceae	Forb	Weed	--
Berkheya pinnatifida	Asteraceae	Forb	Weed	--
Berkheya radula	Asteraceae	Forb	Weed, indicator of moist conditions	Boesmanrietjie (a)
Berkheya seminivea	Asteraceae	Forb	Weed	--
Berkheya setifera	Asteraceae	Forb	Weed, widespread	Rasperdisseldoring (a)
Brachiaria eruciformis	Poaceae	Grass	Indicator of clayey soils, unpalatable, Increaser IIC	Sweet signal grass (e), Litjiesinjaalgras (a)
Brachiaria serrata	Poaceae	Grass	Moderately palatable, indicator of good veld condition, Decreaser	Black-footed Signal Grass (e),

				Swartvoetjiegras (a)
Bromus catharticus	Poaceae	Grass	Weed, average grazing potential, naturalised exotic	Resue Grass (e), Reddingsgras (a)
Brunsvigia natalensis	Amaryllidaceae	Geophyte	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	--
Calamagrostis epigejos var. *epigejos*	Poaceae	Grass	None	--
Carex cernua var. *austro-africana*	Cyperaceae	Sedge	None	--
Carex glomerabilis	Cyperaceae	Sedge	None	--
Centella asiatica	Apiaceae	Hydrophilic	Edible parts, medicinal properties	Marsh pennywort (e), Varkoortjies (a)
Chaetacanthus costatus	Acanthaceae	Forb	None	--
Chamaecrista comosa	Caesalpiniaceae	Forb	None	--
Cheilanthes species	Sinopteridaceae	Fern	None	--
Chironia palustris	Gentianaceae	Forb	Medicinal uses	Marsch Chironia (e), Bitterwortel (a)
Chloris virgata	Poaceae	Grass	None	Feather-top Chloris (e), Witpluim-chloris (a)
Chlorophytum cooperi	Liliaceae	Geophyte	None	--
Chlorophytum species	Liliaceae	Geophyte	None	--
Ciclospermum leptophyllum	Apiaceae	Forb	Exotic weed (S America)	Lawn Celery (e), Wilde Seldery (a)
Cirsium vulgare	Asteraceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Scottish thistle (e), Skotse dissel (a)
Commelina africana	Commelinaceae	Forb	Medicinal properties	Yellow Wandering Jew (e), Geeleendagsblom (a)
Conyza canadensis	Asteraceae	Forb	None	--
Conyza podocephala	Asteraceae	Forb	Weed, indicator of disturbed areas	Bakbossie (a)
Cordylogyne globosa	Apocynaceae	Forb	None	--
Cortaderia selloana	Poaceae	Grass	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Pampas grass (e)
Cosmos bipinnatus	Asteraceae	Forb	Weed, exotic (S. America), aesthetic uses	Cosmos (e), Kosmos (a)
Crabbea acaulis	Acanthaceae	Forb	None	--
Crassula setulosa	Crassulaceae	Succulent	None	--
Crepis hypochoeridea	Asteraceae	Forb	Weed, indicator of disturbed areas, naturalised exotic	--
Crinum bulbispermum	Amaryllidaceae	Geophyte	Declining Status, medicinal uses, indicator of moist conditions, Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Orange River Lily (e), Oranjerivierlelie (a)
Cucumis africanus	Cucurbitaceae	Forb	Edible parts	Wild Cucumber (e), Wildekomkommertjie (a)

Cuscuta campestris	Cuscutaceae	Climber	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), exotic invader from North America	Dodder (a)
Cyanotis speciosa	Commelinaceae	Forb	Medicinal properties	Doll's powder puff (e), Bloupoeierkwassie (a)
Cycnium tubulosum	Scrophulariaceae	Forb	None	--
Cymbopogon pospischilii	Poaceae	Grass	Aromatic grass, unpalatable, Increaser I	Narrow-leaved Turpentine Grass (e), Smalblaarterpentyngras (a)
Cynodon dactylon	Poaceae	Grass	Indicator of disturbed areas, grazing potential	Common Couch Grass (e), Gewone kweekgras (a)
Cynoglossum hispidum	Boraginaceae	Forb	Weed	Beestongblaar (a), Knoppiesklits (a)
Cyperus esculentus	Cyperaceae	Sedge	Weed, edible parts (tuber)	Yellow nutsedge (e), Geeluintjie (a)
Cyperus fastigiatus	Cyperaceae	Sedge	None	--
Cyperus obtusiflorus	Cyperaceae	Sedge	None	White-flowered sedge (e), Geelbiesie (a)
Cyperus sexangularis	Cyperaceae	Sedge	Hydrophylic species, indicator of moist conditions	--
Cyperus solidus	Cyperaceae	Sedge	None	--
Cyperus species	Cyperaceae	Sedge	None	--
Denekia capensis	Asteraceae	Forb	Indicator of moist conditions	--
Dianthus mooiensis	Capparaceae	Forb	None	Wild Pink (e), Wildeangelier (a)
Diclis species	Scrophulariaceae	Forb	None	--
Dicoma anomala	Asteraceae	Forb	Medicinal uses	Maagbitterwortel (a)
Digitaria eriantha	Poaceae	Grass	Weaving, palatable grazing grass, Decreaser	Finger grass (e), Finger gras (a)
Diospyros austro-africana	Ebenaceae	Shrub	None	Fire-sticks (e), Jakkalsbessie (a)
Dipcadi species	Liliaceae	Forb	None	--
Eleocharis dregeana	Cyperaceae	Sedge	None	Finger sedge (e)
Eleocharis species	Cyperaceae	Sedge	None	--
Elephantorrhiza elephantina	Fabaceae	Dwarf shrub	Medicinal uses, poisonous parts, dyes & tanning	Eland's Bean (e), Elandsboontjie (a)
Eleusine coracana	Poaceae	Grass	Poor grazing, weed, Increaser IIC	Goose grass (e), Osgras (a)
Elionurus muticus	Poaceae	Grass	Unpalatable, Increaser IIB	Wire Grass (e), Koperdraad (a)
Eragrostis capensis	Poaceae	Grass	Moderate grazing potential	Heart-seed love grass (e), Hartjiesgras (a)
Eragrostis chloromelas	Poaceae	Grass	Edible parts, Increaser IIB	Curly leaf (e), Krulblaar (a)
Eragrostis curvula	Poaceae	Grass	Edible parts, indicator of degraded areas	Weeping love grass (e), Oulandsgras (a)
Eragrostis gummiflua	Poaceae	Grass	Unpalatable, low grazing potential, Increaser IIC	Gum grass (e), Gomgras (a)
Eragrostis lehmanniana	Poaceae	Grass	Weaving	Lehmanns' Love Grass (e), Knietjiesgras (a)
Eragrostis plana	Poaceae	Grass	Weaving, unpalatable, indicator of degraded areas, Increaser IIC	Tough love grass (e), Taai-pol eragrostis

Eragrostis racemosa	Poaceae	Grass	Palatable grazing, Increaser IIB	Narrow heart love grass (e), Smalhartjiesgras (a)
Eragrostis species	Poaceae	Grass	None	--
Erythrina zeyheri	Fabaceae	Shrub	None	Plough breaker (e), Ploegbreker (a)
Eucalyptus species	Myrsinaceae	Tree	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014) (see act for detail), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Eucaluptus gum tree (e), Bloekomboom (a)
Euphorbia clavarioides	Euphorbiaceae	Succulent	None	Vingerpol (a)
Euphorbia striata	Euphorbiaceae	Forb	None	Milkweed (e), Melkgras (a)
Felicia muricata	Asteraceae	Forb	None	Wild Aster (e), Blouheuning (a)
Fimbristylis complanata	Cyperaceae	Sedge	None	--
Fingerhuthia africana	Poaceae	Grass	Moderate grazing potential, Decreaser	Thimble grass (e), Vingerhoedgras (a)
Fuirena coerulescens	Cyperaceae	Sedge	None	--of
Gazania krebsiana	Asteraceae	Forb	Medicinal uses, food source	Butter flower (e), Botterblom (a)
Geigeria burkei	Asteraceae	Forb	None	Vermeerbos (a)
Gladiolus elliotii	Iridaceae	Geophyte	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Gladiola (e), Gladiolus (a)
Gladiolus species	Iridaceae	Geophyte	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	--
Gnidia capitata	Thymelaeaceae	Shrub	Poisonous extracts	Kerrieblom (a)
Gnidia species	Thymelaeaceae	Shrub	None	--
Gomphocarpus fruticosus	Apocynaceae	Shrub	Medicinal uses	Milkweed (e), Melkbos (a)
Gomphrena celosioides	Amaranthaceae	Forb	Weed, South America	Bachelor's button (e), Mierbossie (a)
Haplocarpha lyrata	Asteraceae	Forb	None	--
Haplocarpha scaposa	Asteraceae	Forb	None	Tonteldoosbossie (a)
Harpochloa falx	Poaceae	Grass	Indicator of pristine veld, palatable, Increaser I	Catterpillar Grass (e), Ruspergras (a)
Helichrysum aureonitens	Asteraceae	Forb	Medicinal properties	--
Helichrysum coriaceum	Asteraceae	Forb	None	Vaalteebossie (a)
Helichrysum nudifolium	Asteraceae	Forb	None	Hottentot's tea (e), Hottentotstee (a)
Helichrysum pilosellum	Asteraceae	Forb	None	--
Helichrysum rugulosum	Asteraceae	Forb	None	--
Helictotrichon turgidulum	Poaceae	Grass	Indicator of moist conditions, palatable, Decreaser	Small oat grass (e), Kleinhawergras (a)
Hemarthria altissima	Poaceae	Grass	Palatable, indicator of moist conditions	Batavian Quick Grass (e), Rooivleigras (a)
Hermannia coccocarpa	Malvaceae	Forb	None	Moederkappie (a)
Hermannia depressa	Malvaceae	Forb	Medicinal uses	Rooiopslag (a)
Hermannia erodioides	Malvaceae	Forb	None	--

Hermannia transvaalensis	Malvaceae	Forb	None	--
Heteropogon contortus	Poaceae	Grass	Moderate grazing potential, irritant	Spear grass (e), Assegaaigras (a)
Hibiscus aethiopicus	Malvaceae	Forb	None	Common Dwarf Wild Hibiscus (e)
Hibiscus micranthus	Malvaceae	Forb	None	-
Hibiscus microcarpus	Malvaceae	Forb	None	--
Hibiscus trionum	Malvaceae	Forb	None	Bladderweed (e), Terblansbossie (a)
Hilliardiella oligocephala	Asteraceae	Forb	Medicinal uses	Bitterbossie (a) (previous Vernonia oligocephala)
Hyparrhenia hirta	Poaceae	Grass	Thatching & weaving	Thatch Grass (e), Dekgras (a)
Hypoxis iridifolia	Hypoxidaceae	Geophyte	None	--
Hypoxis rigidula	Hypoxidaceae	Geophyte	None	Farmer's String (e), Botterblom (a)
Imperata cylindrica	Poaceae	Grass	Thatching & weaving, Increaser I	Cottonwool Grass (e), Donsgras (a)
Indigofera filipes	Fabaceae	Forb	None	--
Indigofera hedyantha	Fabaceae	Forb	None	--
Ipomoea bathycolpos	Convolvulaceae	Prostrate herb	None	Veldsambreeltjies (a)
Ipomoea oblongata	Convolvulaceae	Forb	None	--
Ipomoea simplex	Convolvulaceae	Prostrate herb	None	--
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb	Colours & dyes	Cape Saffron (e), Saffraanbossie (a)
Juncus dregeanus	Cyperaceae	Sedge	None	--
Juncus exsertus	Cyperaceae	Sedge	None	--
Juncus punctorius	Cyperaceae	Sedge	None	--
Juncus species	Cyperaceae	Sedge	None	--
Justicia anagalloides	Acanthaceae	Forb	None	--
Kniphofia porphyrantha	Asphodelaceae	Succulent	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Red-hot poker (e), Vuurpyl (a)
Kyllinga alba	Cyperaceae	Sedge	Medicinal uses	White Buttonsedge (e), Witbiesie (a)
Kyllinga erecta	Cyperaceae	Sedge	None	--
Lactuca capensis	Asteraceae	Forb	None	= L. inermis
Lactuca inermis	Asteraceae	Forb	None	--
Lactuca serriola	Asteraceae	Forb	Weed	Compass Plant (e), Melkdissel (a)
Ledebouria ovalifolia	Liliaceae	Geophyte	None	--
Ledebouria revoluta	Liliaceae	Geophyte	Edible parts	--
Leersia hexandra	Poaceae	Grass	None, host plant for *Metisella meninx*	Wild rice grass (e), Wilderysgras (a)
Lobelia angolensis	Lobeliaceae	Forb	None	--

Mariscus congestus	Cyperaceae	Sedge	Edible parts	--
Marsilea species	Marsileaceae	Hydrophilic	None	--
Melinis repens	Poaceae	Grass	Poor grazing potential, Increaser IIc	Natal Red Top (e), Natal-rooipluim (a)
Melolobium wilmsii	Fabaceae	Forb	None	--
Mentha aquatica	Lamiaceae	Hydrophilic	Indicator of moist conditions	--
Microchloa caffra	Poaceae	Grass	Low grazing potential, Increaser IIC	Pincushion Grass (e), Elsgras (a)
Monopsis decipiens	Lobeliaceae	Forb	Medicinal uses	Butterfly Lobelia (e), Skoenlapperplant (a)
Monsonia angustifolia	Geraniaceae	Forb	None	Crane's Bill (e), Angelbossie (a)
Myriophyllum aquaticum	Haloragaceae	Hydrophilic	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Aquatic invasive (S. America), Prohibited aquatic weed, Schedule 10 (Mpumalanga Nature Conservation Act 10 of 1998)	Parrot's feather (e)
Nerine krigei	Amaryllidaceae	Geophyte	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	--
Nesaea schinzii var. *rehmannii*	Lythraceae	Forb	None	--
Nidorella anomala	Asteraceae	Forb	None	--
Nidorella hottentotica	Asteraceae	Forb	None	--
Oenothera rosea	Onagraceae	Forb	Weed (S. America), moist & degraded places	Rose evening primrose (e), Pienkaandblom (a)
Oenothera tetraptera	Onagraceae	Forb	Weed (Mexico)	White evening primrose (e), Witaandblom (a)
Oldenlandia herbacea	Rubiaceae	Forb	None	False Spurry (e)
Opuntia ficus-indica	Cactaceae	Succulent	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), edible parts	Prickley pear (e), Turksvy (a)
Oxalis semiloba	Oxalidaceae	Geophyte	Edible parts	Transvaal Sorrel (e), Transvaal Suring (a)
Oxalis species	Oxalidaceae	Geophyte	Edible parts	Bobbejaanuintjie (a)
Oxycarpus species	Polygonaceae	Sedge	None	--
Panicum schinzii	Poaceae	Grass	Palatable species, probably Decreaser	Sweet Buffalo Grass (e), Soetbuffelgras (a)
Paspalum dilatatum	Poaceae	Grass	Moist places, palatable, Increaser IIB	Common Paspalum (e), Gewone Paspalum (a)
Paspalum scrobiculatum	Poaceae	Grass	Moist places, palatable grazing grass, Increaser IIC	Veld Paspalum (e), Veldpaspalum (a)
Paspalum urvillei	Poaceae	Grass	Moist conditions, palatable, Increaser I or Decreaser	Giant Paspalum (e), Langbeen Paspalum (a)
Pelargonium luridum	Geraniaceae	Forb	Medicinal uses, traditional uses	Stalked-flower Pelargonium (e), Wildemalva (a)
Pellaea calomelanos	Adianthaceae	Fern	Medicinal properties	Hard Fern (e), Hardevaring (a)
Pennisetum clandestinum	Poaceae	Grass	Declared Invader - Category 1B in protected areas and wetlands (NEM:BA, 2004. AIP, 2014)	Kikuyu Grass (e), Kikoejoegras (a)

Pentarrhinum insipidum	Apocynaceae	Climber	Edible parts, non endemic	African Heartvine (e), Donkieperske (a)
Persicaria lapathifolia	Polygonaceae	Hydrophilic	Indicator of moist conditions, naturalised exotic	Spotted Knotweed (e), Hanekam (a)
Peucedanum magalismontanum	Apiaceae	Forb	Edible parts	Wild Parsely (e), Wildepietersielie (a)
Phragmites australis	Poaceae	Hydrophilic	Thatching, traditional uses, medicinal properties	Common Reed (e), Fluitjiesriet (a)
Plantago lanceolata	Plantaginaceae	Forb	Weed (Europe)	Buckhorn Plantain (e), Oorpynhoutjie (a)
Plantago longissima	Plantaginaceae	Forb	None	--
Polygala hottentotta	Polygalaceae	Forb	None	--
Polygala uncinata	Polygalaceae	Forb	None	--
Populus alba	Salicaceae	Tree	Declared Invader - Category 2 (NEM:BA, 2004. AIP, 2014), America, timber, Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	White poplar (e), Witpopulier (a)
Potamogeton species	Potamogetonaceae	Hydrophilic	None	--
Pseudognaphalium luteo-album	Asteraceae	Forb	Weed (Europe)	Jersey Cudweed (e), Roerkruid (a)
Pycreus macranthus	Cyperaceae	Sedge	None	--
Ranunculus multifidus	Ranunculaceae	Forb	Indicator of moist conditions	Buttercup (e), Botterblom (a)
Rhynchosia adenodes	Fabaceae	Forb	None	--
Rhynchosia caribaea	Fabaceae	Forb	None	--
Richardia brasiliensis	Rubiaceae	Forb	None	Mexican Richardia (e), Meksikaanse Richardia (a)
Rorippa nudiuscula	Brassicaceae	Forb	None	--
Rubus rigidus	Rosaceae	Climber	Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998), edible parts	Bramble (e), Braambos (a)
Rumex crispus	Polygonaceae	Forb	Edible parts	--
Rumex species	Polygonaceae	Forb	Edible parts	--
Salvia runcinata	Lamiaceae	Forb	Medicinal properties	Widesalie (a)
Scabiosa columbaria	Dipsacaceae	Forb	Medicinal uses	Morning Bride (e), Jonkmansknoop (a)
Schistostephium crataegifolium	Asteraceae	Forb	None	Bergkruie (a)
Schkuhria pinnata	Asteraceae	Forb	Medicinal uses, weed (S. America)	Dwarf Marigold (e), Bitterbossie (a)
Schoenoplectus corymbosus	Cyperaceae	Sedge	None	--
Searsia magalismontana	Anacardiaceae	Shrub	None	Mountain Wild Current (e), Bergtaaibos (a)
Selago densiflora	Selaginaceae	Forb	None	--
Senecio achilleifolius	Asteraceae	Forb	Indicator of moist conditions	Slootopdammer (a)
Senecio erubescens	Asteraceae	Forb	None	--
Senecio inaequidens	Asteraceae	Forb	None	Canary Weed (e), Geelopslag (a)
Senecio inornatus	Asteraceae	Forb	None, indicator of moist conditions	--

Senecio polyodon var. *polyodon*	Asteraceae	Forb	None	--
Setaria nigrirostris	Poaceae	Grass	Indicator of moist conditions, clayey soils, palatable, Decreaser	Black-seed bristle grass (e), Swartsaadmannagras (a)
Setaria species	Poaceae	Grass	None	Bristle grass (e), Mannagras (a)
Setaria sphacelata	Poaceae	Grass	Edible parts, palatable, Decreaser	Common bristle grass (e), Gewone Mannagras (a)
Setaria verticillata	Poaceae	Grass	Edible parts, palatable grazing	Bur Britle Grass (e), Klitsgras (a)
Solanum panduriforme	Solanaceae	Dwarf shrub	Weed, traditional medicine, poisonous	Poison Apple (e), Gifappel (a)
Solanum sisymbriifolium	Solanaceae	Dwarf shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Wild tomato (e), Doringbitterappel (a)
Sonchus asper	Asteraceae	Forb	None	Common Sowthisthle (e), Doringsydissel (a)
Sphenostylis angustifolia	Fabaceae	Forb	None	Wild sweetpea (e), Wilde-ertjie (a)
Striga asiatica	Scrophulariaceae	Parasite	Parasitic on grasses	Witchweed (e), Rooiblom (a)
Striga elegans	Scrophulariaceae	Parasite	None	--
Sutherlandia frutescens	Fabaceae	Forb	Medicinal uses	Cancer Bush (e), Kankerbos (a), Keurtjie (a)
Tagetes minuta	Asteraceae	Forb	Essential oils, colours & dyes	Khaki Weed (e), Kakiebos (a)
Tephrosia longipes	Fabaceae	Forb	None	--
Tephrosia species	Fabaceae	Forb	None	--
Themeda triandra	Poaceae	Grass	Palatable grazing, Decreaser	Red grass (e), Rooigras (a)
Trachyandra asperata	Liliaceae	Geophyte	None	--
Trachypogon spicatus	Poaceae	Grass	Moderate palatability, Increaser I	Giant Spear Grass (e), Bokbaardgras (a)
Trichoneura grandiglumis	Poaceae	Grass	None	Small Rolling Grass (e), Kleinrolgras (a)
Trifolium africanum	Fabaceae	Forb	Weed of damp and disturbed places	Wild clover (e), Wildeklawer (a)
Trifolium burchellianum	Fabaceae	Forb	None	Wild Clover (e), Wildeklawer (a)
Tristachya leucothrix	Poaceae	Grass	Moderate palatable grazing, Increaser I	Hairy trident grass (e), Harige-drieblomgras (a)
Typha capensis	Typhaceae	Hydrophilic	Cosmopolitan weed, edible parts, medicinal uses	Bulrush (e), Papkuil (a)
Urochloa panicoides	Poaceae	Grass	None	Garden Urochloa (e), Tuinbeesgras (a)
Verbena bonariensis	Verbenaceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Weed (S. America)	Purple Top (e), Blouwaterbossie (a)
Verbena brasiliensis	Verbenaceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Weed (S. America)	Brazilian verbena
Wahlenbergia undulata	Campanulaceae	Forb	None	African Bluebell (e)
Xanthium spinosum	Asteraceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Spiny coklebur (e), Kleinkankerroos (a)

Xanthium strumarium	Asteraceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Large cocklebur (e), Kankerroos (a)
Xysmalobium undulatum	Apocynaceae	Forb	Medicinal uses, diarrhoea, colic	Bitterhout (a)
Ziziphus zeyheriana	Rhamnaceae	Shrub	None	Dwarf Buffalo-thorn (e), Dwerg-blinkblaar-wag-'n-bietjie (a)
Zornia capensis	Fabaceae	Forb	None	--

14 APPENDIX 3: BIRD SPECIES RECORDED IN THE STUDY AREA

A list of bird species observed on the study site during July 2011 and February 2012. # - Refers to the new SA numbers. Scientific and colloquial names were used according to Hockey *et al*. (2005).

Order	Family	#	Scientific Name	Colloquial Name
Galliformes	Phasianidae	8	*Scleroptila levaillantoides*	Orange River Francolin
		14	*Pternistis swainsonii*	Swainson's Spurfowl
		15	*Coturnix coturnix*	Common Quail
	Numididae	20	*Numida meleagris*	Helmeted Guineafowl
Anseriformes	Dendrocygnidae	21	*Dendrocygna bicolor*	Fulvous Duck
		22	*Dendrocygna viduata*	White-faced Duck
		23	*Thalassornis leuconotus*	White-backed Duck
	Anatidae	24	*Oxyura Maccoa*	Maccoa Duck
		25	*Alopochen aegyptiacus*	Egyptian Goose
		26	*Tadorna cana*	South African Shelduck
		27	*Plectropterus gambensis*	Spur-winged Goose
		31	*Anas sparsa*	African Black Duck
		33	*Anas undulata*	Yellow-billed Duck
		34	*Anas smithii*	Cape Shoveler
		37	*Anas erythrorhyncha*	Red-billed Teal
		39	*Anas hottentota*	Hottentot Teal
		40	*Netta erythrophthalma*	Southern Pochard
Gruiformes	Turnicidae	41	*Turnix sylvaticus*	Kurrichane Buttonquail
Bucerotiformes	Phoeniculidae	81	*Phoeniculus purpureus*	Green Wood-Hoopoe
Coraciiformes	Alcedinidae	91	*Alcedo cristata*	Malachite Kingfisher
		99	*Ceryle rudis*	Pied Kingfisher
Cuculiformoes	Cuculidae	125	*Chrysococcyx caprius*	Diderick Cuckoo
Apodiformes	Apodidae	151	*Apus affinis*	Little Swift
		153	*Apus caffer*	White-rumped Swift
Strigiformes	Strigidae	171	*Asio capensis*	Marsh Owl
Columbiformes	Columbidae	180	*Columba guinea*	Speckled Pigeon
		185	*Streptopelia senegalensis*	Laughing Dove
		187	*Streptopelia capicola*	Cape Turtle-Dove
		188	*Streptopelia semitorquata*	Red-eyed Dove
		179	*Columba livia*	Rock Dove

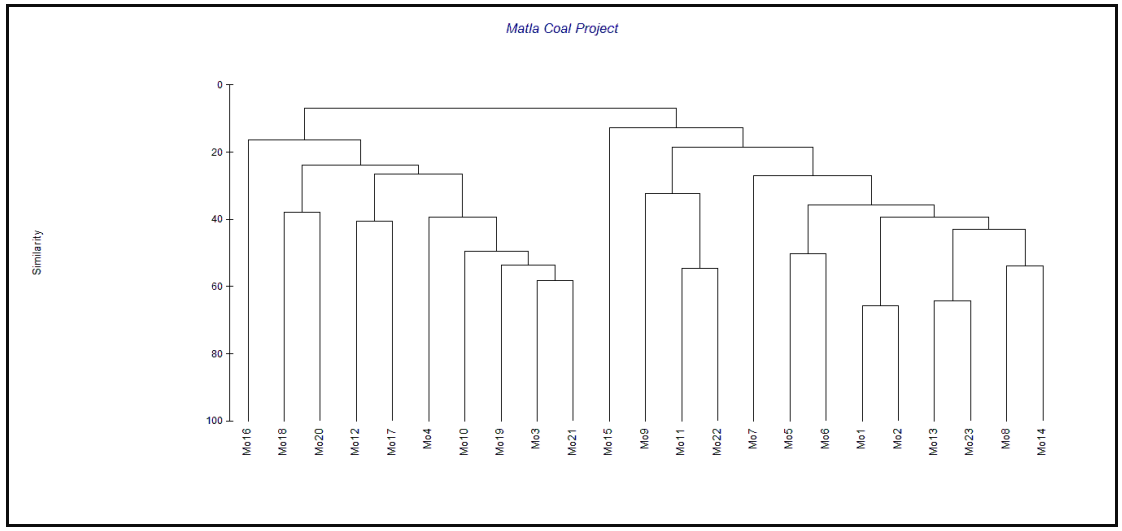
Order	Family	#	Scientific Name	Colloquial Name
Gruiformes	Oditidae	203	*Eupodotis caerulescens*	Blue Korhaan
	Rallidae	221	*Porphyrio madagascariensis*	African Purple Swamphen
		224	*Gallinula chloropus*	Common Moorhen
		226	*Fulica cristata*	Red-knobbed Coot
Charadriiformes	Scolopacidae	232	*Gallinago nigripennis*	African Snipe
		241	*Tringa nebularia*	Common Greenshank
		245	*Tringa glareola*	Wood Sandpiper
		247	*Actitis hypoleucos*	Common Sandpiper
		252	*Calidris minuta*	Little Stint
		260	*Calidris ferruginea*	Curlew Sandpiper
		263	*Philomachus pugnax*	Ruff
	Burhinidae	272	*Burhinus capensis*	Spotted Thick-knee
	Recurvirostridae	275	*Himantopus himantopus*	Black-winged Stilt
		276	*Recurvirostra avosetta*	Pied Avocet
	Charadriidae	280	*Charadrius hiaticula*	Common Ringed Plover
		282	*Charadrius pecuarius*	Kittlitz's Plover
		283	*Charadrius tricollaris*	Three-banded Plover
		291	*Vanellus armatus*	Blacksmith Lapwing
		294	*Vanellus senegallus*	African Wattled Lapwing
		297	*Vanellus coronatus*	Crowned Lapwing
	Laridae	316	*Larus cirrocephalus*	Grey-headed Gull
		339	*Chlidonias hybrida*	Whiskered Tern
Falconiformes	Accipitridae	348	*Elanus caeruleus*	Black-shouldered Kite
		367	*Circus ranivorus*	African Marsh-Harrier
		370	*Circus pygargus*	Montagu's Harrier
		381	*Accipiter melanoleucus*	Black Sparrowhawk
		382	*Buteo vulpinus*	Steppe Buzzard
		386	*Buteo rufofuscus*	Jackal Buzzard
	Sagittariidae	398	*Sagittarius serpentarius*	Secretarybird
	Falconidae	407	*Falco amurensis*	Amur Falcon
		412	*Falco biarmicus*	Lanner Falcon
Ciconiiformes	Podicipedidae	415	*Tachybaptus ruficollis*	Little Grebe
		416	*Podiceps cristatus*	Great Crested Grebe
		417	*Podiceps nigricollis*	Black-necked Grebe

Order	Family	#	Scientific Name	Colloquial Name
	Anhingidae	425	*Anhinga rufa*	African Darter
	Phalacrocoracidae	426	*Phalacrocorax africanus*	Reed Cormorant
		428	*Phalacrocorax lucidus*	White-breasted Cormorant
	Ardeidae	435	*Egretta intermedia*	Yellow-billed Egret
		432	*Egretta ardesiaca*	Black Heron
		433	*Egretta garzetta*	Little Egret
		439	*Ardea cinerea*	Grey Heron
		440	*Ardea melanocephala*	Black-headed Heron
		443	*Bubulcus ibis*	Cattle Egret
		442	*Ardea purpurea*	Purple Heron
		444	*Ardeola ralloides*	Squacco Heron
		448	*Nycticorax nycticorax*	Black-crowned Night-Heron
	Scopidae	453	*Scopus umbretta*	Hamerkop
Phoenicopteriformes	Phoenicopteridae	454	*Phoenicopterus ruber*	Greater Flamingo
	Threskiornithidae	456	*Plegadis falcinellus*	Glossy Ibis
		457	*Bostrychia hagedash*	Hadeda Ibis
		459	*Threskiornis aethiopicus*	African Sacred Ibis
		460	*Platalea alba*	African Spoonbill
Passeriformes	Laniidae	576	*Lanius collaris*	Common Fiscal
	Hirundinidae	594	*Riparia paludicola*	Brown-throated Martin
		598	*Hirundo rustica*	Barn Swallow
		604	*Hirundo cucullata*	Greater Striped Swallow
		609	*Hirundo spilodera*	South African Cliff-Swallow
		611	*Delichon urbicum*	Common House-Martin
	Sylviidae	638	*Acrocephalus baeticatus*	African Reed-Warbler
		643	*Acrocephalus gracilirostris*	Lesser Swamp-Warbler
	Cisticolidae	683	*Cisticola tinniens*	Levaillant's Cisticola
		687	*Cisticola juncidis*	Zitting Cisticola
		688	*Cisticola aridulus*	Desert Cisticola
		689	*Cisticola textrix*	Cloud Cisticola
		691	*Cisticola ayresii*	Wing-snapping Cisticola
		690	*Cisticola cinnamomeus*	Pale-crowned Cisticola
		692	*Prinia subflava*	Tawny-flanked Prinia
		693	*Prinia flavicans*	Black-chested Prinia

Order	Family	#	Scientific Name	Colloquial Name
	Alaudidae	733	*Eremopterix leucotis*	Chestnut-backed Sparrowlark
		735	*Calandrella cinerea*	Red-capped Lark
	Muscicapidae	782	*Saxicola torquatus*	African Stonechat
		787	*Oenanthe pileata*	Capped Wheatear
		793	*Myrmecocichla formicivora*	Anteating Chat
	Sturnidae	807	*Spreo bicolor*	Pied Starling
		810	*Acridotheres tristis*	Common Myna
	Ploceidae	838	*Plocepasser mahali*	White-browed Sparrow-Weaver
		846	*Ploceus velatus*	Southern Masked-Weaver
		854	*Quelea quelea*	Red-billed Quelea
		855	*Euplectes afer*	Yellow-crowned Bishop
		857	*Euplectes orix*	Southern Red Bishop
		859	*Euplectes axillaris*	Fan-tailed Widowbird
		861	*Euplectes albonotatus*	White-winged Widowbird
		863	*Euplectes progne*	Long-tailed Widowbird
	Estrildidae	867	*Amandava subflava*	Orange-breasted Waxbill
		868	*Ortygospiza atricollis*	African Quailfinch
		878	*Estrilda astrild*	Common Waxbill
		898	*Vidua macroura*	Pin-tailed Whydah
	Passeridae	901	*Passer domesticus*	House Sparrow
		903	*Passer melanurus*	Cape Sparrow
	Motacillidae	908	*Motacilla capensis*	Cape Wagtail
		915	*Macronyx capensis*	Cape Longclaw
		920	*Anthus cinnamomeus*	African Pipit
	Fringillidae	935	*Serinus atrogularis*	Black-throated Canary
		937	*Serinus mozambicus*	Yellow-fronted Canary

15 APPENDIX 4: AVIFAUNAL ASSOCIATION GROUPS WITH DIFFERENT COMPOSITIONS

A dendrogram illustrating avifaunal association groups with different compositions: (1) a community pertaining to Highveld grassland, and (2) a community restricted to landscape features holding open water and shoreline habitat.

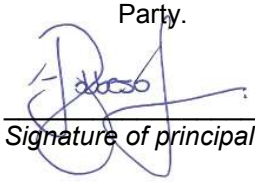


16 RESERVED COPYRIGHT

17 DECLARATION OF INDEPENDENCE

Individual declarations attached as addendums. All specialist investigators, project investigators and members of companies employed for conducting this biodiversity investigation declare that:

- We act as independent specialist consultants conducting the assessment and compiling the report;
- We consider ourselves bound to the rules and ethics of the South African council for natural scientific professions;
- Bathusi Environmental Consulting cc is not a subsidiary, legally or financially, of either the proponent or GCS (Pty) Ltd;
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than fair financial compensation for work performed in a professional capacity;
- We will not be affected in any manner by the outcome of the environmental process of which this assessment forms part of, other than being part of the general public;
- We do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience; and
- We do not have any influence over decisions made by the governing authorities;
- Undertake to disclose, to the competent authority, any material information that have 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 environmental impact assessment regulations, 2005;
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.



Signature of principal ecologist:

Bathusi Environmental Consulting cc (CK1999/052182/23)

Name of company:

31st October 2014

Date:

18 LIMITATIONS OF THIS INVESTIGATION

- Findings, results, observations, conclusions and recommendations presented in this report are based on the authors' best scientific and professional knowledge as well as information available to them at the time of compiling this report.
- This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.
- Results presented in this report are based on a snapshot investigation of the study area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the study area.
- In particular, rare and endemic species normally do not occur in great densities and, because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible. Results are ultimately based on estimations and specialist interpretation of imperfect data.
- It is emphasised that information, as presented in this document, only have bearing on the site as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.
- Furthermore, additional information may become known during a later stage of the process or development. The authors therefore reserve the right to modify aspects of the report including the recommendations should new information may become available from ongoing research or additional work in this particular area, or pertaining to this investigation.
- This report should always be considered as a whole. Reading and representing portions of the report in isolation could lead to incorrect conclusions and assumptions. In case of any uncertainty, the authors should be contacted to clarify any viewpoints, recommendations and/ or results.
- Not all areas could be accessed during the respective site investigations. Results are extrapolated to include these properties, but no responsibility could be taken should discrepancies be indicated at a later stage. It is strongly recommended that these areas be subjected to a basic site investigation to confirm initial results.

19 LEGISLATION

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(a) Details of (i) The person who prepared the report, and
(ii) The expertise of that person to carry our the specialist study or specialised process;
(b) A declaration that the person is independent in a form as may be specified by the competent authority;
(c) An indication of the scope of, and the purpose for which, the report was prepared;
(d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) A summary and copies of any comments that were received during any consultation process;
(i) Any other information requested by the competent authority.

Compliance with provincial, national and international legislative aspects is strongly advised during the planning, assessment, authorisation and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to, **Table 23.**

Table 26: Legislative guidance for this project	
Legislation	**Relevance**
Biodiversity Act (No. 10 of 2004)	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
Conservation of Agricultural Resources Act 43 of 1983	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
Environmental Conservation Act (No. 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
Mpumalanga Nature Conservation Act No. 10 of 1998	To consolidate and amend the laws relating to nature conservation within the Province and to provide for matters connected therewith.
National Environmental Management Act (No. 107 of 1998)	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated and positive aspects enhanced.
National Environmental Management Act (No 10 of 2004)	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
Protected Areas Act (No. 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

20 ANNOTATIONS ON NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT 2004 (ACT NO. 10 OF 2004) ALIEN AND INVASIVE SPECIES LISTS, 2014

Notice 1: Notice in respect of Categories 1a, 1 b, 2 and 3, Listed Invasive Species, in terms of which certain Restricted Activities are prohibited in terms of section 71A(1); exempted in terms of section 71(3); require a Permit in terms of section 71(1);
Notice 2: Exempted Alien Species in terms of section 66(1);
Notice 3: National Lists of Invasive Species in terms section 70 1; and
Notice 4: Prohibited Alien Species in terms of section 67(1 560 species /croups of species.

Categories 1 a, 1 b, 2 and 3 Listed Invasive Species, in terms of which certain Restricted Activities are:
a. prohibited in terms of section 71A(1);
b. exempted in terms of section 71(3); or
c. require a Permit in terms of Chapter 7
and must be read with the lists in Notice 3.

Table 27: Clarification notes on Alien and Invasive Act

Restricted Activities as defined in the Act	**Category Ia**	**Category 1 b**	**Category 2**	**Category 3**
a. Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
b. Having in possession or exercising physical control over any specimen of a listed invasive species.	Exempted	Exempted	Permit Required	Exempted
c. Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply.	Prohibited	Prohibited	Permit Required	Prohibited
d. Conveying, moving or otherwise translocating any specimen of a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
e. Selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of any specimen of a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
Restricted Activities as defined in Regulation 6				
f. Spreading or allowing the spread of any specimen of a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
g. Releasing any specimen of a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
h. The transfer or release of a specimen of a listed invasive fresh-water species from one discrete catchment system in which it occurs, to another discrete catchment system in which it does not occur; or, from within a part of a discrete catchment system where it does occur to another part where it does not occur as a result of a natural or artificial barrier.	Prohibited	Prohibited	Permit Required	Prohibited
i. Discharging of or disposing into any waterway or the ocean, water from an aquarium, tank or other receptacle that has been used to keep a specimen of an alien or a listed invasive species.	Prohibited	Prohibited	Permit Required	Prohibited
j. Catch and release of a specimen of a listed invasive fresh-water fish or listed invasive fresh-water invertebrate species.	Prohibited	See Notice 3	See Notice 3	See Notice 3
k. The introduction of a specimen of an alien or a listed invasive species to offshore islands.	Prohibited	Prohibited	Prohibited	Prohibited
l. The release of a specimen of a listed invasive fresh-water fish species, or of a listed invasive fresh-water invertebrate species, into a discrete catchment system in which it already occurs.	See Notice 3	See Notice 3	See Notice 3	See Notice 3

Chapter 2 – Categories of Listed Invasive Species

- **Category Ia Listed Invasive Species**

1) Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combated or eradicated.
2) A person in control of a Category 1a Listed Invasive Species must-
   a) comply with the provisions of section 73(2) of the Act;
   b) immediately take steps to combat or eradicate listed invasive species in compliance with sections 75(1), (2) and (3) of the Act; and
   c) allow an authorised official from the Department to enter onto land to monitor, assist with or implement the combating or eradication of the listed invasive species.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must combat or eradicate the listed invasive species in accordance with such programme.

- **Category 1b Listed Invasive Species**

1) Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled.
2) A person in control of a Category 1 b Listed Invasive Species must control the listed invasive species in compliance with sections 75(1), (2) and (3) of the Act.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.
4) A person contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the control of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in section 75(4) of the Act.

- **Category 2 Listed Invasive Species**

1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be.
2) Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit.
3) A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit.
4) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.
5) Unless otherwise specified in the Notice, any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1 b Listed Invasive Species and must be managed according to Regulation 3.
6) Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species published in Government Gazette No. 37886, Notice 599 of 1 August 2014 (as amended), any person or organ of state must ensure that the specimens of such Listed Invasive Plant Species do not spread outside of the land over which they have control.

Category 3 Listed Invasive Species

1) Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.
2) Any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.

Chapter 3 Restricted Activities

In addition to those activities defined in terms of section 1 of the Act as restricted activities, the following activities are hereby prescribed as restricted activities:

a) spreading or allowing the spread of, any specimen of a listed invasive species;
b) releasing any specimen of a listed invasive species;
c) the transfer or release of a specimen of a listed invasive fresh-water species from one discrete catchment system in which it occurs, to another discrete catchment system in which it does not occur; or, from within a part of a discrete catchment system where it does occur to another part where it does not occur as a result of a natural or artificial barrier;
d) discharging of or disposing into any waterway or the ocean, water from an aquarium, tank or other receptacle that has been used to keep a specimen of an alien species or a listed invasive;
e) freshwater species;
f) catch and release of a specimen of a listed invasive fresh-water fish or listed invasive fresh-water invertebrate species;
g) the introduction of a specimen of an alien or listed invasive species to off-shore islands; or the release of a specimen of a listed invasive fresh-water fish species, or of a listed invasive fresh water invertebrate species into a discrete catchment system in which it already occurs.

21 INDIVIDUAL SPECIALIST DECLARATIONS

21.1 R.AJ. ROBBESON

22 PLANNED LAYOUT OF THE OPERATIONS

23 PHOTOGRAPHIC RECORDS

24 REFERENCES

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