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Strategic Biodiversity EIA Assessment for the proposed Valleyview Residential Development in Witbank, Mpumalanga Province©

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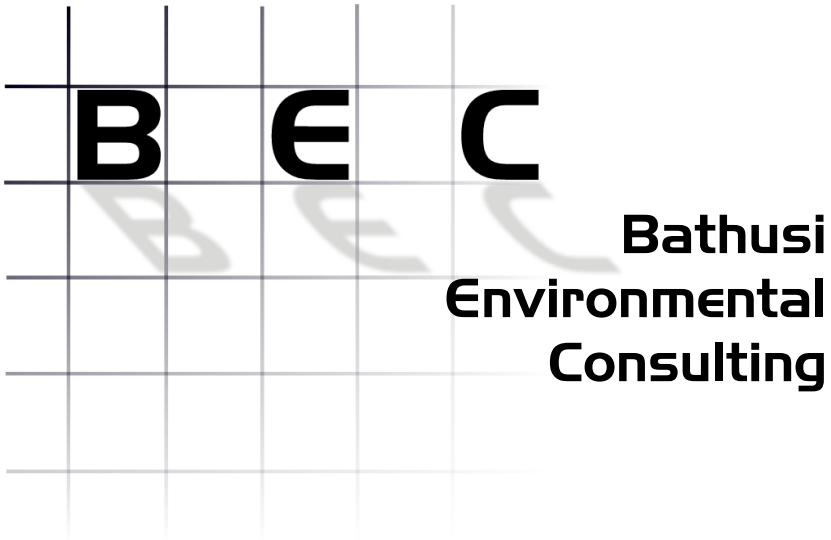

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I PROJECT DETAILS

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Authority Reference	N/A

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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).

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1 EXECUTIVE SUMMARY

The study site is situated on the Farm Naauwpoort 335 in Emahlahleni (Witbank) in the Emahlahleni Municipality, Mpumalanga Province. The site comprises approximately 41 ha. A general GPS co-ordinate for the site is S 25.912395° and E 29.275232°. The N4 highway is situated approximately 2 km to the northeast of the proposed site.

(double click to open in Google Earth)

A previous study was done by De Castro & Brits (2007). This study will aim to refine findings and mapping of results obtained during that particular assessment. Towards this purpose, a suitable survey of the site was conducted during January 2013. Riaan Robbeson (Pr.Sci.Nat.) conducted that floristic assessment and Dewald Kamffer (Pr.Sci.Nat.) conducted the faunal investigation.

1.1 BIOPHYSICAL ASSESSMENT

The Emalahleni Municipality comprises of approximately 267,761 ha, of which only 137,489 (51.3 %) remains untransformed (SANBI, 2007). In spite of extensive areas of remaining natural ('untransformed) grassland indicated by the ENPAT infobase (2006), the effects of agriculture (maize production), infestation by alien invasive trees and recent increase in mining activities and urbanisation are evident from the mosaical appearance of land cover in the immediate region. Existing data (ENPAT) was reviewed and it was concluded that the extent of remaining natural (grassland) habitat in the region is considerably underestimated.

Effects of commercial agriculture (maize production), increase in mining activities and urbanisation in particular, are evident from the mosaical appearance of land cover in the immediate region. Noteworthy land transformation effects that are not necessarily accurately depicted in the database resulted from afforestation and urban settlements. Road infrastructure in the region caused a moderate level of habitat fragmentation and isolation.

The proposed sites are situated immediately adjacent to the following areas of conservation:

- Bankenveld Proposed Conservancy;
- Witbank Nature Reserve; and
- Bankenveld Conservancy.

It is evident that the region in which the study site is situated is regarded highly sensitive in terms of biodiversity conservation efforts on a national and local level. The proximity of these areas of conservation effort and importance is likely to affect the potential conservation status of the proposed site.

The study site is situated within the Olifants Catchment area. The Emalahleni Municipality comprises approximately 24,206 ha of wetlands (SANBI, 2007). Significant areas of surface water are present in the immediate region of the study sites in the form of the Witbank Dam, which is being fed by the Olifants River. A previous study revealed the presence of a non-perennial drainage line and associated hillslope seepages on the site (De Castro & Brits, 2007). While these areas of surface water are unlikely to be affected directly by the proposed development, cumulative impacts of developments in the immediate vicinity of these important wetland features are considered severe, significant and of high concern.

Topography of the immediate region conforms to 'Moderately Undulating Plains and Pans' (ENPAT, 2006). Slopes in the region generally vary between 0 and 9 %. The study site does not exhibit any localised feature of topographical variability. Altitude varies around 1,600 m above sea level and relief varies between 30 and 210 m.

Geology of the site comprises of the Selons River Rhyolite. The Fa8 land type unit is spatially represented on the site, comprising mostly terrain types 3 (midslopes), 4 (footslopes) and 5 (valley bottoms). Unit Fa8, exhibit dominant Mispah and Glenrosa on the midslopes, Huttons on the footslopes and the Dundee soil formation in the valley bottoms where the clay content typically vary between 40 and 50 % (Land Type Survey Staff, 1987).

According to the Mpumalanga Biodiversity Conservation Plan, the study site is situated within an Ecological Corridor, comprising the 'Highly Significant' category, which should preferably be maintained as natural vegetation cover. The proposed development relates to 'Urban & Business Development' (Land Use Type 10) and is included in the category 'Urban Industrial Land Uses' with the other development types of Major Development Projects, Linear Engineering Structures, Water Projects & Transfers, Underground Mining and Surface Mining, dumping, dredging. The study site is situated within portions where major developments should not be permitted according to the Mpumalanga Biodiversity Conservation Plan (MBCP).

1.2 BOTANICAL ASSESSMENT

The study site corresponds to the Grassland Biome, more specifically the Mesic Highveld Grassland as defined by Mucina & Rutherford (VegMap, 2006). The study site comprehends an ecological type known as the Rand Highveld Grassland, which is currently afforded an 'Endangered' conservation status as it is poorly conserved in statutory reserves and in private reserves.

Information obtained from the SANBI database (POSA, 2012) indicates the known presence of approximately 490 plant species within the ¼-degree grid that is sympatric to the study site (2529CD). The high floristic diversity of the region reflects the regional diversity context of the Grassland Biome. A total of 198 plant species were recorded during the survey period. A basic synopsis of the growth forms recorded in the study site reflects the major physiognomic variations that are present in the study site, being dominated by a species rich herb layer and grass sward. A total of 48 grass species (24.2 %) were recorded while the herbaceous comprises of 96 herbs and forbs (48.5 %). The diversity of plants within the study site represents 45 plant families, typically dominated by Poaceae (graminoids), comprising 50 species (25.3 %) and Asteraceae (Daisy family, 34 species, 17.2 %). A total of 48 plant species of conservation importance are known to persist in the immediate region; four conservation important plant taxa were recorded during the survey period, namely:

- *Boophone disticha;*
- *Gladiolus ecklonii;*
- *Gladiolus vinosomaculatus;* and
- *Watsonia* species.

The number of conservation important species recorded within the study site during the relatively brief survey period, is a reflection of the pristine nature of most of the vegetation encountered in the study site. It also reflects the pristine nature of the vegetation on a larger (local and regional scale), as well as the sensitivity of the regional vegetation type (Rand Highveld Grassland, Endangered). Considering the brief nature of the survey, the pristine nature of the vegetation and the number of conservation important species that are known

to occur in the general region, it is highly likely that additional conservation important species will be recorded in the study site should subsequent surveys be conducted.

Results of the photo analysis and site observations revealed the presence of the following macro habitat types, communities and variations (with floristic sensitivities):

- Degraded & Transformed Areas, including
  - Degraded Grassland (medium floristic sensitivity);
  - Transformed Habitat (low floristic sensitivity); and
- Wetland Habitat, including:
  - Channelled Valley Bottoms (high floristic sensitivity);
  - Mesic Grasslands (high floristic sensitivity); and
- Rocky Grassland (high floristic sensitivity).

In spite of high level of transformation and degradation of the immediate surrounds (urban development), the vegetation of this portion of grassland exhibits significant and pristine attributes of the endangered Rand Highveld Grassland. Characteristics of the vegetation include a high diversity of plants, particularly those that are normally associated with pristine highveld grassland ecotypes, presence of conservation important taxa and the absence of poor status and degraded vegetation.

Habitat types identified on this site conforms to the natural types of the grassland; terrestrial grasslands typified by a high degree of rockiness, mesic grasslands that are inundated periodically during the raining season and wetland habitat that contains a high degree of obligate wetland taxa. Limited portions of degraded grassland reveal the effect of historic agricultural attempts and recent anthropogenic impacts, but have since reverted to secondary climax grassland. This portion of grassland, in spite of surrounding transformation and development pressures, is functioning ecologically effective, performing critical supporting roles for adjacent (continuous) natural habitat.

A high conservation status is consequently ascribed to this portion of land, not only because of the pristine nature of the vegetation persisting on the site, but also because of sustained pressure from surrounding development and activities that results in habitat loss and transformation on a local and regional scale. It is therefore important to prioritise conservation of this land by means of two major principles:

- Ensuring sufficient connectivity with adjacent natural habitat in order to ensure ecological functionality; and
- Implementing a conservation and management strategy in order to ensure the longevity of the ecological characteristics on this site.

Importantly, the Mpumalanga Biodiversity Conservation Plan categorised this portion of land as ‘Highly Significant’ (also situated within an Ecological Corridor), and developments within this category is regarded ‘Restricted’. This land should ideally be included in local and regional conservation efforts, such as the Bankenveld Proposed Conservancy and Witbank Nature Reserve, Bankenveld Conservancy, providing the land with a declared conservation status.

1.3 FAUNAL ASSESSMENT

Biological diversity everywhere is at great risk as a direct result of an ever-expanding human population and its associated needs for energy, water, food and minerals. Landscape transformation that is needed to accommodate these activities inevitably leads to habitat loss and habitat fragmentation, resulting in the mosaical appearance of undisturbed habitat within a matrix of transformed areas. These remaining areas of natural habitat are frequently too small to support the biodiversity that previously occupied the area and the region loses its ecological integrity (Kamffer, 2004).

Animals known to be present in the ¼-degree grid 2529CD were considered potential inhabitants of the study site (all species known from Mpumalanga were included in the assessment to limit the known effects of sampling bias, except for birds which have been sampled extensively and the data for the Q-grid is accepted as accurate). The presence of 59 animal taxa was confirmed during the January 2013 investigation by means of visual sightings, tracks, scats, burrows and species-specific calls as well as camera and small mammal trapping. The following results were recorded:

- 21 invertebrates;
- 1 frog species;
- 1 reptile species;
- 36 bird species; and
- 4 mammals.

The diversity of animals recorded in the study site included four Alien and/or Invasive species, namely:

- Spotted Maize Beetle (*Astylus atromaculatus*);
- Common Pigeon (*Columba livia*);
- Common Myna (*Acridotheres tristis*); and
- Feral Domestic Cat (*Felis catus*).

No provincially protected or alien and invasive fauna taxa were recorded in the study site during the survey period.

A total of 112 Red Data animals are known to occur in Mpumalanga (butterflies, frogs, reptiles and mammals) and in the ¼-degree grid 2529CD (birds). An assessment of the PoC for these animals yielded the following probabilities:

- 94 species have a low PoC;
- 12 species have a moderate-low PoC;
- 5 species have a moderate PoC; and
- 1 species has a high PoC.

The 'Vulnerable' butterfly *Metisella meninx* (Marsh Sylph – Hesperiidae) is a likely inhabitant of the study site as the presence of medium to large stands of the wetland grass *Leersia hexandra* was noted, which is an important larval host plant for this butterfly. Records of its presence were collected in similar habitat types in the surrounding region (pers. obs.).

In addition to the above-mentioned Red Data species of Mpumalanga, 31 animal taxa (some overlap does occur) have protected status (NEMBA) within Mpumalanga (www.speciesstatus.sanbi.org). The estimated PoC for these species are as follows:

- 28 species have a low PoC;
- 1 species has a moderate-low PoC; and
- 2 species have a moderate PoC.

None of these species was recorded during the survey period, but some species are likely to persist in the immediate region.

Plant communities or macro habitat types are regarded as representative of the faunal habitats within the study site for the purposes of this EIA assessment; the following faunal sensitivities were estimated for these habitat types:

- Transformed Habitat (low faunal sensitivity);
- Grassland Habitat, including:
  - Degraded Grassland (medium faunal sensitivity);
  - Rocky Grassland (high faunal sensitivity);
- Wetland Habitat, including:
  - Channelled Valley Bottoms (high faunal sensitivity);
  - Mesic Grasslands (high faunal sensitivity); and

Despite the small size and spatial presence of the study site in a landscape characterised by urban development, remaining natural habitat of the site is regarded pristine, comprising rocky grassland and wetland habitat. The status of these remaining natural habitats is highly representative of typical (pristine) faunal habitats of the grasslands and wetlands of the Rand Highveld Grassland ecological type. Although no Red Data species were recorded in the study site during the brief field investigation, natural rocky grassland, mesic grassland and channelled valley bottom habitats of the study site are considered to be of high biodiversity values, exhibiting high faunal sensitivities pertaining to activities that may lead to degradation and/or transformation of these habitats. These habitats are currently under significant threat in the region (Mesic Highveld Bioregion of Mpumalanga) – a fact confirmed by the Mpumalanga Biodiversity Plan (the area is categorised as 'Highly Significant' and falls within an Ecological Corridor).

Connectivity with other natural faunal habitats (both terrestrial and wetland) of this site is high, increasing the biodiversity value and sensitivity of the study site. Important, connectivity with the Olifants River – Witbank Dam wetland system is also established and the site will undoubtedly provide valuable sink habitats for some of the wetland species persisting in this system.

Data and visual observations indicate that remaining natural habitat (regional) are characterised by severe degradation and transformation, with high levels of habitat fragmentation and isolation. Habitat of this pristine nature (site) is therefore not abundantly encountered in the region. The inclusion of this portion of pristine grassland in adjacent areas of conservation will therefore be regarded a positive contribution towards conservation efforts on a local scale. Potential and likely impacts of development of these portions of natural habitat are regarded significant and severe on a local scale. Impacts are also regarded significant on a larger scale, considering the proximity of conservation important areas.

1.4 ECOLOGICAL IMPACT ASSESSMENT & DISCUSSION

The impact assessment is aimed at presenting a description of the nature and extent of identified impacts on the ecological environment. Direct or primary impacts from proposed development will result from any activity that involves land clearance or alteration. No impacts were identified that could lead to a beneficial impact on the ecological environment of the study site since the proposed development is largely destructive, involving the alteration of natural habitat or degradation of habitat that is currently in a climax status. The following impacts are relevant to this particular type of development (with estimated significance):

- Impacts on flora species of conservation importance (HIGH significance);
- Impacts on fauna species of conservation importance (HIGH significance);
- Impacts on/ loss/ degradation of natural/ sensitive/ protected habitat types (HIGH significance);
- Displacement of fauna species, human-animal conflicts & interactions (HIGH significance);
- Impacts on ecological connectivity and ecosystem functioning (HIGH significance);
- Indirect impacts on surrounding habitat (MEDIUM significance);
- Cumulative impacts on conservation obligations & targets (national and regional) (HIGH significance);
- Cumulative increase in local and regional fragmentation/ isolation of habitat (HIGH significance); and
- Cumulative increase in environmental degradation, pollution (MEDIUM significance).

The evaluation of impacts resulting from the proposed development on this site was made with the following assumptions:

- Wetland habitat, as defined and delineated by the wetland ecologist, as well as applicable buffer zones, will be excluded from the proposed development. As such, only terrestrial habitat will be utilised for the development;
- Evaluation of impact significance prior to mitigation assumes the complete destruction of all terrestrial habitat; which is a reasonable assumption considering the nature of residential developments; and
- Evaluation of impact significance subsequent to mitigation measures assumes the implementation of all recommended generic and site-specific mitigation measures, but **excluding** the implementation of an Offset strategy.

Expected impacts on biodiversity attributes of the site is expected to be severe and significant, on both a local and regional scale. It is particularly important to note that the implementation of all possible and sensible mitigation measures is unlikely to ameliorate the significance of perceived and likely impacts to an acceptable level. Development of this portion of land will therefore lead to an inevitable loss of natural habitat, notwithstanding the attempted mitigation thereof. It is therefore critical to note that a Biodiversity Offset strategy is not regarded as a mitigation measure as the impacts on the site will remain of a similar nature and extent. An offset strategy should be considered and evaluated by the authorities as a contribution to conservation efforts on a local and regional scale. Aspects that should be considered during a suitable offset assessment include (*inter alia*):

- Evaluation of Offset Adequacy and Site selection;
- Relating impacts significance to a local and regional context; and
- Offset measurement and Compensation Strategies.

Mitigation measures are aimed at providing protection of remaining natural habitat within the proposed site (mostly wetland related habitat), as well as adjacent natural habitat.

2 TERMS OF REFERENCE FOR THIS ASSESSMENT

Objectives of this Biodiversity Impact Assessment are to establish the presence/ absence of ecologically sensitive areas or species within the proposed project area. Secondly, in order to guide and assist the planning process of the proposed development it is necessary to assess potential impacts of the development on the biological environment (terrestrial biodiversity), comment 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 site in terms of biophysical attributes and phytosociological characteristics;
- Compile a floristic sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects;
- Provide pertinent recommendations; 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;
- Map all relevant aspects; and
- Present all results in a suitable format.

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.

Activities responsible for land transformation and loss of biodiversity is under increasing scrutiny from NGOs, commentators and financial analysts. In part, this is due to the legacy of industry environmental neglect, and in part. Any transformative activity therefore requires 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 from land development, 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. Furthermore, the next 50 years could see a further acceleration in the degradation of ecosystem services unless action is taken to reverse current trends.

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.

4 THE BIOPHYSICAL ENVIRONMENT

4.1 LOCATION

The study site is situated on the Farm Naauwpoort 335 in Emahlahleni (Witbank) in the Emahlahleni Municipality, Mpumalanga Province. The site comprises approximately 40 ha. A general GPS co-ordinate for the site is S 25.912395° and E 29.275232°. The N4 highway is situated approximately 2 km to the northeast.

The regional location of the study site is illustrated in **Figure 1**. A composite Google Earth image of the site and immediate surrounds is presented in **Figure 2**, reflecting a relatively high habitat fragmentation of the general region and immediate surrounds.

4.2 LAND COVER & LAND USE OF THE REGION

Land use often determines land cover; it is an important factor contributing to the condition of the landscape. Different uses have varying effects on the integrity of the land. Areas that are characterised by high levels of transformation and habitat degradation are generally more appropriate for development purposes as it is unlikely that biodiversity attributes of importance will be present or affected by development. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes, particularly in cases where these habitat types are under threat from local and regional development.

The Emalahleni Municipality comprises of approximately 267,76 1ha, of which only 137,489 (51.3 %) remains untransformed (SANBI, 2007). In spite of extensive areas of remaining natural ('untransformed) grassland indicated by the ENPAT infobase (2006), the effects of agriculture (maize production), infestation by alien invasive trees and recent increase in mining activities are evident from the mosaical appearance of land cover in the immediate region (refer Figure 3). Existing data (ENPAT) was reviewed and it was concluded that the extent of remaining natural (grassland) habitat in the region is considerably underestimated. This statement is based on the following:

- the current land cover, as presented in ENPAT (2006) does not accurately reflect the current land cover status; in particular, several mining areas and stands of exotics are not captured within the existing data (pers. obs.); and
- it is well established that 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 cultivated fields 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 as well as sub-climax grassland types within the category of 'Natural Grassland' a fallacious view is created of the extent of remaining natural habitat in the region. It is therefore extremely likely that remaining untransformed habitat within the municipality has decreased to less than 50 %. Ultimately, the greater region is characterised by high levels of habitat transformation, isolation and habitat fragmentation, resulting from persistent increases in mining and agricultural activities, urban developments, linear infrastructure and poor management practices.

Land cover categories, as presented in **Figure 3**, were loosely categorised into classes that represent natural habitat and other categories that are characterised by degraded and transformed habitat. In terms of the importance for biodiversity, the assumption is that landscapes exhibiting high transformation levels are

normally occupied by plant communities and faunal assemblages that do not necessarily reflect the original or pristine status. This is particularly important in the case of conservation important taxa as these plants and animals generally exhibit extremely low tolerances levels towards disturbances. This is one of the main reasons for the threatened status of these species; changes in the natural environment that is available to these species are likely to result in severe impacts on these species and, subsequently, their conservation status.

Three important aspects are associated with habitat changes that accompany certain land uses. The transformation of natural habitat by land uses such as agriculture, mining and urbanisation results in the permanent decimation of available habitat; these areas will not recover to the original pristine status. A second aspect of habitat transformation or degradation is that it affects species directly, namely changes in 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 of invasive exotic species that can effectively sterilise large tracts of remaining natural habitat.

Effects of commercial agriculture (maize production), increase in mining activities and urbanisation in particular, are evident from the mosaical appearance of land cover in the immediate region. Noteworthy land transformation effects that are not necessarily accurately depicted in the database resulted from afforestation and urban settlements. Road infrastructure in the region caused a moderate level of habitat fragmentation and isolation.

4.3 DECLARED AREAS OF CONSERVATION

The proposed sites are situated immediately adjacent to the following areas of conservation (refer **Figure 4**):

- Bankenveld Proposed Conservancy;
- Witbank Nature Reserve; and
- Bankenveld Conservancy.

It is evident that the region in which the study site is situated is regarded highly sensitive in terms of biodiversity conservation efforts on a national and local level. The proximity of these areas of conservation effort and importance is likely to affect the potential conservation status of the proposed site.

Figure 1: Regional setting of the study sites

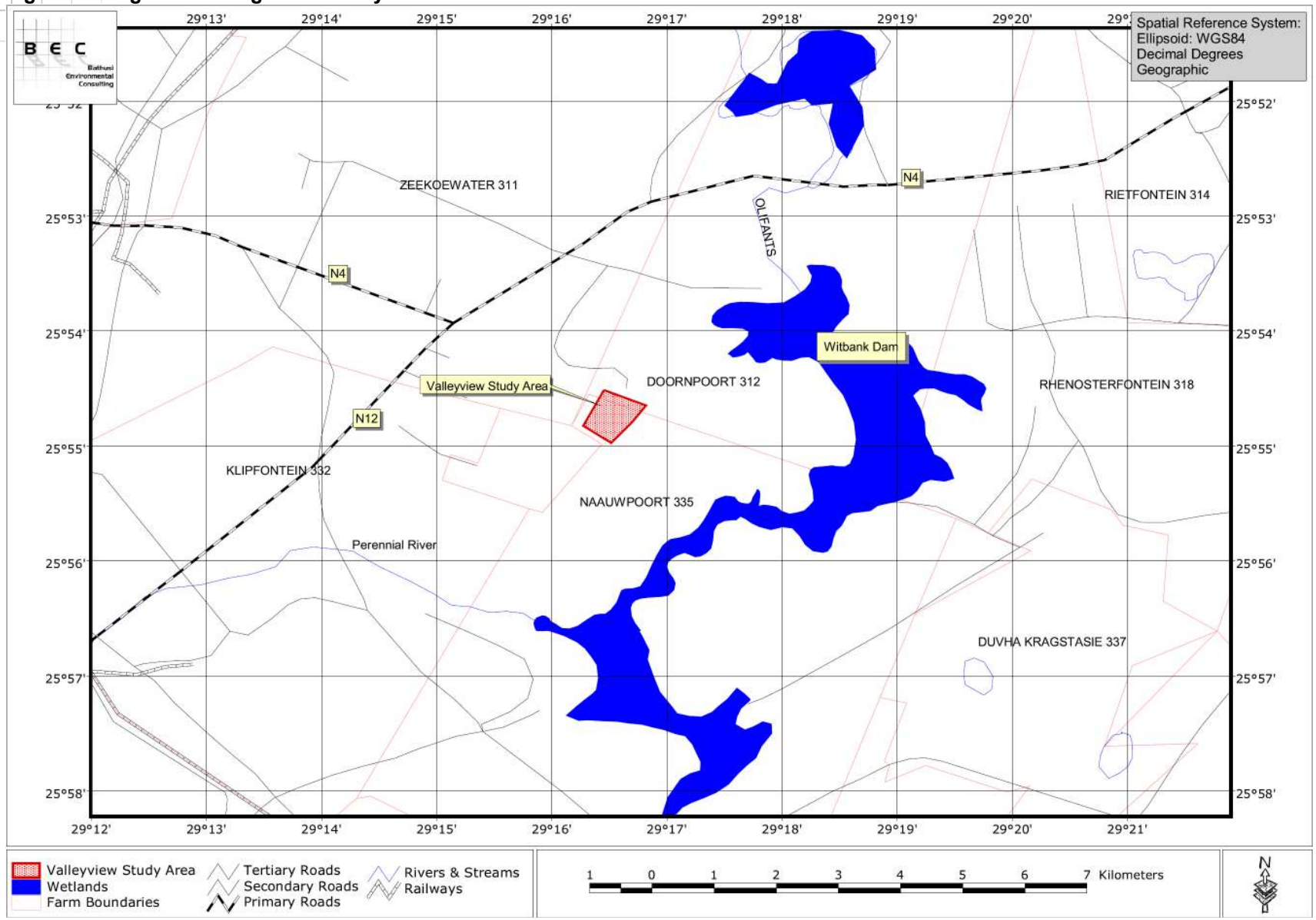


Figure 2: Composite aerial image of the study sites (courtesy of www.googleearth.com)

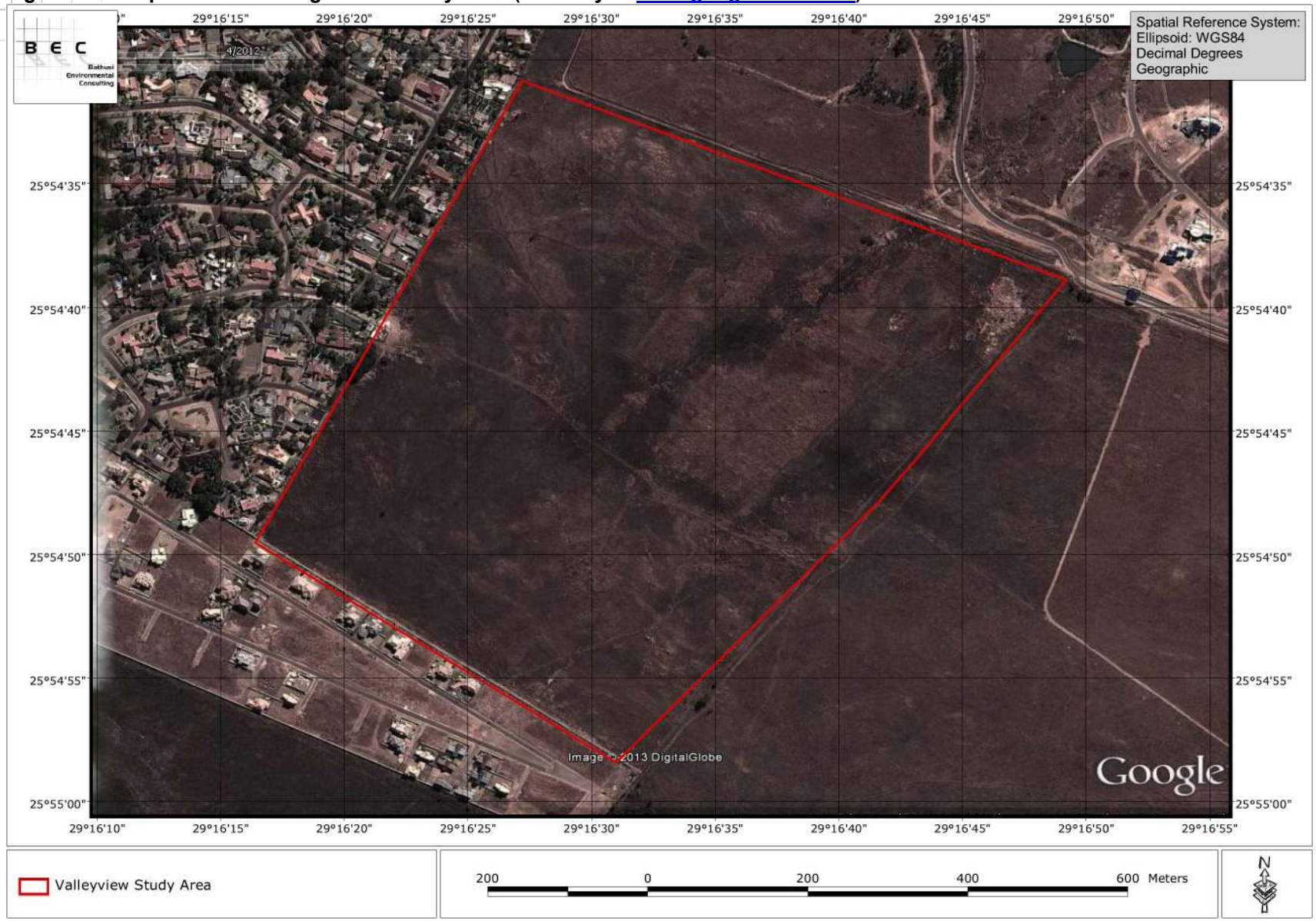


Figure 3: Land cover categories of the region

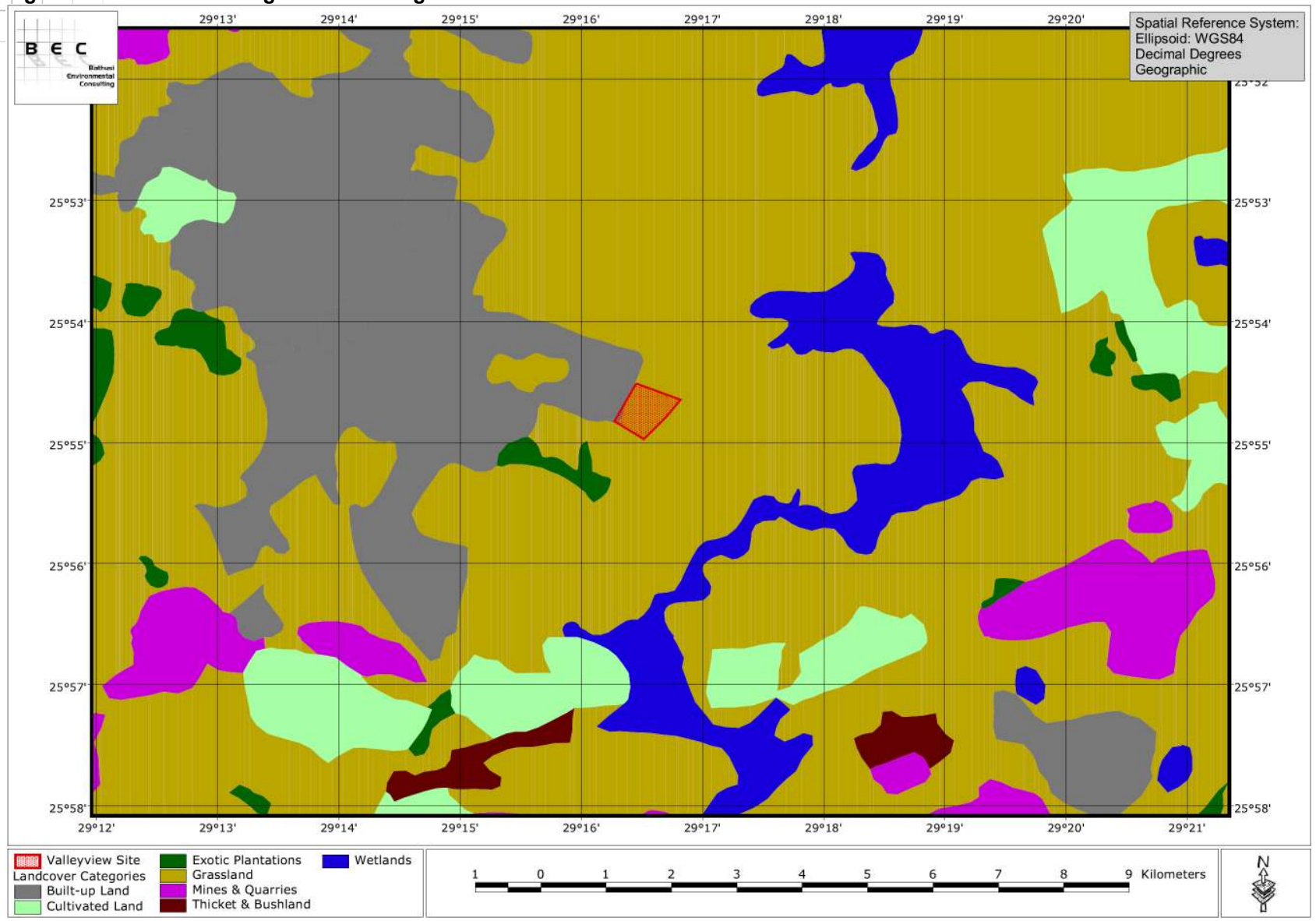
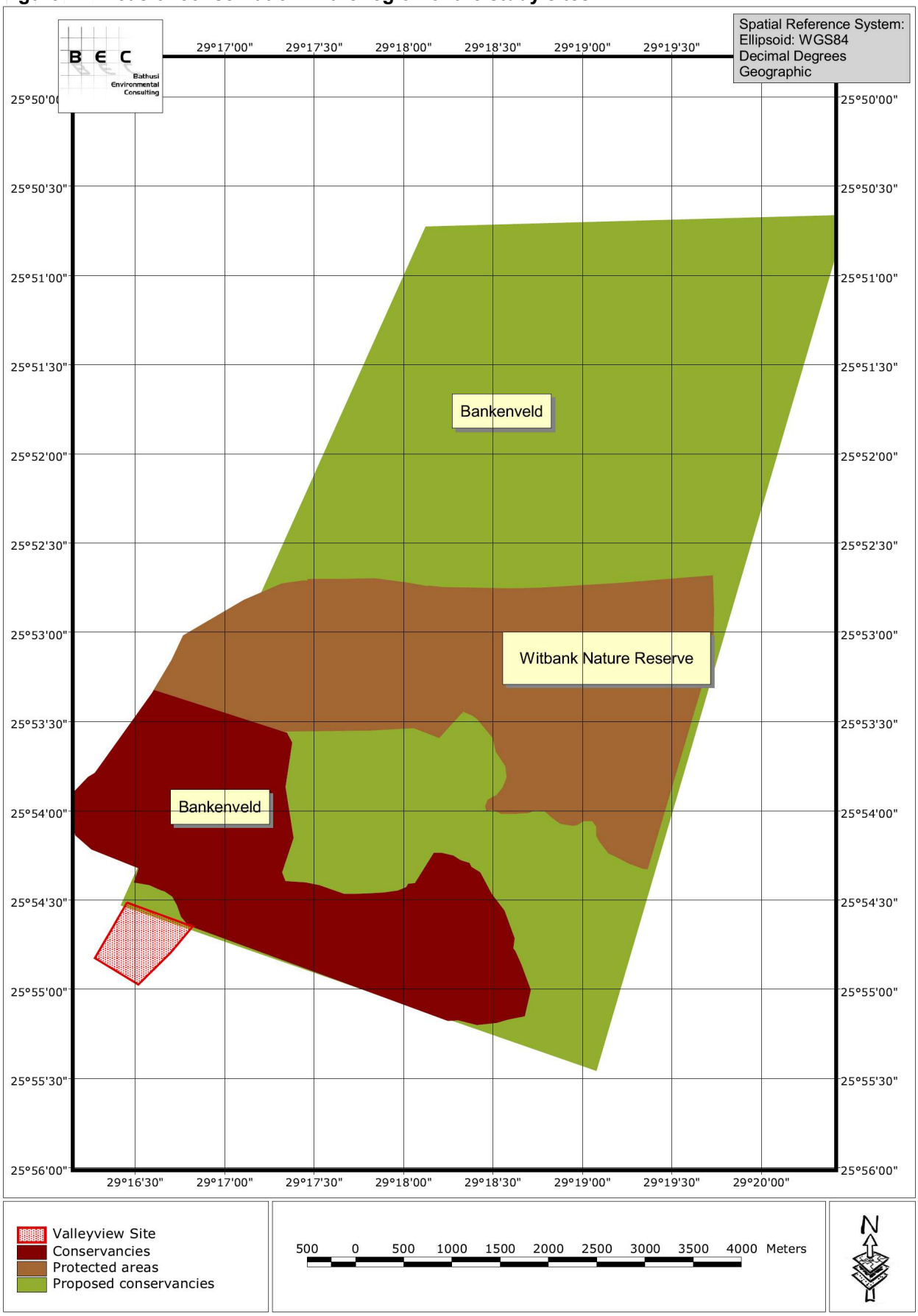


Figure 4: Areas of conservation in the region of the study sites



4.4 SURFACE WATER[1]

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. 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 (Mucina & Rutherford, 2006).

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 site is situated within the Olifants Catchment area. The Emalahleni Municipality comprises approximately 24,206 ha of wetlands (SANBI, 2007). Significant areas of surface water are present in the immediate region of the study sites in the form of the Witbank Dam, which is being fed by the Olifants River (refer **Figure 5**). A previous study revealed the presence of a non-perennial drainage line and associated hillslope seepages on the site (De Castro & Brits, 2007). While these areas of surface water are unlikely to be affected directly by the proposed development, cumulative impacts of developments in the immediate vicinity of these important wetland features are considered severe, significant and of concern.

4.5 TOPOGRAPHY, RELIEF & SLOPES

The presence of habitat types of physical variability represents important biodiversity attributes. Hills and ridges have generally been shown to have a rich biodiversity consisting of an important habitat for sensitive species as well as high plant diversity. The study site is situated within a topographical category of 'Moderately Undulating Plains and Pans' (ENPAT, 2006). Slopes in the region generally vary between 0 and 9 %[2]. The study site does not exhibit any localised feature of topographical variability.

The study site is situated at approximately 1,600m above sea level and relief varies between 30 and 210 m.

[1] Please note that it is not the intention of this report to present a detailed account of the wetland and aquatic habitat types of the area; this is addressed in a separate specialist report. However, certain aspects do related to the biodiversity of the study site and general comments pertaining to this attribute are therefore included in this report.
[2] Topographic features in a landscape that is characterized by slopes of 5° or more (i.e. ≥ 8.8%, ≥ 1 in 11 gradient), as determined by means of a GIS digital elevation model, is defined as a ridge (GDACE, Development guidelines for ridges, 2001)

4.6 GEOLOGY

The geological formations represented in the various study sites comprises of Selons River Rhyolite. This formation has a bed of sandstone or quartzite at the base and consists further mainly of massive, red rhyolite of which the topmost part shows flow bedding. It contains a few intercalations of sandstone, tuff, black rhyolite and breccia. A bed of dark, fine-grained mudstone is present approximately in the middle of the sequence. The top is ruffaceous locally.

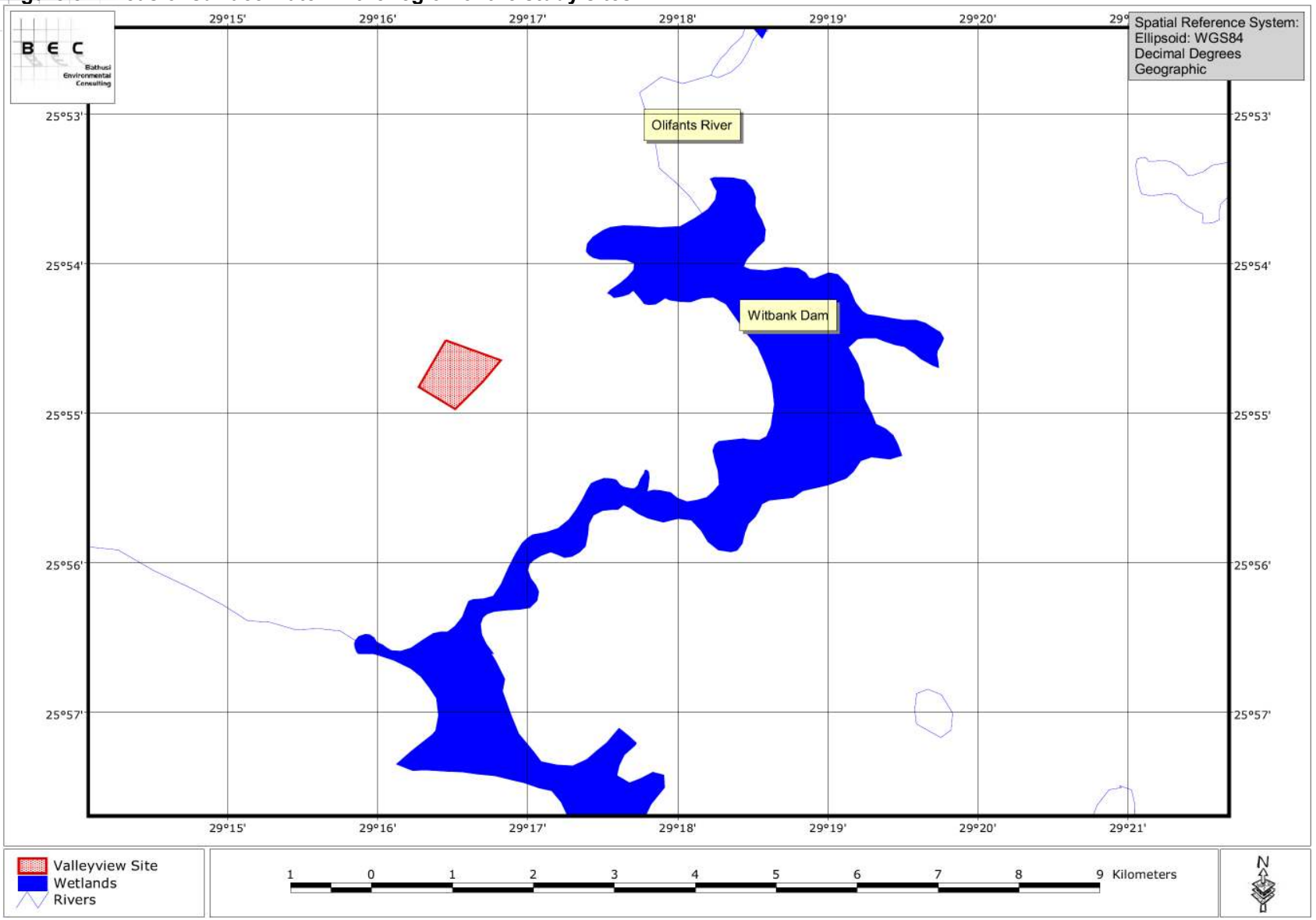
4.7 LAND TYPES & SOILS

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. The preferred site is situated within the Fa8 type unit.

F- Units are intended to accommodate pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. The soil forms, which epitomise these processes, are Glenrosa and Mispah. However, exposed rock and soils belonging in almost an of the other 39 soil forms may be found in these land types, provided these other soils do not qualify the land for inclusion in another map unit. Shallow and deep soils of the Oakleaf from (usually on upland sites) developed by rock weathering (e.g. gneiss, aeolianite etc.) are accommodated here. Fa refers to land in which lime in the soils is not encountered regularly in any part of the landscape,

The study site comprises mostly terrain types 3 (midslopes), 4 (footslopes) and 5 (valley bottoms). Unit Fa8, exhibit dominant Mispah and Glenrosa on the midslopes, Huttons on the footslopes and the Dundee soil formation in the valley bottoms where the clay content typically vary between 40 and 50% (Land Type Survey Staff, 1987).

Figure 5: Areas of surface water in the region of the study sites



5 MPUMALANGA BIODIVERSITY CONSERVATION PLAN

5.1 TERRESTRIAL BIODIVERSITY SENSITIVITIES ON A LOCAL SCALE

5.1.1 Category Designation

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) 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 designation of biodiversity conservation categories according to the MBCP (Lötter & Ferrar, 2006) is illustrated in **Figure 8**. The MBCP maps the distribution of Mpumalanga Province's known biodiversity into six categories (Lötter & Ferrar, 2006). 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 targets.

The study site is situated within an Ecological Corridor, also comprising the 'Highly Significant' category (refer **Figure 6**).

Land included 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. All cultivation-based agriculture and all urban/industrial development (Land-Use Types 5 – 15) should not 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[3]. 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 in HIGHLY SIGNIFICANT land may result in remaining areas being moved into the IRREPLACEABLE category.

[3]Undertake specialist studies according to MTPA's 'Requirements for Assessing and Mitigating Environmental Impacts of Development Applications' document.

5.1.2 MBCP Ecological Corridors

Ecological processes include an endless list of natural cause-and-effect relationships, including pollination, migration, soil erosion, water purification and climate regulation. Such processes are complex and often poorly understood and are difficult to measure or to manage and plan for. Few can be represented spatially on a map, but ecological processes are as important to the persistence of biodiversity as the biological feature i.e. species, itself.

The protected area conservation system seeks to protect a representative sample of species, communities and ecosystems. Although many ecological processes will be conserved along with the protected biota, some are not. The most obvious are those involving species movement and connectivity, i.e. those that are thwarted by habitat fragmentation. These processes can be spatially represented and are incorporated into MBCP as ecological corridors. Corridors in MBCP have been aligned using expert opinion, mostly along river-lines and in some cases following altitudinal gradients and mountain ranges. Set at 7km in width, the purpose of the corridors is to cater for long-term, landscape-scale movement of plants and animals, and to provide links following high-value biodiversity areas. To be effective they must provide relatively uninterrupted strips of natural habitat in perpetuity, ultimately with special measures provided to encourage biological movement along their full length.

Land-use and administrative options for positive biodiversity outcomes in ecological corridors include:

- Corridors need to retain natural vegetation cover and in some key 'critical-link' areas undergo active repair and restoration of ecosystem functioning;
- Land-use planners to refer development applications to MTPA/DALA for all applications involving probable biodiversity impacts;
- Prioritize the monitoring of changes in land use and loss of natural habitat to protect ecosystem functioning and connectivity;
- Conduct focused public awareness and/or extension efforts on biodiversity values and connectivity to limit natural habitat loss and encourage free movement of plants and animals through biodiversity barriers;
- Identify critical link areas where local sites are protected and promoted to a higher biodiversity conservation category;
- Corridors are pre-disposed towards conservancy-type protection and co-operative management arrangements to provide for cross-barrier movement;
- Treat corridors as priority areas for Working for Water and other alien plant control projects to deny these species the benefits intended for indigenous species;
- Develop activities/procedures for encouraging free movement of indigenous plants and animals across boundaries and barriers in agricultural landscapes;
- EIA applications should assess the impact of the proposed development on the functionality of the ecological corridor;
- Compensatory offsets in corridors can be considered if they result in a net biodiversity gain and improvement in corridor functioning.

5.1.3 Development Restrictions in Terms of the MBCP

The MBCP suggests that 'Highly Significant' areas should remain unaltered and be managed for biodiversity by various means. Other categories incorporate increasing options for different types of land use that should be decided by the application of EIA procedures and negotiation between stakeholders. The MBCP also identifies that 35.8 % of the Province is included in the category of 'No natural habitat remaining', which has very little biodiversity value.

The proposed development relates to 'Urban & Business Development' (Land Use Type 10) and is included in the category 'Urban Industrial Land Uses' with the other development types of Major Development Projects, Linear Engineering Structures, Water Projects & Transfers, Underground Mining and Surface Mining, dumping, dredging. These six land uses cause the greatest environmental impact 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 Mpumalanga Biodiversity Conservation Plan (MBCP) are illustrated in **Figure 7**. Limitations in terms of the proposed surface mining development comprise the 'Restricted' category.

Extensive parts of the study site are situated within areas where major developments should not be permitted according to the Mpumalanga Biodiversity Conservation Plan (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 site or on a local and regional scale (refer **Footnote 3**). 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 6: Terrestrial and Biodiversity Conservation (MBCP) categories of the study site

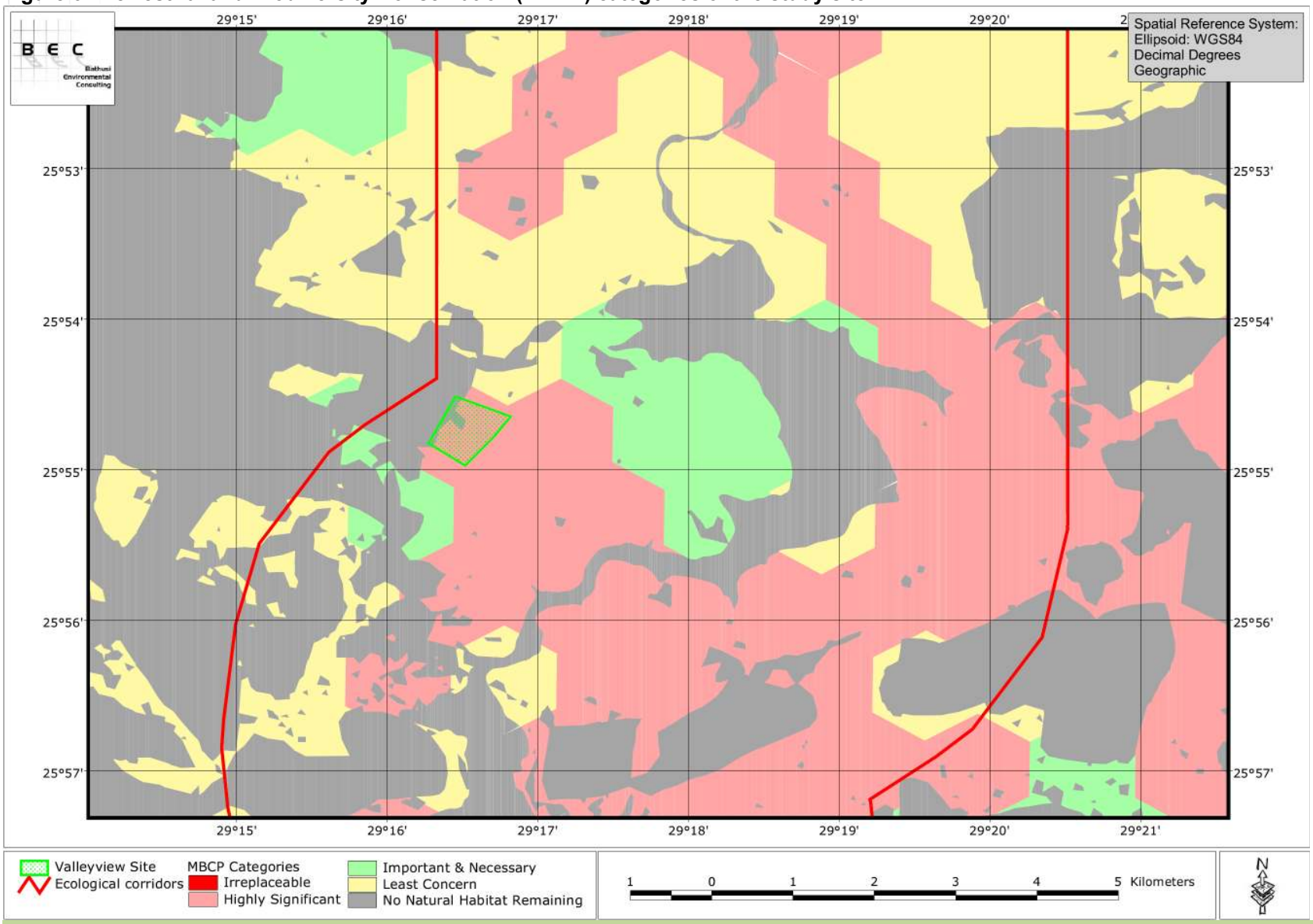
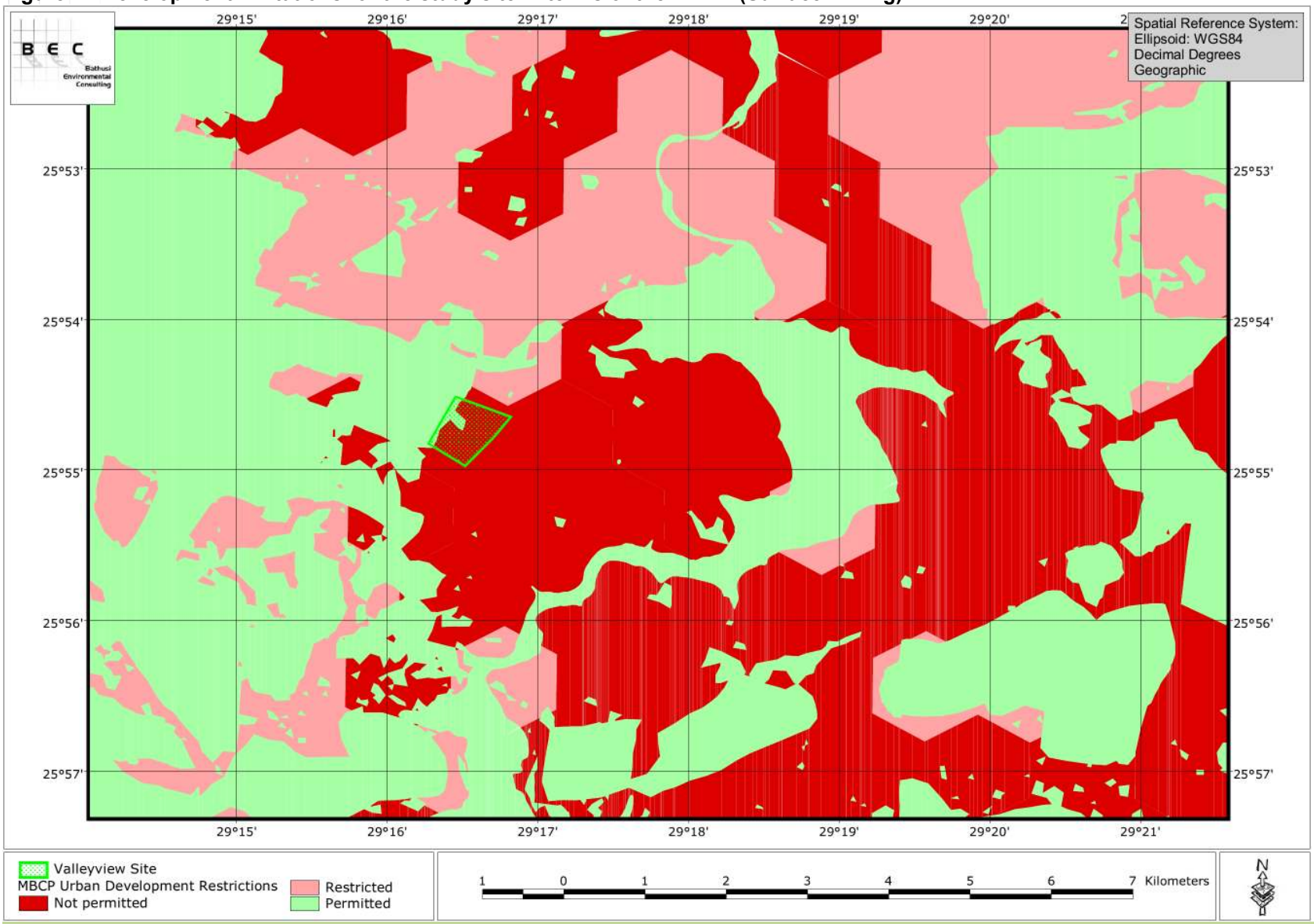


Figure 7: Development limitations for the study site in terms of the MBCP (Surface Mining)



6 BACKGROUND TO THE REGIONAL 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 other herbaceous species, especially those with belowground storage organs such as bulbs or tubers. These plants 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 no 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 grasslands are mainly found in the highveld above 1000m. These are cool, dry open landscapes, with rainfall of mare than 500mm/year. Frost, hailstorms and lightning strikes are common. The natural occurrence of fire and other defoliating events favours 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 650mm 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 root-stocks.

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.

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 forestation 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 BOTANICAL ASSESSMENT

7.1 REGIONAL FLORISTIC TRAITS

The study site corresponds to the Grassland Biome, more specifically the Mesic Highveld Grassland as defined by Mucina & Rutherford (VegMap, 2006). This unit is situated in the eastern, precipitation-rich grassland regions ('sour grasslands') of the Highveld. The study site comprehends an ecological type known as the Rand Highveld Grassland.

Rand Highveld Grassland vegetation is classified as 'Endangered' as it is poorly conserved in statutory reserves and in private reserves. Almost half have been transformed by cultivation, plantations, urbanisation and dam-building. Cultivation may also have had an impact on the surface area of the unit where old lands are currently classified as grasslands in land cover datasets. Poor land management has furthermore led to degradation of significant portions of the remainder of this unit. Scattered aliens (most prominently *Acacia mearnsii*) occur in about 7 % of this ecological unit.

This is a highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species rich, wire, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus.* High diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra, P. welwitschii, Acacia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* (especially *Searsia magalismontanum*) is most prominent.

Biogeographically important species include *Agapanthus inapertus* subsp. *pendulus, Eucomis vandermerwei, Huernia insigniflora* and *Melhania randii*. Endemic species include *Melanospermum rudolfi, Polygala spicata, Anacampseros subnuda, Frithia humilis, Crassula arborescens, Delosperma purpureum, Encephalartos lanatus* and *E. middelburgensis.*

The following species are regarded representative of the Rand Highveld Grassland vegetation type:

- ***Grasses***

Ctenium concinnum, Cynodon dactylon, Digitaria monodactyla, Diheteropogon amplectens, Eragrostis chloromelas, Heteropogon contortus, Loudetia simplex, Monocymbium cerisiiforme, Panicum natalense, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Trachypogon spicatus, Tristachya biseriata, T. rehmannii, Andropogon schirensis, Aristida aequiglumis, A. congesta, A. junciformis subsp. *galpinii, Bewsia biflora, Brachiaria nigropedata, B. serrata, Bulbostylis burchellii, Cymbopogon caesius, Digitaria tricholaenoides, Elionurus muticus, Eragrostis capensis, E. curvula, E. gummiflua, E. plana, E. racemosa, Hyparrhenia hirta, Melinis nerviglumis, M. repens, Microchloa caffra, Setaria nigrirostris, Sporobolus pectinatus, Trichoneura grandiglumis* and *Urelytrum agropyroides*

- **Herbs**

Acanthospermum australe, Justicia anagalloides, Pollichia campestris, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Helichrysum caespititium, H. nudifolium, H. rugulosum, Ipomoea crassipes, Kohautia amatymbica, Lactuca inermis, Macledium zeyheri, Nidorella hottentotica, Oldenlandia herbacea, Rotheca hirsuta, Selago densiflora, Senecio coronatus, Sonchus dregeanus, Vernonia oligocephala and *Xerophyta retinervis.*

- **Geophytic Herbs**

Boophone disticha, Cheilanthes hirta, Haemanthus humilis subsp. *humilis, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia* and *Oxalis corniculata.*

- **Succulent Herbs**

Aloe greatheadii var. *davyana*

- **Low Shrubs**

Anthospermum rigidum subsp. *pumilum, Indigofera comosa, Searsia magalismontana* and*, Stoebe plumosa*

- **Succulent Shrub**

Lopholaena coriifolia

- **Geoxylic Suffrutex**

Elephantorrhiza elephantina

7.2 PHYTODIVERSITY

7.2.1 Regional Phytodiversity (POSA, 2012)

Information obtained from the SANBI database (POSA, 2012) indicates the known presence of approximately 490 plant species within the ¼-degree grid that is sympatric to the study site (2529CD)[4]. The high floristic diversity of the immediate region reflects the regional diversity context of the Grassland Biome. However, the paucity of accurate floristic richness information is indicated by the absence of some common plant taxa from these data records and the true species richness is therefore likely to be much higher than indicated.

An appraisal of the growth forms (refer **Table 1**) reflects the diverse grassland physiognomy with 148 herb species (38.2 %), 65 geophyte species (13.3%), 50 grass species, (10.2 %). The physiognomical dominance of the grassland biome is also illustrated by the low diversity of trees (6 species, 1.2 %). This species richness also represents 107 plant families, typically dominated by Asteraceae (55 species, 11.2 %), Poaceae (50 species, 10.2 %), Fabaceae (49 species, 10.1 %), Apocynaceae (25 species, 5.1 %) and Cyperaceae (25 species, 5.1 %). Importantly, Orchidaceae, which is one of the provincially protected families, is represented by 12 species (2.4 %).

Table 1: Growth forms of the region

Growth Form	*Number*	*Percentage*
Bryophytes	12	2.4 %
Carnivores	1	0.2 %
Climbers	15	3.1 %
Cyperoids	25	5.1 %
Dwarf shrubs	39	8.0 %
Forbs	2	0.4 %
Geophytes	65	13.3 %
Graminoids	50	10.2 %

[4] This list is not included in the report due to the size, but can be presented separately on request.

Table 1: Growth forms of the region		
Growth Form	***Number***	***Percentage***
Helophytes	7	1.4 %
Herbs	187	38.2 %
Hydrophilics	1	0.2 %
Lichens	16	3.3 %
Shrubs	42	8.6 %
Succulents	21	4.3 %
Suffrutex	1	0.2 %
Trees	6	1.2 %
Total	**490**	

7.2.2 Survey Results - Recorded Phytodiversity (Species Richness)

Species richness is the number of different species represented in a set or collection of individuals. It is therefore simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions. In contrast, species diversity takes into account both species richness and species evenness.

A total of 198 plant species were recorded during the survey period. This high diversity is regarded representative of the regional diversity. A list with the identified plant species, together with their growth forms, medicinal/ traditional uses and colloquial names are presented in **Appendix 1**.

A basic synopsis of the growth forms recorded in the study site reflects the major physiognomic variations that are present in the study site (refer **Table 2**). The grassland physiognomy is dominated by a species rich herb layer and grass sward. Typically, the herbaceous layer is prominent and is physiognomically dominated by the grass sward. A total of 48 grass species (24.2 %) were recorded. The herbaceous layer is rich in species, comprising 96 herbs and forbs (48.5 %). With the exception of altered habitat, trees are generally absent or occur as scattered shrubs. The pristine nature of the grasslands is reflected by the presence of 17 geophyte species (8.6 %), some of which are conservation important species.

The diversity of plants within the study site represents 45 plant families (refer **Table 3**), typically dominated by Poaceae (graminoids), comprising 50 species (25.3 %) and Asteraceae (Daisy family, 34 species, 17.2 %).

Table 2: Growth forms recorded in the study site		
Growth Form	***Number***	***Percentage***
Ferns	1	0.5 %
Forbs	96	48.5 %
Geophytes	17	8.6 %
Grasses	48	24.2 %
Hydrophilics	4	2.0 %
Parasites	1	0.5 %
Sedges	10	5.1 %
Shrubs	15	7.6 %
Succulents	3	1.5 %
Trees	3	1.5 %
Total	**198**	

Table 3: Plant families recorded in the study site		
Growth Form	***Number***	***Percentage***

Table 3: Plant families recorded in the study site		
Growth Form	***Number***	***Percentage***
Acanthaceae	1	0.5 %
Adianthaceae	1	0.5 %
Aizoaceae	1	0.5 %
Amaranthaceae	4	2.0 %
Amaryllidaceae	1	0.5 %
Anacardiaceae	3	1.5 %
Apiaceae	1	0.5 %
Apocynaceae	6	3.0 %
Asteraceae	34	17.2 %
Caesalpiniaceae	1	0.5 %
Capparaceae	1	0.5 %
Chenopodiaceae	1	0.5 %
Chrysobalanaceae	1	0.5 %
Commelinaceae	2	1.0 %
Convolvulaceae	3	1.5 %
Crassulaceae	2	1.0 %
Cucurbitaceae	1	0.5 %
Cyperaceae	10	5.1 %
Ebenaceae	1	0.5 %
Euphorbiaceae	3	1.5 %
Fabaceae	14	7.1 %
Gentianaceae	1	0.5 %
Geraniaceae	2	1.0 %
Hypericaceae	1	0.5 %
Hypoxidaceae	3	1.5 %
Illebracaceae	1	0.5 %
Iridaceae	4	2.0 %
Lamiaceae	6	3.0 %
Liliaceae	7	3.5 %
Lobeliaceae	1	0.5 %
Malvaceae	1	0.5 %
Oxalidaceae	1	0.5 %
Periplocaceae	2	1.0 %
Poaceae	50	25.3 %
Polygonaceae	2	1.0 %
Proteaceae	1	0.5 %
Rhamnaceae	1	0.5 %
Rubiaceae	5	2.5 %
Scrophulariaceae	1	0.5 %
Selaginaceae	3	1.5 %
Solanaceae	5	2.5 %
Thymelaeaceae	3	1.5 %
Typhaceae	1	0.5 %
Velloziaceae	1	0.5 %
Verbenaceae	3	1.5 %

7.3 PLANT TAXA OF CONSERVATION IMPORTANCE

7.3.1 Available Information

South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the assessment of the conservation status of South African plants. This scientific 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.

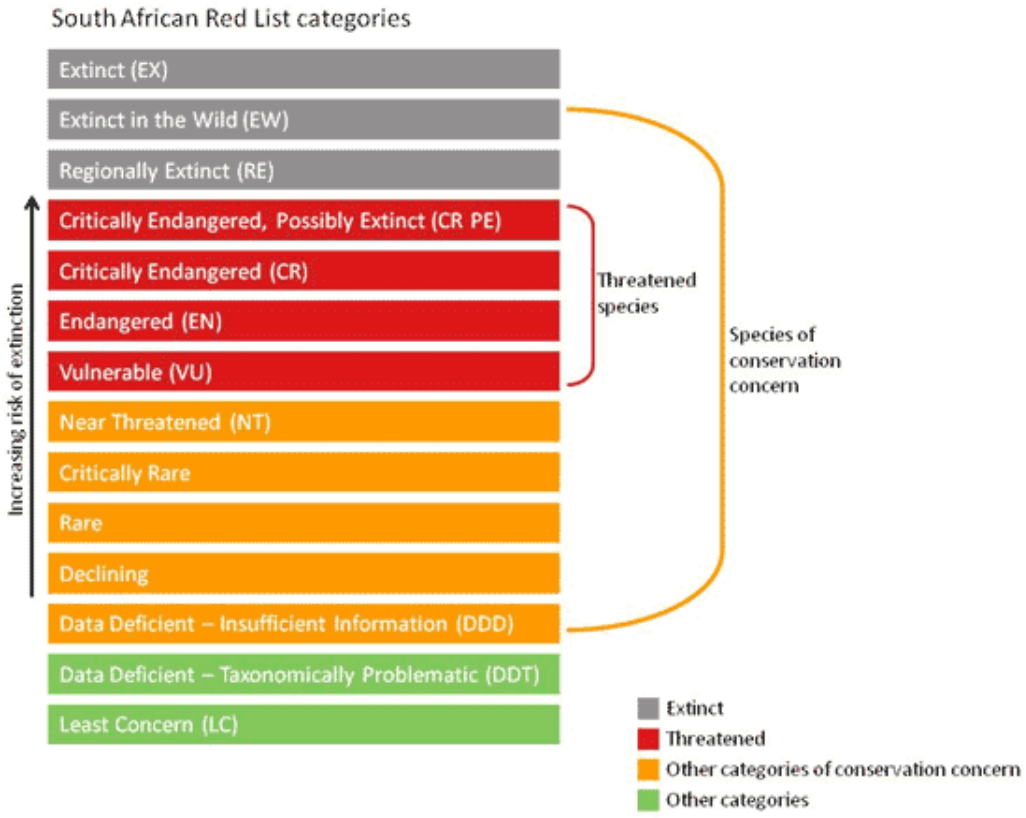
Guidelines for the assessment of Red List species include (but are not necessarily limited to):

- 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.

Mpumalanga Province comprises 4,256 plant species of which 276 are included in the following conservation categories:

- 1 Extinct;
- 30 Endangered;
- 80 Vulnerable;
- 36 Near Threatened;
- 2 Critically Rare;
- 47 Rare;
- 25 Declining;
- 19 DDD; and
- 36 DDT.

Figure 8: South African Red List Categories (courtesy of SANBI)



In addition, provincially protected species are also included in the list of conservation important plants (Mpumalanga Nature Conservation Act N0. 10 of 1998) (MCA). Data records indicate the presence of approximately 48 plant species of conservation importance within the ¼-degree grid that is sympatric to the study site (refer **Table 4**).

Table 4: Conservation important taxa recorded in the region (POSA, 2009)

Binomial Name	***Family***	***Status***
Adenia digitata	Passifloraceae	MCA (Schedule 11)
Alepidea peduncularis	Apiaceae	Data Deficient
Aloe aculeata	Asphodelaceae	MCA (Schedule 11)
Aloe arborescens	Asphodelaceae	MCA (Schedule 11)
Aloe castanea	Asphodelaceae	MCA (Schedule 11)
Aloe verecunda	Asphodelaceae	MCA (Schedule 11)
Aloe zebrina	Asphodelaceae	MCA (Schedule 11)
Bonatea antennifera	Orchidaceae	MCA (Schedule 11)
Brachycorythis ovata subsp. *ovata*	Orchidaceae	MCA (Schedule 11)
Brachycorythis tenuior	Orchidaceae	MCA (Schedule 11)
Brachystelma circinatum	Apocynaceae	MCA (Schedule 11)
Brachystelma nanum	Apocynaceae	MCA (Schedule 11)
Brachystelma rubellum	Apocynaceae	MCA (Schedule 11)
Callilepis leptophylla	Asteraceae	Declining
Crinum bulbispermum	Amaryllidaceae	Declining
Crinum graminicola	Amaryllidaceae	MCA (Schedule 11)
Crinum macowanii	Amaryllidaceae	Declining
Encephalartos lanatus	Zamiaceae	Near Threatened

Table 4: Conservation important taxa recorded in the region (POSA, 2009)		
Binomial Name	***Family***	***Status***
Eucomis autumnalis subsp. *clavata*	Hyacinthaceae	Not Evaluated
Faurea saligna	Proteaceae	MCA (Schedule 11)
Gladiolus crassifolius	Iridaceae	MCA (Schedule 11)
Gladiolus elliotii	Iridaceae	MCA (Schedule 11)
Gladiolus longicollis subsp. *platypetalus*	Iridaceae	MCA (Schedule 11)
Gladiolus permeabilis subsp. *edulis*	Iridaceae	MCA (Schedule 11)
Gladiolus vinosomaculatus	Iridaceae	MCA (Schedule 11)
Habenaria epipactidea	Orchidaceae	MCA (Schedule 11)
Habenaria falcicornis subsp. *caffra*	Orchidaceae	MCA (Schedule 11)
Habenaria filicornis	Orchidaceae	MCA (Schedule 11)
Habenaria galpinii	Orchidaceae	MCA (Schedule 11)
Habenaria tridens	Orchidaceae	MCA (Schedule 11)
Hesperantha coccinea	Iridaceae	MCA (Schedule 11)
Huernia kirkii	Apocynaceae	MCA (Schedule 11)
Huernia loeseneriana	Apocynaceae	MCA (Schedule 11)
Huernia stapelioides	Apocynaceae	MCA (Schedule 11)
Hypoxis hemerocallidea	Hypoxidaceae	Declining
Ilex mitis var. *mitis*	Aquifoliaceae	Declining
Khadia carolinensis	Mesembryanthemaceae	Vulnerable
Kniphofia ensifolia subsp. *ensifolia*	Asphodelaceae	MCA (Schedule 11)
Kniphofia porphyrantha	Asphodelaceae	MCA (Schedule 11)
Myrothamnus flabellifolius	Myrothamnaceae	Data Deficient
Pachycarpus suaveolens	Apocynaceae	Vulnerable
Pavetta zeyheri subsp. *middelburgensis*	Rubiaceae	Rare
Protea roupelliae subsp. *roupelliae*	Proteaceae	MCA (Schedule 11)
Protea welwitschii	Proteaceae	MCA (Schedule 11)
Satyrium cristatum var. *cristatum*	Orchidaceae	MCA (Schedule 11)
Satyrium hallackii subsp. *ocellatum*	Orchidaceae	MCA (Schedule 11)
Stapelia gettliffei	Apocynaceae	MCA (Schedule 11)
Zantedeschia albomaculata subsp. *macrocarpa*	Araceae	MCA (Schedule 11)

7.3.2 Survey Results (January 2013)

The following conservation important plant taxa were recorded during the survey period.

Table 5: Conservation important taxa recorded on the study site (Mpumalanga Nature Conservation Act)		
Binomial Name	***Family***	***Colloquial Name***
Boophone disticha	Amaryllidaceae	Bushman Poison Bulb (e), Gifbol (a) (Declining)
Gladiolus ecklonii	Iridaceae	Common Speckled Gladiolus (e), Spikkel Gladiolus (a)
Gladiolus vinosomaculatus	Iridaceae	Gladiola
Watsonia species	Iridaceae	--
Protea welwitschii	Proteaceae	--

The number of conservation important species recorded within the study site during the brief survey period, is a reflection of the pristine nature of most of the vegetation encountered in the study site. It also reflects the pristine nature of the vegetation on a larger (local and regional scale), as well as the sensitivity of the regional vegetation type (Rand Highveld Grassland, Endangered). Considering the brief nature of the survey, the pristine nature of the vegetation and the number of conservation important species that are known to occur in the immediate region, it is highly likely that additional conservation important species will be recorded in the

study site should subsequent surveys be conducted that include a variation of seasonal conditions and interludes.

7.3.3 Weeds and Invasive Plants

The presence of numerous weeds and poor quality species strongly reflects the transformed and degraded nature of much of the study site, with particular reference to the agricultural fields. The following weeds and invasive plant taxa were recorded within the study site:

Table 6: Common weeds and invasive plant species recorded on the study site

Taxon	*Colloquial Name*	*Status/ Uses*
Acacia mearnsii	Declared Invader - Category 2	Black Wattle (e), Swartwattel (a)
Alternanthera pungens	Weed, pioneer species	Khaki Weed (e), Dubbeltjie (a)
Amaranthus hybridus	Naturalised exotic, edible parts	Pigweed (e), Misbredie (a)
Cosmos bipinnatus	Weed, exotic (S. America), aesthetic uses	Cosmos (e), Kosmos (a)
Bidens pilosa	Naturalised exotic, edible parts	Black-jack (e), Knapsekêrel (a)
Campuloclinium macrocephalum	Declared Invader - Category 1, Noxious weed	Pom Pom Weed (e), Pompom bossie (a)
Cirsium vulgare	Declared Invader - Category 1B, weed	Scottish thistle (e), Skotse dissel (a)
Conyza bonariensis	Weed, indicator of disturbed areas	Flax-leaf Fleabane (e), Kleinskraalhans (a)
Conyza podocephala	Weed, indicator of disturbed areas	Bakbossie (a)
Cyperus esculentus	Weed, edible parts (tuber)	Yellow nutsedge (e), Geeluintjie (a)
Datura stramonium	Declared Invader - Category 1B, weed	Common thorn apple (e)
Gomphrena celosioides	Weed, South America	Bachelor's button (e), Mierbossie (a)
Pennisetum clandestinum	Invader (E. Africa), palatable grazing	Kikuyu Grass (e), Kikoejoegras (a)
Persicaria lapathifolia	Indicator of moist conditions, Naturalised exotic	Spotted Knotweed (e), Hanekam (a)
Pseudognaphalium luteo-album	Weed (Europe)	Jersey Cudweed (e), Roerkruid (a)
Schkuhria pinnata	Medicinal uses, weed (S. America)	Dwarf Marigold (e), Bitterbossie (a)
Seriphium plumosum	Invasive properties	Bankrupt bush (e), Bankrotbos (a)
Solanum mauritianum	Declared Invader - Category 1B	Bugweed (a), Groot Bitterappel (a)
Solanum nigrum	Weed	Black Berry (e), Nastergal (a)
Solanum sisymbriifolium	Declared Invader - Category 1B	Wild tomato (e), Doringbitterappel (a)
Trifolium africanum	Weed of damp and disturbed places	Wild clover (e), Wildeklawer (a)
Typha capensis	Cosmopolitan weed, edible parts, medicinal uses	Bulrush (e), Papkuil (a)
Verbena bonariensis	Declared Invader - Category 1B, Weed (S. America)	Purple Top (e), Blouwaterbossie (a)

The relative high number of weeds and invasive species (although not being abundant) provide some indication of the degraded nature of small portions of the study site. The control and removal of alien and invasive plant species from the site is recommended as per the Conservation of Agricultural Resources Act (Act No. 43 of 1983).

7.4 VEGETATION DEVELOPMENT DRIVERS

Development of the regional (natural) vegetation is generally the result of complex interacting driving forces that include climatic-, geological (soil), topographical- and moisture gradients typical of the grassland regions of southern Africa. The study site and the general surrounds is characterised by extensive transformation that resulted from agriculture, residential and urban development and mining activities. Additionally, some degradation of remaining natural grassland is evident on a local and regional scale, resulting from livestock farming and suboptimal management strategies (fire management) that tend to result in irreversible changes to the herbaceous layer (*also refer to Section 6.2 for comments pertaining to the capturing and representation of natural grasslands in available infobases*). These changes are reflected in species changes of the grass sward, indicating a moderate divergence from the 'normal' composition of the primary grassland habitat (Rand Highveld Grassland, Section 7.1). Remaining natural grassland of the study site is however highly representative of the regional grassland vegetation, representing a primary climax status.

Wetland related and ephemeral grassland habitat, reflecting regional vegetation patterns (primary grassland), comprises some portions of the study site; moderate to severe degradation is caused by livestock grazing and historic utilisation patterns. Development of wetland communities and variations are driven by the 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 is likely to be driven by topographical placement, slopes, extent of surface rocks and outcrops and local soil characteristics. Variation in moisture content and the inundation of soils on a periodic or permanent nature results in a gradient between wetland and terrestrial grasslands that is characterised by the absence/ presence and abundance of specific species (flora and fauna).

7.5 MACRO HABITAT TYPES & VARIATIONS

Remaining natural (untransformed) vegetation of the study site is regarded representative of the regional vegetation type (Rand Highveld Grassland). While limited to severe divergence from the original species composition, diversity and vegetation structure (described by Mucina and Rutherford, Vegmap, 2006) is noted, most of the original elements of the original grassland remain. Zonality of natural habitat of the study site is represented by the interplay of terrestrial and wetland related grassland habitat types, while deterioration of parts of the terrestrial grassland types is noted. Results of the photo analysis and site observations revealed the presence of the following macro habitat types, communities and variations[5] (refer **Figure 10**):

- Degraded & Transformed Areas, including
  - Degraded Grassland;
  - Transformed Habitat; and
- Wetland Habitat, including:
  - Channelled Valley Bottoms;
  - Mesic Grasslands; and
- Rocky Grassland.

[5] Since important floristic habitat types and variations are present in close vicinity, or adjacent to, the proposed development areas, the mapping of vegetation units was done to incorporate most of the surrounding habitat

7.5.1 Degraded & Transformed Habitat

Areas included in this category are characterised by the atypical and degraded (or altered) nature of the vegetation present within these areas.

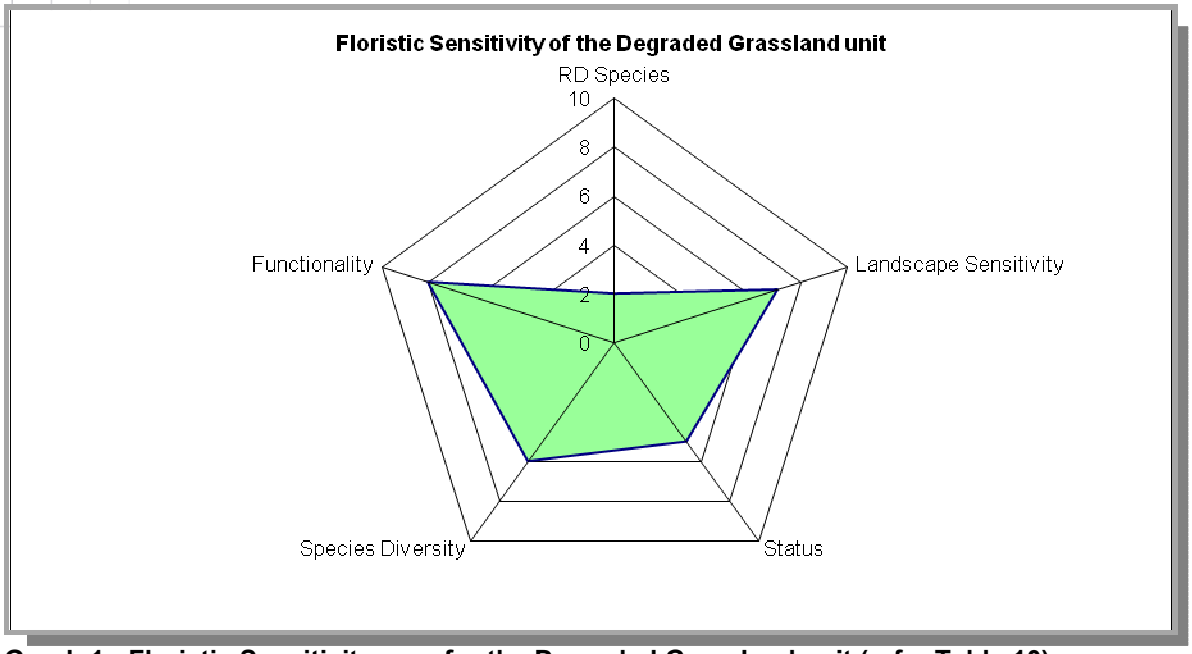
- **Degraded Grassland**

It would appear as if parts of the study site were historically, but for only a relative short period, subjected to some form of agricultural activity. While the physiognomy of this unit does not vary significantly from the surrounding, pristine grasslands, a marked difference is noted in the floristic composition, more particularly the absence of several climax grasses and forbs. Also of importance is the variation in interspecific dominance values recorded in this variation. Degraded grasslands, such as these portions, are frequently dominated by a low number of species (typically in the 3, 4 or 5 cover abundance categories), *i.e.* two or three species tend to dominate in certain areas, occurring in abundance. This is in contrast with pristine grasslands where there is normally a higher number of co-dominant species are recorded, *i.e.* more species occurring together at lower abundance values (typically ranging between 1, 2A and 2B cover abundance values).

The low occurrence of surface rock in these areas is probably another reason why agriculture was attempted in these areas. The short period of disturbance is assumed due to the presence of several forbs and geophytes that are normally known to be absent in areas that were subjected to prolonged periods of disturbance. It is speculated that the agricultural activity was attempted in order to assess the potential success within these parts, particularly since these areas are located within the grassland seepages and would appear to be conducive for agriculture. However, poor soil qualities probably resulted in meagre success and the lands was left to revert to grasslands.

Noteworthy plants that were recorded in this unit include the grasses *Andropogon eucomus, Aristida junciformis, Eragrostis chloromelas, Eragrostis gummiflua, Hyparrhenia hirta, Melinis repens, Setaria sphacelata, Sporobolus africanus* and *Trichoneura grandiglumis* as well as the forbs *Chenopodium album, Conyza bonariensis, Cyperus esculentus, Helichrysum nudifolium, Lippia javanica, Monopsis decipiens* and *Senecio erubescens*.

A medium floristic status and sensitivity (refer **Graph 1**) is ascribed to these parts, as they could potentially recover to a pristine condition under correct management principles, as well as occurring in close proximity to highly sensitive habitat. Because of the relative degraded nature and the sub climax status of the vegetation, the likelihood of encountering plants of conservation importance is regarded relative low.



Graph 1: Floristic Sensitivity rose for the Degraded Grassland unit (refer Table 10).

- **Transformed Habitat**

Typically, a high degree of transformation of the natural vegetation in these areas is noted due to existing and recent anthropogenic impacts, particularly from adjacent residential developments. Dumping of litter and rubble has resulted in a high disturbance factor within these areas. The vegetation is characterised by a high degree of weeds and poor status plants. In most cases, the original vegetation is entirely transformed and replaced by either infrastructure, stands of exotic trees, crops, or has been degraded beyond any recognition and is devoid of any natural vegetation.

These areas are fortunately limited and occur mostly on the perimeter of the site. Rehabilitation and cleanup operations will greatly assist in the preservation and conservation of the natural grasslands that surround these parts.

Noteworthy forbs recorded in these parts include *Amaranthus hybridus, Cosmos bipinnatus, Bidens pilosa, Cyperus esculentus, Leonotis ocymifolia Phragmites australis, Richardia brasiliensis, Richardia brasiliensis, Solanum sisymbriifolium* and *Tagetes minuta*. The secondary climax grasses *Eragrostis curvula, Hyparrhenia hirta, Hyparrhenia tamba, Melinis repens, Pennisetum clandestinum* and *Sporobolus africanus* were recorded. Sporadic occurrences of the invasive tree *Acacia mearnsii* were also noted.

Because of the transformed nature of the habitat as well as the secondary climax status of the vegetation, a low floristic sensitivity is ascribed to these parts. It should however be noted that, despite the low floristic sensitivity, these areas are not necessarily regarded suitable for development purposes because of the proximity to highly sensitive grassland habitat. Removal of exotic and weedy plants and moderate rehabilitation towards a semi-natural status will result in an important buffer function that these areas will perform between natural vegetation and impacts from surrounding developed areas.

7.5.2 Wetland Habitat Types[6]

This community is characterised by permanently or temporary inundated soils, comprising of channelled valley bottom (rivers/ streams) and the mesic grasslands (hillslope seepages). A schematic diagram of how these systems are frequently positioned in the landscape and the general topography is presented in **Figure 9**.

This concomitance of habitat types is characterised by permanent or periodic waterlogged soil conditions. The vegetation typically comprises an admixture of species associated with nearby wetland types as well as upland terrestrial grasslands.

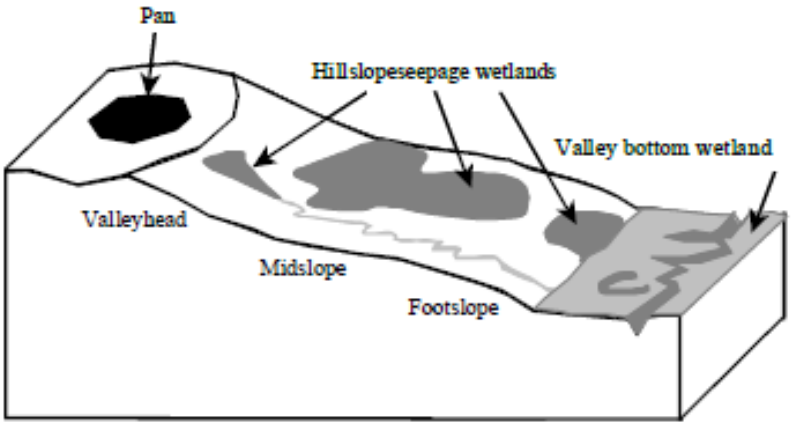


Figure 9: Schematic illustration of the topographical settings of typical wetland types

Wetland habitat of the study site is regarded as being of significant conservation value for the following reasons (De Castro & Brits, 2007):

- Wetlands constitute an important and restricted habitat type for a variety of plants and animals;
- Indigenous riparian vegetation, such as those occurring in the study site, throughout the highveld region of the Mpumalanga Province is under great threat from factors such as alien invasive plant species (Henderson & Musil, 1987), altered hydrological patterns, reduced water quality, ploughing and overgrazing. Any remaining area of untransformed wetland must therefore be regarded as of elevated conservation importance; and
- A river or drainage line is a 'longitudinal ecosystem', and its condition at any point is a reflection not only of all upstream activities within the river/drainage line, but also of all activities in the adjacent and upstream parts of the catchment (O'Keefe, 1986).

- **Channelled Valley Bottoms**

Perennial drainage lines in the study site is characterised by soils types with high clay content (35 – 60 %). This terrain unit typically comprises approximately 5 % of the landscape. Channelled valley bottoms of the study site comprise a narrow drainage line with ill-defined banks and streambeds. These features are also closely associated with valley bottom seepages as well as upland terrestrial grasslands, differentiated by the variation in soil conditions and slopes that results in a varied nature.

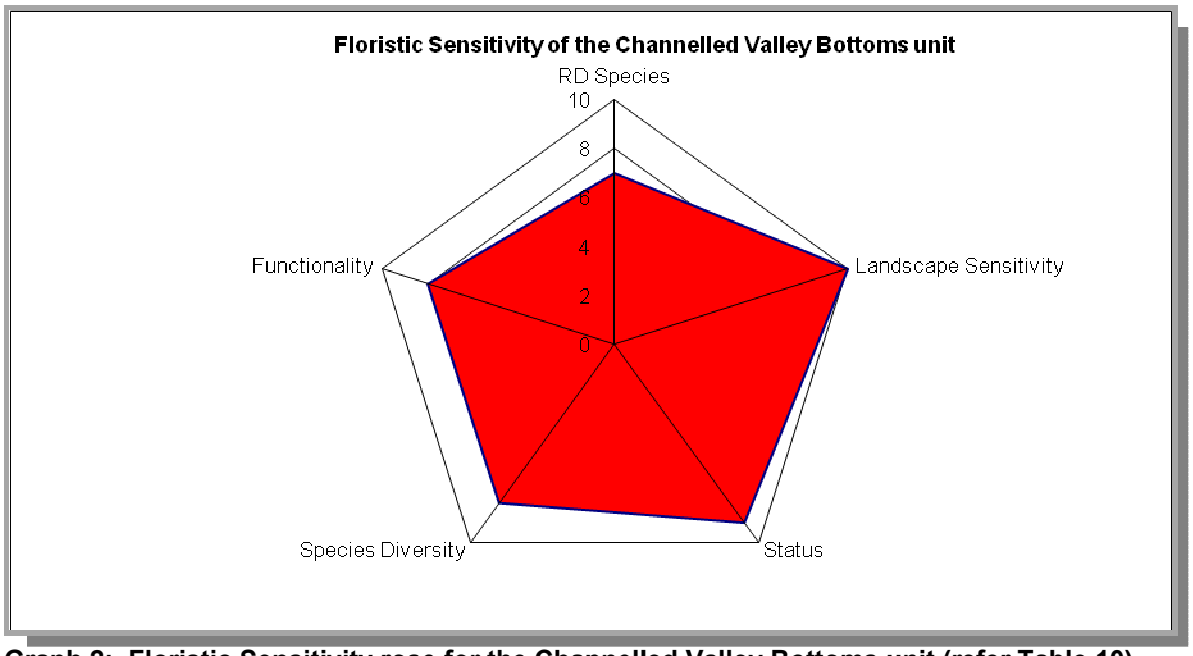
[6] Please note that the delineation of wetland habitat types, as illustrated on the accompanying maps, are not based on soil delineation techniques, as per DWAF guidelines, but are an interpretation of the floristic attributes and visual observations made during the field survey and desktop analysis

Because of the relative narrow width of this unit, the vegetation is not particularly diverse, but nonetheless comprehending dominant grasses and forbs embedded as localised stands. A total of 51 plant species were recorded in this unit, presented in **Table 7**. Geophytes and obligate wetland species occur in this unit, particularly towards the lower parts. Generally, the floristic status of this habitat unit is regarded pristine and only localised areas of deterioration and severe degradation is noted, hence a high conservation status and sensitivity is ascribed this unit (refer **Graph 2**). Taking cognisance of the Red Data species that occur in the region, these areas are regarded highly suitable for the potential occurrence of RD species, although none was recorded during the brief survey period.

Table 7: Plant taxa recorded in the Channelled Valley Bottom of the study site

Family	*Binomial Name*	*Growth Form*
Anacardiaceae	*Searsia lancea*	Tree
Apocynaceae	*Asclepias aurea*	Forb
Asteraceae	*Bidens pilosa*	Forb
	Campuloclinium macrocephalum	Forb
	Cirsium vulgare	Forb
	Haplocarpha scaposa	Forb
	Helichrysum aureonitens	Forb
	Helichrysum setosum	Forb
	Nidorella anomala	Forb
	Pseudognaphalium luteo-album	Forb
	Senecio inornatus	Forb
	Senecio polyodon var. *polyodon*	Forb
	Seriphium plumosum	Shrub
	Tagetes minuta	Forb
Convolvulaceae	*Ipomoea bathycolpos*	Forb
Cyperaceae	*Cyperus digitatus*	Sedge
	Cyperus esculentus	Sedge
	Cyperus solidus	Sedge
	Cyperus species	Sedge
	Fimbristylis species	Sedge
	Fuirena pubescens	Sedge
	Isolepis cernua	Sedge
	Kyllinga alba	Sedge
Fabaceae	*Trifolium africanum*	Forb
Geraniaceae	*Pelargonium luridum*	Geophyte
Lamiaceae	*Leonotis ocymifolia*	Forb
Lobeliaceae	*Monopsis decipiens*	Forb
Poaceae	*Agrostis eriantha*	Grass
	Agrostis lachnantha	Grass
	Andropogon eucomus	Grass
	Aristida aequiglumis	Grass
	Aristida junciformis	Grass
	Cynodon dactylon	Grass
	Eragrostis capensis	Grass
	Eragrostis chloromelas	Grass
	Eragrostis gummiflua	Grass
	Eragrostis plana	Grass
	Hyparrhenia filipendula	Grass
	Hyparrhenia tamba	Grass
	Leersia hexandra	Grass
	Melinis repens	Grass

Table 7: Plant taxa recorded in the Channelled Valley Bottom of the study site		
Family	***Binomial Name***	***Growth Form***
	Panicum aequinerve	Grass
	Paspalum dilatatum	Grass
	Setaria nigrirostris	Grass
Polygonaceae	*Persicaria lapathifolia*	Hydrophilic
Selaginaceae	*Selago densiflora*	Forb
Solanaceae	*Datura stramonium*	Forb
	Solanum mauritianum	Shrub
	Solanum sisymbriifolium	Forb
Verbenaceae	*Verbena bonariensis*	Forb



Graph 2: Floristic Sensitivity rose for the Channelled Valley Bottoms unit (refer Table 10).

- **Mesic Grasslands**

The vegetation of this variation comprehends mesic grasslands in the form of grassland seepages situated on the slopes surrounding the channelled valley bottoms. Surface water is present during periods of the year subsequent to raining events and the vegetation manifests as dense, moribund grasses and cyperoid species, some of which are obligate wetland taxa. Soils that characterise this habitat type are characteristic, comprising a humic A-horizon, frequently an E-horizon and typically a clayey B-horizon of which the clay content varies between 35 and 45%. The clayey B-horizon facilitates retention of water in the top part of the soils, which seeps throughout the year within the humic A-horizon. This wetland variation is also situated on the valley bottom floor (Terrain Unit 4) where the topography is relatively flat, causing the slow drainage of water towards the non-perennial drainage line (channelled valley bottom).

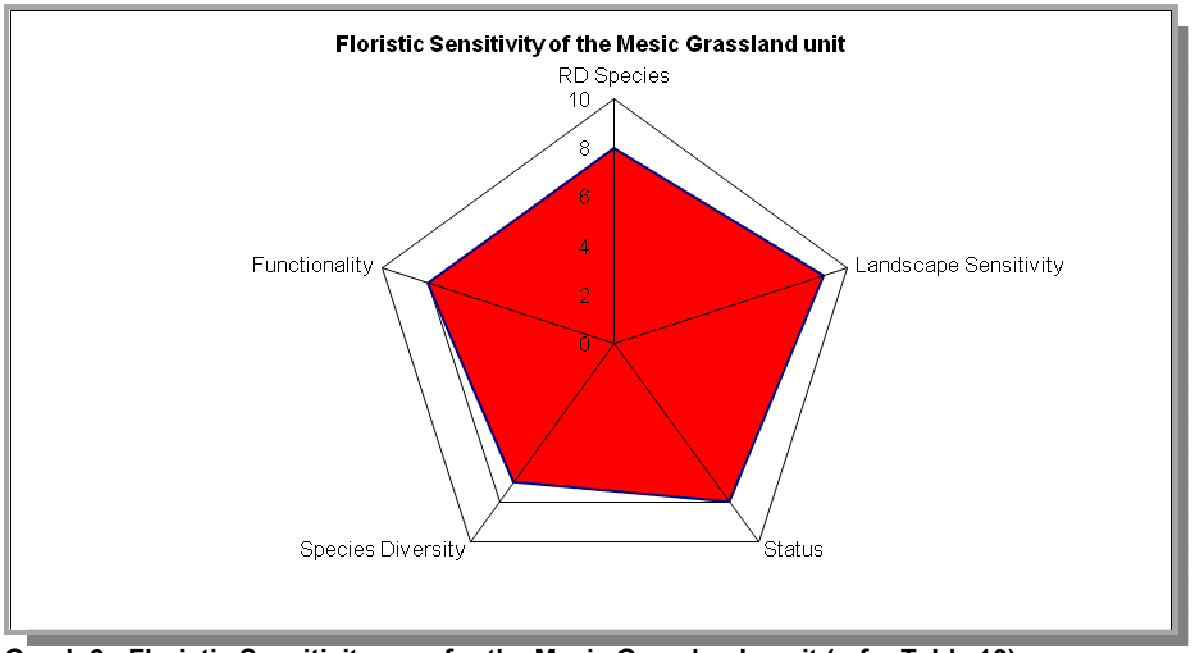
The floristic status of these parts varies greatly across the site; historic agricultural practices caused some damage to the vegetation in some parts. However, the vegetation of most of this habitat type is regarded relatively pristine, exhibiting the normal species composition and abundance values of typical mesic grassland types.

A dominant (sometimes moribund) grass sward and diverse herbaceous component is typical of the vegetation of these parts. Because of the association with the nearby sensitive channelled valley bottoms, a high floristic sensitivity is estimated, specifically because many plant taxa of conservation importance have strong affinity with this type of vegetation (Refer Graph 3). A total of 56 species were recorded in this unit (refer **Table 8**). This high diversity is the result of the ecotonal interface between the valley bottoms and the adjacent terrestrial grasslands. While a relative high percentage of the species composition comprises obligate wetland taxa, a portion of the composition is also strongly associated with the drier upland environs.

Table 8: Plant taxa recorded in the Mesic Grassland type of the study site

Family	***Binomial Name***	***Growth Form***
Anacardiaceae	*Searsia pyroides*	Shrub
Apocynaceae	*Cordylogyne globosa*	Forb
Asteraceae	*Campuloclinium macrocephalum*	Forb
	Conyza bonariensis	Forb
	Haplocarpha scaposa	Forb
	Helichrysum aureonitens	Forb
	Helichrysum nudifolium	Forb
	Helichrysum rugulosum	Forb
	Nidorella anomala	Forb
	Senecio erubescens	Forb
	Senecio inornatus	Forb
	Senecio polyodon var. *polyodon*	Forb
Chenopodiaceae	*Chenopodium album*	Forb
Commelinaceae	*Commelina africana*	Forb
	Cyanotis speciosa	Forb
Crassulaceae	*Crassula capitella*	Succulent
Cyperaceae	*Cyperus esculentus*	Sedge
	Cyperus solidus	Sedge
Fabaceae	*Eriosema cordatum*	Forb
	Pearsonia sessilifolia	Forb
	Tephrosia capensis	Forb
	Trifolium africanum	Forb
Gentianaceae	*Chironia palustris*	Forb
Geraniaceae	*Monsonia angustifolia*	Forb
	Pelargonium luridum	Geophyte
Hypericaceae	*Hypericum aethiopicum*	Forb
Hypoxidaceae	*Hypoxis iridifolia*	Geophyte
	Hypoxis rigidula	Geophyte
Iridaceae	*Watsonia* species	Geophyte
Lamiaceae	*Teucrium trifidum*	Shrub
Liliaceae	*Asparagus* species	Shrub
	Chlorophytum fasciculatum	Geophyte
Lobeliaceae	*Monopsis decipiens*	Forb
Poaceae	*Andropogon eucomus*	Grass
	Aristida junciformis	Grass
	Aristida stipitata	Grass
	Elionurus muticus	Grass
	Eragrostis capensis	Grass
	Eragrostis chloromelas	Grass
	Eragrostis gummiflua	Grass
	Eulalia villosa	Grass
	Heteropogon contortus	Grass

Table 8: Plant taxa recorded in the Mesic Grassland type of the study site		
Family	***Binomial Name***	***Growth Form***
	Hyparrhenia hirta	Grass
	Hyparrhenia tamba	Grass
	Melinis repens	Grass
	Panicum coloratum	Forb
	Paspalum distichum	Grass
	Perotis patens	Grass
	Schizachyrium sanguineum	Grass
	Setaria sphacelata	Grass
	Sporobolus africanus	Grass
	Themeda triandra	Grass
	Trichoneura grandiglumis	Grass
	Tristachya leucothrix	Grass
Rubiaceae	*Anthospermum rigidum*	Forb
Verbenaceae	*Lippia javanica*	Shrub



Graph 3: Floristic Sensitivity rose for the Mesic Grasslands unit (refer Table 10).

7.5.3 Rocky Grassland Habitat

Terrestrial grasslands comprise natural grasslands situated in upland positions (topographical unit 3), characterized by a short, low cover of herbaceous species, physiognomically dominated by grasses, but with a high diversity of forbs. A high degree of rockiness is characteristic of this unit, varying between 75% and 30% cover and manifesting as surface outcrops, rarely higher than 1m. This community comprehends the natural terrestrial grassland habitat of the study site and is regarded highly representative of the regional ecological type (Rand Highveld Grassland). The exceptional diversity recorded in this unit attests to the regional diversity of the grasslands; a total of 134 species was recorded during the brief survey (refer **Table 9**).

The status of this grassland is currently in a primary climax status, as is attested to by the species composition recorded within this unit. Previous investigations conducted by De Castro and Brits (2007) found that the dominant species within this unit include the grasses *Aristida junciformis, Themeda triandra, Loudetia simplex,*

Eragrostis racemosa and *Schizachyrium sanguineum*. Thatch grass (*Hyparrhenia hirta*), occur sporadically, but may be locally dominant in disturbed patches. Other common grass species include *Brachiaria serrata, Panicum natalense, Melinis nerviglumis, Monocymbium cerisiiforme, Diheteropogon amplectens, Trachypogon spicatus, Digitaria monodactyla, Elionurus muticus, Sporobolus stapfianus* and *Microchloa caffra. Bulbostylis contexta* is a common forb that is occasionally a localised dominant. Other noteworthy forbs include *Oxygonum dregeanum*, *Xerophyta retinervis*, *Dicoma anomala*, *Chascanum hederaceum*, *Gnidia capitata, Parinari capensis, Anthospermum rigidum, Pygmaeothamnus zeyheri, Hemizygia pretoriae, Acrotome hispida, Senecio venosus, Zornia linearis, Pentanisia angustifolia, Pearsonia sessilifolia, Acalypha angustata, Tephrosia lupinifolia, Hypoxis rigidula, Gazania krebsiana* and *Vernonia galpinii*. In areas characterised by high rockiness, a low 'shrubland' community may be found dominated by *Lopholaena coriifolia* and *Protea welwitschii*.

The conservation status of these grasslands, on a regional scale, is regarded 'Endangered' (Rand Highveld Grassland). All natural grassland habitats within the study site where the species composition and floristic character approximates that of the regional vegetation type is therefore regarded sensitive. The natural grassland habitat of the region represents the major floristic unit and other variations, such as outcrops and wetland related habitat, are embedded within this unit. It is therefore reasonable to assume that the highest proportion of ecological services will be performed by this unit. The importance of terrestrial grasslands in terms of moisture retention and other aquatic services to the catchment can therefore not be overemphasised. In addition, the following contributing factors render the floristic sensitivity of this habitat high:

- Few unfragmented areas of untransformed grassland remain within the region of the highveld within which the study site is situated. Grasslands are considered a threatened vegetation type due to extensive transformation on a local and national scale (Hoare & Wessels 2000; van Wyk 1998; Driver et al. 2005). Rocky grassland of this particular site therefore represents a poorly conserved and threatened vegetation type;
- The grassland is linked to an area of grassland that includes the Witbank Nature Reserve, consequently forming part of continuous grassland vegetation that has high regional conservation value. The maintenance of this uninterrupted grassland represents a much more viable conservation unit than any fragmented portions and
- The grassland vegetation on site has a high local species richness (α-diversity) and there is high habitat variability leading to high overall species richness within the vegetation (De Castro & Brits, 2007).

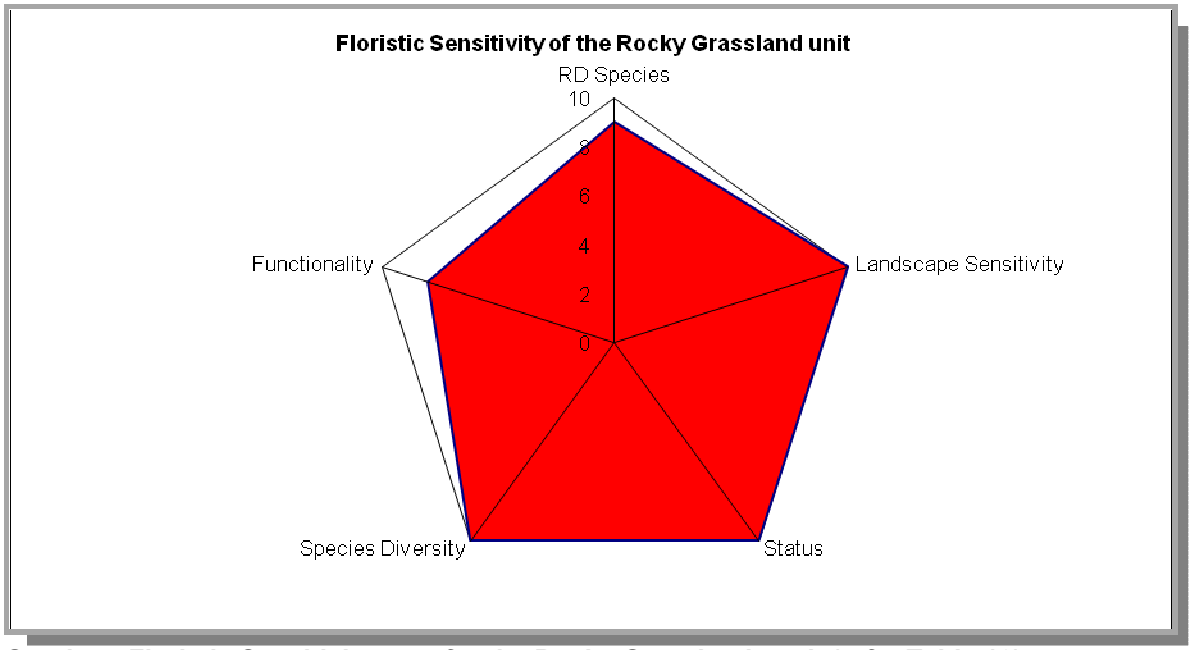
Table 9: Plant taxa recorded in the Rocky Grassland habitat type

Family	***Binomial Name***	***Growth Form***
Acanthaceae	*Justicia anagalloides*	Forb
Adianthaceae	*Pellaea calomelanos*	Fern
Aizoaceae	*Psammotropha myriantha*	Forb
Amaranthaceae	*Alternanthera pungens*	Forb
	Gomphrena celosioides	Forb
	Kyphocarpa angustifolia	Forb
Amaryllidaceae	***Boophone disticha***	**Geophyte**
Anacardiaceae	*Searsia magalismontana*	Shrub
	Searsia pyroides	Shrub
Apiaceae	*Peucedanum magalismontanum*	Forb
Apocynaceae	*Asclepias eminens*	Forb
	Aspidoglossum lamellatum	Forb
	Brachystelma species	Forb

Table 9: Plant taxa recorded in the Rocky Grassland habitat type		
Family	***Binomial Name***	***Growth Form***
	Xysmalobium undulatum	Shrub
Asteraceae	*Berkheya insignis*	Forb
	Bidens pilosa	Forb
	Castalis spectabilis	Forb
	Conyza podocephala	Forb
	Dicoma anomala	Forb
	Euryops laxus	Forb
	Felicia muricata	Forb
	Gazania krebsiana	Forb
	Helichrysum aureonitens	Forb
	Helichrysum chionosphaerum	Forb
	Helichrysum coriaceum	Forb
	Helichrysum dasymallum	Forb
	Helichrysum nudifolium	Forb
	Helichrysum rugulosum	Forb
	Helichrysum species	Forb
	Hilliardiella oligocephala	Forb
	Lactuca inermis	Forb
	Lopholaena coriifolia	Shrub
	Nidorella anomala	Forb
	Nidorella hottentotica	Forb
	Senecio inornatus	Forb
	Senecio venosus	Forb
	Seriphium plumosum	Shrub
Caesalpiniaceae	*Chamaecrista comosa*	Forb
Capparaceae	*Dianthus mooiensis*	Forb
Chrysobalanaceae	*Parinari capensis*	Forb
Commelinaceae	*Commelina africana*	Forb
	Cyanotis speciosa	Forb
Convolvulaceae	*Ipomoea crassipes*	Forb
	Ipomoea ommanneyi	Forb
Crassulaceae	*Crassula capitella*	Succulent
	Crassula setulosa	Succulent
Cucurbitaceae	*Cucumis zeyheri*	Forb
Cyperaceae	*Bulbostylis contexta*	Sedge
	Cyperus esculentus	Sedge
	Cyperus rupestris	Sedge
Ebenaceae	*Diospyros lycioides*	Shrub
Euphorbiaceae	*Acalypha angustata*	Forb
	Euphorbia clavarioides	Succulent
	Euphorbia striata	Forb
Fabaceae	*Acacia karroo*	Tree
	Elephantorrhiza elephantina	Shrub
	Eriosema cordatum	Forb
	Indigofera zeyheri	Forb
	Lotononis calycina	Forb
	Lotononis foliosa	Forb
	Pearsonia cajanifolia subsp. *cajanifolia*	Shrub
	Pearsonia sessilifolia	Forb
	Sphenostylis angustifolia	Forb
	Tephrosia capensis	Forb
	Tephrosia lupinifolia	Forb

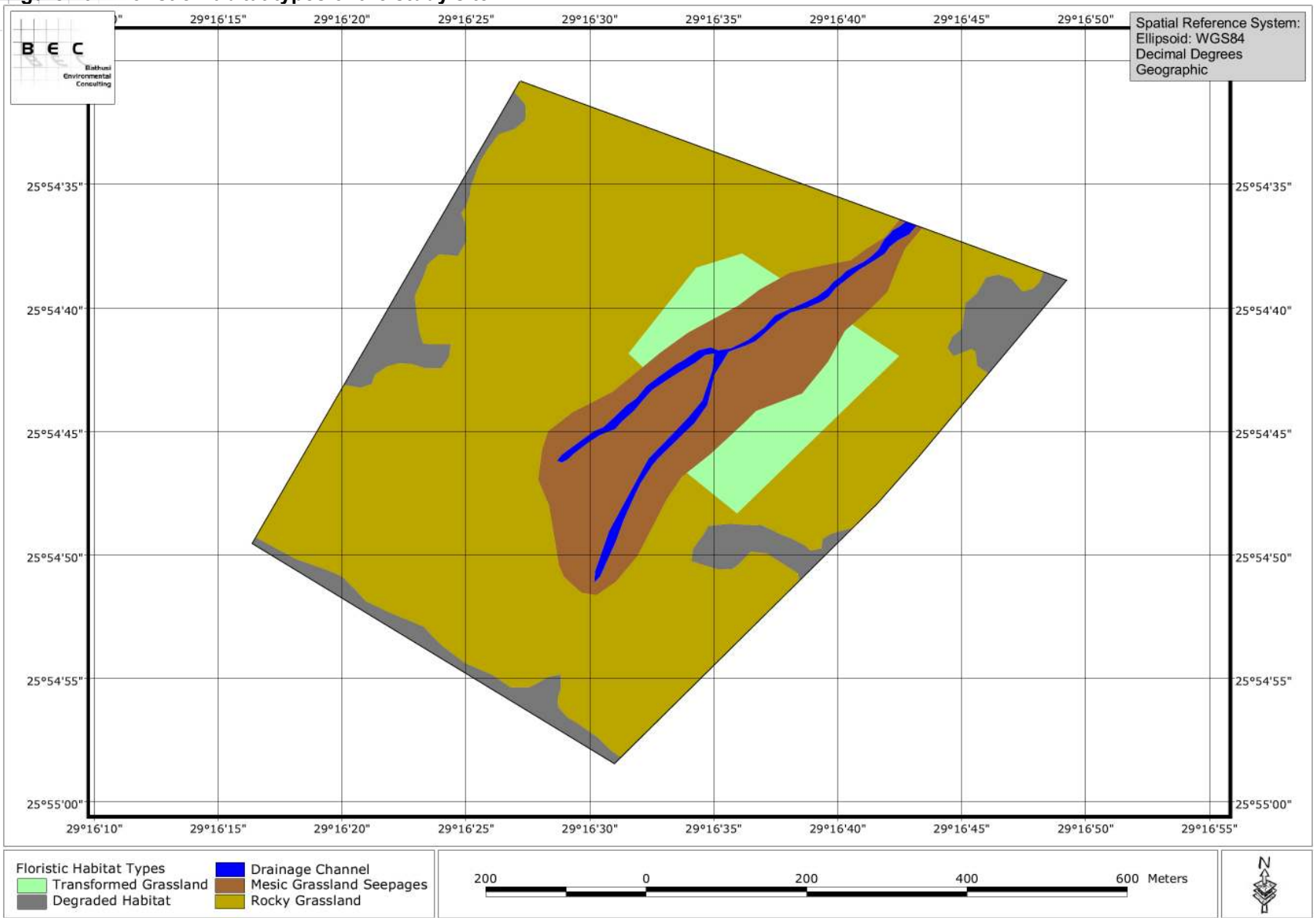
Table 9: Plant taxa recorded in the Rocky Grassland habitat type		
Family	***Binomial Name***	***Growth Form***
	Zornia linearis	Forb
Hypoxidaceae	*Hypoxis iridifolia*	Geophyte
	Hypoxis obtusa	Geophyte
	Hypoxis rigidula	Geophyte
Illebracaceae	*Pollichia campestris*	Shrub
Iridaceae	***Gladiolus ecklonii***	**Geophyte**
	Gladiolus vinosomaculatus	**Geophyte**
	Lapeirousia sandersonii	Geophyte
Lamiaceae	*Becium obovatum*	Forb
	Stachys species	Forb
	Syncolostemon pretoriae	Forb
Liliaceae	*Asparagus* species	Shrub
	Dipcadi species	Geophyte
	Eriospermum abyssinicum	Geophyte
	Ledebouria ovatifolia	Geophyte
	Ledebouria revoluta	Geophyte
	Ledebouria species	Geophyte
Lobeliaceae	*Monopsis decipiens*	Forb
Oxalidaceae	*Oxalis obliquifolia*	Geophyte
Periplocaceae	*Raphionacme hirsuta*	Forb
	Raphionacme species	Forb
Poaceae	*Andropogon schirensis*	Grass
	Aristida aequiglumis	Grass
	Brachiaria serrata	Grass
	Ctenium concinnum	Grass
	Cymbopogon pospischilii	Grass
	Cynodon dactylon	Grass
	Digitaria monodactyla	Grass
	Diheteropogon amplectens	Grass
	Elionurus muticus	Grass
	Eragrostis chloromelas	Grass
	Eragrostis gummiflua	Grass
	Eragrostis nindensis	Grass
	Eragrostis plana	Grass
	Eragrostis racemosa	Grass
	Hyparrhenia hirta	Grass
	Hyparrhenia tamba	Grass
	Loudetia simplex	Grass
	Melinis repens	Grass
	Microchloa caffra	Grass
	Monocymbium ceresiiforme	Grass
	Panicum natalense	Grass
	Pennisetum clandestinum	Grass
	Schizachyrium sanguineum	Grass
	Sporobolus africanus	Grass
	Sporobolus pectinatus	Grass
	Themeda triandra	Grass
	Trachypogon spicatus	Grass
	Tristachya rehmannii	Grass
	Urelytrum agropyroides	Grass
Polygonaceae	*Oxygonum dregeanum*	Forb
Proteaceae	*Protea welwitschii*	Shrub

Table 9: Plant taxa recorded in the Rocky Grassland habitat type		
Family	***Binomial Name***	***Growth Form***
Rhamnaceae	*Ziziphus mucronata*	Shrub
Rubiaceae	*Anthospermum rigidum*	Forb
	Oldenlandia herbacea	Forb
	Pentanisia angustifolia	Forb
	Pygmaeothamnus chamaedendrum	Forb
	Richardia brasiliensis	Forb
Scrophulariaceae	*Striga bilabiata*	Parasite
Selaginaceae	*Hebenstretia comosa*	Forb
	Selaginella dregei	Hydrophilic
Solanaceae	*Solanum lichtensteinii*	Forb
	Solanum nigrum	Forb
	Solanum sisymbrifolium	Forb
Thymelaeaceae	*Gnidia capitata*	Forb
	Gnidia sericocephala	Forb
	Gnidia species	Forb
Velloziaceae	*Xerophyta retinervis*	Geophyte
Verbenaceae	*Chascanum hederaceum*	Forb



Graph 4: Floristic Sensitivity rose for the Rocky Grasslands unit (refer Table 10).

Figure 10: Floristic Habitat types of the study site



7.6 FLORISTIC SENSITIVITY OF THE STUDY SITE

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:** 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.

Botanical sensitivity values are presented in **Table 10**. These estimations are used to ascribe a sensitivity index value to units of the respective variations, illustrated in **Figure 11**. 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 include 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:

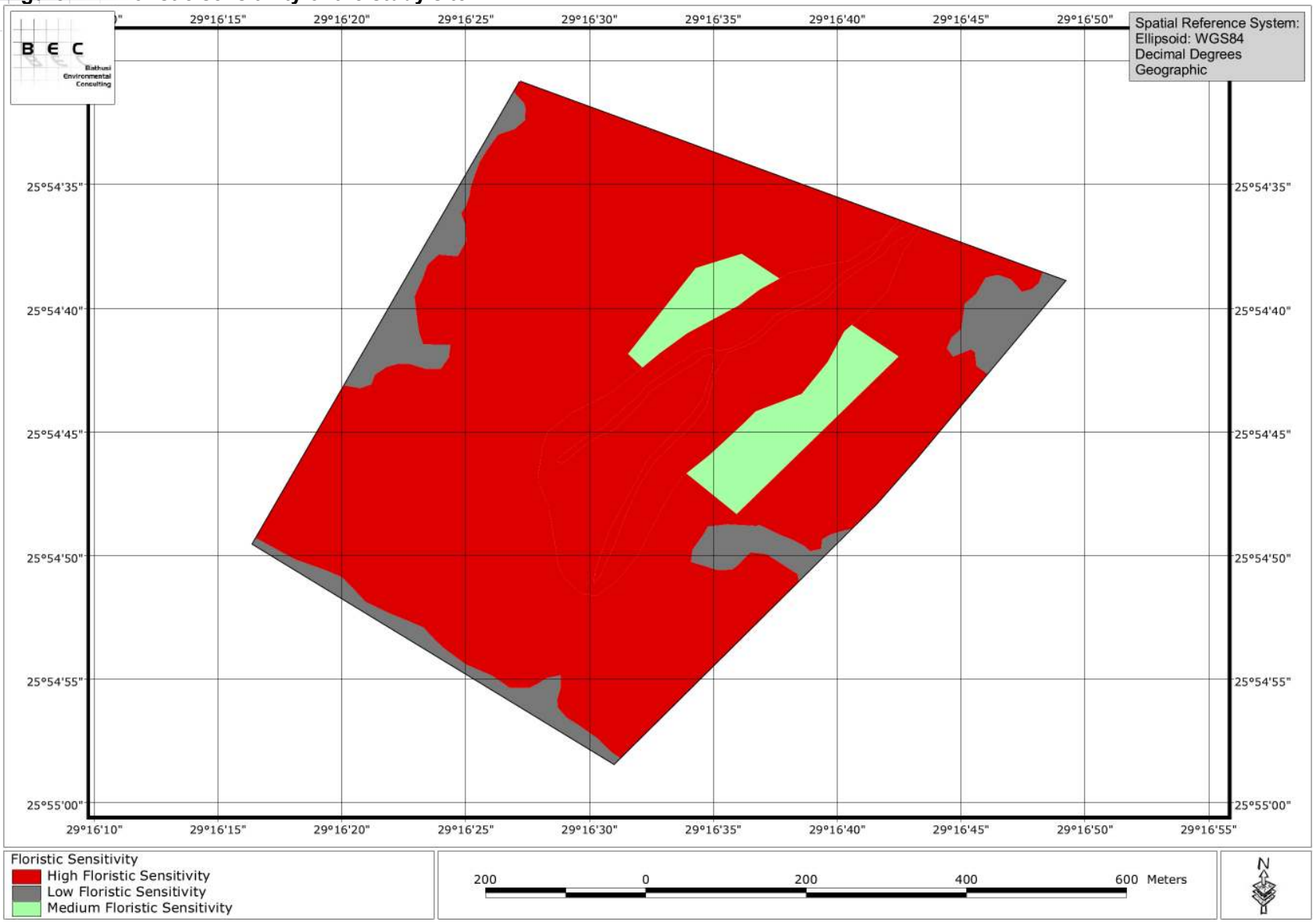
- The presence of plant species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable);
- Areas where 'threatened' plants are known to occur, or habitat that is highly suitable for the presence of these species;
- Regional vegetation types that 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).

Table 10: Floristic sensitivity estimations for the respective habitat types								
Criteria	***RD species***	***Landscape sensitivity***	***Status***	***Species diversity***	***Functionality/ fragmentation***	***TOTAL***	***SENSITIVITY INDEX***	***SENSITIVITY CLASS***
Community	**Criteria Ranking**							
Channelled Valley Bottoms	7	10	9	8	8	268	84%	**high**
Degraded Grassland	2	7	5	6	8	160	50%	**medium**
Mesic Grassland	8	9	8	7	8	259	81%	**high**
Rocky Grassland	9	10	10	10	8	304	95%	**high**
Transformed Areas	1	2	1	3	1	50	16%	**low**

A map depicting the floristic sensitivity of the study site is presented in **Figure 11**.

Figure 11: Floristic sensitivity of the study site



7.7 DISCUSSION

The study site comprises a relatively small portion (approximately 40 ha) of pristine grassland situated adjacent to several existing and planned urban developments in the Emalahleni Municipality. In spite of a high level of transformation and degradation of the immediate surrounds, the vegetation of this portion of grassland exhibits sensitive and important attributes of pristine Rand Highveld Grassland, which is an endangered vegetation type. Characteristics of the vegetation include a high diversity of plants, particularly those that are normally associated with pristine highveld grassland ecotypes. Several protected plant species were also recorded during the brief survey, enhancing the sensitivity and importance of this land, particularly in view of continued local and regional transformation.

Habitat types identified on this site conforms to the natural types of the grassland; terrestrial grasslands typified by a high degree of rockiness, mesic grasslands that are inundated periodically during the raining season and wetland habitat that contains a high degree of obligate wetland taxa. Small portions of degraded grassland reveal the effect of historic agricultural attempts and recent anthropogenic impacts, but have since reverted to secondary climax grassland. This portion of grassland, in spite of surrounding transformation and development pressures, is functioning ecologically effective, performing critical supporting roles for adjacent (continuous) natural habitat.

Importantly, the Mpumalanga Biodiversity Conservation Plan categorised this portion of land as 'Highly Significant' (also situated within an Ecological Corridor), and developments within this category is regarded 'Restricted'. Local and regional conservation efforts (including the Bankenveld Proposed Conservancy, Witbank Nature Reserve, Bankenveld Conservancy) should be included in this effort and much of the conservation goals and aims can be achieved by inclusion of this portion of land in the adjacent conservancies, providing the land with a declared conservation status.

A high floristic sensitivity and conservation status is consequently ascribed to this portion of land, not only because of the pristine nature of much of the vegetation persisting on the site, but also because of sustained pressure from surrounding development and activities that results in habitat loss and transformation on a local and regional scale. It is therefore important to prioritise the conservation of this land (and other similar portions) by means of the implementation of two important conservation principles:

- Prevention of transformation and implementing a conservation and management strategy in order to ensure the longevity of the ecological characteristics on this site and
- Ensuring sufficient connectivity with adjacent natural habitat in order to ensure ecological functionality.

Should the proponent wish to proceed with the application, it is strongly recommended that a Biodiversity Offset be included as part of the submission of documents to the authorities for consideration of the EIR. Details of such a Biodiversity Offset should flow from an Offset Assessment that takes cognisance of the type of habitat that will be transformed, local and regional conservation efforts and the perceived sensitivity of the affected environment, ultimately making pertinent recommendations to the location and type of area suggested as a suitable offset. Determination of an offset ratio is also a critical component of such a study. Guidelines and recommendations for a suitable Biodiversity Offset should preferably form part of the.

Considering the type of development (residential), mitigation of impacts within the terrestrial environment (which will form the focus of the proposed development) is not perceived as possible. The type of development implies the complete destruction of all terrestrial ecological attributes on the site, Because

wetland habitat cannot be developed as such, mitigation measures should provide for the management and protection of the wetland related habitat and required buffer zones (please refer to the wetland ecological report for suitable comments).

Should this application, including the Biodiversity Offset guidelines and recommendations, be viewed in a positive light by the authorities, mitigation measures must also aim to provide adequate and sufficient protection for adjacent natural terrestrial and aquatic habitat against peripheral and indirect impacts resulting from development of this portion of land. Casual observations of surrounding natural grasslands revealed a similar floristic status to this site. It is therefore reasonable to assume that a similar sensitivity can be ascribed to these areas. It is therefore critical to afford these portions of land adequate and effective protection against possible and likely impacts.

8 FAUNAL ASSESSMENT

8.1 REGIONAL FAUNAL DIVERSITY

Biological diversity everywhere is at great risk as a direct result of an ever-expanding human population and its associated needs for energy, water, food and minerals. Landscape transformation that is needed to accommodate these activities inevitably leads to habitat loss and habitat fragmentation, resulting in the mosaical appearance of undisturbed habitat within a matrix of transformed areas. These remaining areas of natural habitat are frequently too small to support the biodiversity that previously occupied the area and the region loses its ecological integrity (Kamffer 2004). Grasslands are the habitat of large herds of antelope, as well as many smaller animals, but are currently one of the most threatened in South Africa; 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).

Grasslands of Mpumalanga are no exception and the presence minerals, such as coal, has led to the significant transformation, degradation and fragmentation of the region's grasslands. Agriculture and pastoral activities have also had a significant impact on the biodiversity of the region, in fact, farming is believed by some to be the most damaging sector of human activity affecting wild nature (Balmford *et al* 2012). The study site is spatially represented in the Rand Highveld Grassland ecological type (Mesic Highveld Grassland Bioregion, VegMap 2006), which is listed as Endangered; only 58.5% remains untransformed.

It is important to view the study site on an ecologically relevant scale; consequently, all sensitive animal species (specific faunal groups) known from the Mpumalanga Province 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.
- Birds: All bird groups (Roberts VII Multimedia: Birds of Southern Africa, PC Edition).
- 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 ¼-degree grid 2529CD were considered potential inhabitants of the study site (all species known from Mpumalanga were included in the assessment to limit the known effects of sampling bias, except for birds which have been sampled extensively and the data for the Q-grid is accepted as accurate).

8.2 FAUNAL DIVERSITY OF THE SITE

8.2.1 General Diversity

The presence of 59 animal taxa was confirmed during the January 2013 investigation (refer **Table 11** – summer survey) by means of visual sightings, tracks, scats, burrows and species-specific calls as well as camera and small mammal trapping. The following results were recorded:

- 21 invertebrates;
- 1 frog species;
- 1 reptile species;
- 36 bird species; and
- 4 mammals.

The diversity of animals recorded in the study site included four Alien and/or Invasive species (refer Table 11), namely:

- Spotted Maize Beetle (*Astylus atromaculatus*);
- Common Pigeon (*Columba livia*);
- Common Myna (*Acridotheres tristis*); and
- Feral Domestic Cat (*Felis catus*).

No provincially protected or alien and invasive fauna taxa were recorded in the study site during the survey period.

Table 11: Animal species recorded in the study site

Class	*Order*	*Family*	*Binomial Name*	*Colloquial Name*
Insecta	Odonata	Aeshnidae	*Anax imperator*	Blue Emperor
	Isoptera	Termitidae	*Trinervitermes* species	Snouted Harvester Termite
	Orthoptera	Pyrgomorphidae	*Zonocerus elegans*	Elegant Grasshopper
	Hemiptera	Lygaeidae	*Spilostethus pandurus*	Milkweed Bug
	Neuroptera	Myrmeleontidae	*Palpares caffer*	Mottled Veld Antlion
	Coleoptera	Scarabaeidae	*Xeloma tomentosa*	Gold-haired Fruit Chafer
			Popillia biguttata	Yellow Shining Leaf Chafer
		Melyridae	*Astylus atromaculatus*	Spotted Maize Beetle
		Coccinellidae	*Cheilomenes lunata*	Lunate Ladybird
		Tenebrionidae	*Lagria* species	Hairy Darkling Beetle
	Hymenoptera	Apidae	*Apis mellifera*	Honey Bee
	Lepidoptera	Nymphalidae	*Danaus chryssipus*	African Monarch
			Telchinia rahira	Marsh Acraea
			Hypolimnas missipus	Common Diadem
			Junonia hierta	Yellow Pansy

Table 11: Animal species recorded in the study site				
Class	***Order***	***Family***	***Binomial Name***	***Colloquial Name***
			Junonia oenone	Blue Pansy
			Vanessa cardui	Painted Lady
		Pieridae	*Eurema brigitta*	Broad-bordered Grass Yellow
			Belenois aurota	Brown-veined White
			Pontia helice	Meadow White
		Papilionidae	*Papilio demodocus*	Citrus Swallowtail
Reptilia	Squamata	Scincidae	*Trachylepis varia*	Variable Skink
Amphibia	Anura	Pyxicephalidae	*Amietia angolensis*	Common River Frog
Aves	Galliformes	Numididae	*Numida meleagris*	Helmeted Guineafowl
		Phasianidae	*Coturnix coturnix*	Common Quail
	Ciconiiformes	Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis
		Ardeidae	*Bubulcus ibis*	Western Cattle Egret
			Ardea melanocephala	Black-headed Heron
	Falconiformes	Accipitridae	*Elanus caeruleus*	Black-winged Kite
		Falconidae	*Falco amurensis*	Amur Falcon
	Gruiformes	Otididae	*Afrotis afraoides*	Northern Black Korhaan
	Charadriiformes	Charadriidae	*Vanellus armatus*	Blacksmith Lapwing
			Vanellus coronatus	Crowned Lapwing
	Columbiformes	Columbidae	*Columba livia*	Common Pigeon
			Streptopelia capicola	Ring-necked Dove
			Spilopelia senegalensis	Laughing Dove
	Cuculiformes	Cuculidae	*Chrysococcyx caprius*	Diderick Cuckoo
	Apodiformes	Apodidae	*Apus affinis*	Little Swift
			Apus caffer	White-rumped Swift
	Coliiformes	Coliidae	*Colius striatus*	Speckled Mousebird
	Coraciiformes	Meropidae	*Merops apiaster*	European Bee-eater
	Upupiformes	Upupidae	*Upupa africana*	African Hoopoe
	Piciformes	Lybiidae	*Trachyphonus vaillantii*	Crested Barbet
	Passeriformes	Laniidae	*Lanius collaris*	Common Fiscal
		Alaudidae	*Mirafra africana*	Rufous-naped Lark
		Pycnonotidae	*Pycnonotus tricolor*	Dark-capped Bulbul
		Hirundinidae	*Hirundo rustica*	Barn Swallow
			Cecropis cucullata	Greater Striped Swallow
		Cisticolidae	*Cisticola lais*	Wailing Cisticola
			Cisticola tinniens	Levaillant's Cisticola
			Cisticola juncidis	Zitting Cisticola
		Sturnidae	*Acridotheres tristis*	Common Myna
		Passeridae	*Passer melanurus*	Cape Sparrow
		Ploceidae	*Ploceus velatus*	Southern Masked Weaver
			Euplectes progne	Long-tailed Widowbird
		Estrildidae	*Uraeginthus angolensis*	Blue Waxbill
		Viduidae	*Vidua macroura*	Pin-tailed Whydah
		Motacillidae	*Macronyx capensis*	Cape Longclaw
			Anthus cinnamomeus	African Pipit
Mammalia	Lagomorpha	Leporidae	*Lepus saxatilis*	Scrub Hare
	Rodentia	Hystricidae	*Hystrix africaeaustralis*	Porcupine
	Carnivora	Felidae	*Felis catus*	Feral Domestic Cat
	Artiodactyla	Bovidae	*Raphicerus campestris*	Steenbok

8.3 RED DATA FAUNA ASSESSMENT

A total of 112 Red Data animals are known to occur in Mpumalanga (butterflies, frogs, reptiles and mammals) and in the ¼-degree grid 2529CD (birds), indicated in **Table 12**. The following conservation categories are included:

- 23 species are listed as Data Deficient (DD);
- 40 species are listed as Near Threatened (NT);
- 33 species are listed as Vulnerable (VU);
- 12species are listed as Endangered (EN); and
- 4 species are listed as Critically Endangered (CR).

The estimated probabilities of the Red Data fauna assessment are based on:

- the size of the study site;
- the location of the study site;
- the diversity and status of each faunal habitat within the study site; and
- the connectivity of the study site to other untransformed faunal habitats.

An assessment of the PoC for these animals yielded the following probabilities (refer **Table 12**):

- 94 species have a low PoC;
- 12 species have a moderate-low PoC;
- 5 species have a moderate PoC; and
- 1 species has a high PoC.

The 'Vulnerable' butterfly *Metisella meninx* (Marsh Sylph – Hesperiidae) is a likely inhabitant of the study site as the presence of medium to large stands of the wetland grass *Leersia hexandra* was noted, which is an important larval host plant for this butterfly. Records of its presence were collected in similar habitat types in the surrounding region (pers. obs.).

Table 12: Red Data faunal assessment for the study site

Species Details			***Probability Assessment***
Binomial Name	***Colloquial Name***	***RD Status***	
Dragonflies and Damselflies			
Pseudagrion inopinatum	Balinsky's Sprite	Endangered	low
Pseudagrion newtoni	Newton's Sprite	Vulnerable	low
Butterflies			
Aloeides barbarae	Barbara's Copper	Endangered	low
Aloeides merces	Wakkerstroom Copper	Vulnerable	low
Aloeides nubilus	Cloud Copper	Endangered	low
Aloeides rossouwi	Rossouw's Copper	Endangered	low
Chrysoritis aureus	Heidelberg Opal	Vulnerable	low
Chrysoritis phosphor borealis	Scarce Scarlet	Data Deficient	low
Lepidochrysops irvingi	Irving's Blue	Vulnerable	low
Lepidochrysops jefferyi	Jeffrey's Blue	Endangered	low
Lepidochrysops swanepoeli	Swanepoel's Blue	Vulnerable	low
Metisella meninx	**Marsh Sylph**	**Vulnerable**	**high**
Frogs			
Breviceps sopranus	Whistling Rain Frog	Data Deficient	low
Hemisus guttatus	Spotted Shovel-nosed Frog	Vulnerable	low
Strongylopus wageri	Plain Stream Frog	Near Threatened	low

Table 12: Red Data faunal assessment for the study site

Species Details			*Probability Assessment*
Binomial Name	***Colloquial Name***	***RD Status***	
Reptiles			
Acontias breviceps	Short-headed Legless Skink	Near Threatened	low
Afroedura major	Swazi Flat Gecko	Near Threatened	low
Chamaesaura aenea	Coppery Grass Lizard	Near Threatened	moderate-low
Chamaesaura macrolepis	Large-scaled Grass Lizard	Near Threatened	low
Homoroselaps dorsalis	Striped Harlequin Snake	Near Threatened	moderate-low
Kininyx natalensis	Natal Hinged Tortoise	Near Threatened	low
Lamprophis fuscus	Yellow-bellied House Snake	Near Threatened	low
Smaug giganteus	Giant Girdled Lizard	Vulnerable	low
Tetradactylus breyeri	Breyer's Long-tailed Seps	Vulnerable	low
Birds			
Phoenicopterus roseus	Greater Flamingo	Near Threatened	low
Phoenicopterus minor	Lesser Flamingo	Near Threatened	low
Mycteria ibis	Yellow-billed Stork	Near Threatened	low
Ciconia nigra	Black Stork	Near Threatened	low
Leptoptilos crumeniferus	Marabou Stork	Near Threatened	low
Geronticus calvus	Southern Bald Ibis	Vulnerable	low
Botaurus stellaris	Eurasian Bittern	Critically Rare	low
Sagittarius serpentarius	Secretarybird	Near Threatened	moderate-low
Gyps coprotheres	Cape Vulture	Vulnerable	low
Circus ranivorus	African Marsh Harrier	Vulnerable	low
Circus maurus	Black Harrier	Vulnerable	low
Circus macrourus	Pallid Harrier	Near Threatened	moderate-low
Hieraaetus ayresii	Ayres's Hawk-Eagle	Near Threatened	low
Polemaetus bellicosus	Martial Eagle	Vulnerable	low
Falco naumanni	Lesser Kestrel	Vulnerable	moderate
Falco biarmicus	Lanner Falcon	Near Threatened	moderate-low
Neotis denhami	Denham's Bustard	Vulnerable	low
Eupodotis caerulescens	Blue Korhaan	Near Threatened	low
Podica senegalensis	African Finfoot	Vulnerable	low
Crex crex	Corn Crake	Vulnerable	low
Balearica regulorum	Grey Crowned Crane	Vulnerable	low
Anthropoides paradisea	Blue Crane	Vulnerable	low
Bugeranus carunculatus	Wattled Crane	Critically Rare	low
Charadrius pallidus	Chestnut-banded Plover	Near Threatened	low
Rostratula benghalensis	Greater Painted-snipe	Near Threatened	low
Glareola nordmanni	Black-winged Pratincole	Near Threatened	low
Hydroprogne caspia	Caspian Tern	Near Threatened	low
Tyto capensis	African Grass-owl	Vulnerable	low
Alcedo semitorquata	Half-collared Kingfisher	Near Threatened	low
Mirafra cheniana	Melodious Lark	Near Threatened	moderate-low
Spizocorys fringillaris	Botha's Lark	Endangered	low
Mammals			
Chrysospalax villosus	Rough-haired Golden Mole	Critically Rare	low
Amblysomus hottentotus	Hottentot's Golden Mole	Data Deficient	low
Amblysomus robustus	Robust Golden Mole	Endangered	low
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened	low
Neamblysomus julianae	Juliana's Golden Mole	Vulnerable	low
Atelerix frontalis	South African Hedgehog	Near Threatened	moderate
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	Data Deficient	low
Myosorex cafer	Dark-footed Forest Shrew	Data Deficient	low

Table 12: Red Data faunal assessment for the study site

Species Details			*Probability Assessment*
Binomial Name	***Colloquial Name***	***RD Status***	
Myosorex varius	Forest Shrew	Data Deficient	moderate
Crocidura cyanea	Reddish-grey Musk Shrew	Data Deficient	moderate
Crocidura flavescens	Greater Musk Shrew	Data Deficient	low
Crocidura fuscomurina	Tiny Musk Shrew	Data Deficient	moderate-low
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient	low
Crocidura maquassiensis	Maquassie Musk Shrew	Vulnerable	low
Crocidura mariquensis	Swamp Musk Shrew	Data Deficient	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	Data Deficient	low
Suncus infinitesimus	Least Dwarf Shrew	Data Deficient	moderate-low
Suncus lixus	Greater Dwarf Shrew	Data Deficient	low
Suncus varilla	Lesser Dwarf Shrew	Data Deficient	moderate-low
Cloeotis percivali	Percival's Short-eared Trident Bat	Vulnerable	low
Rhinolophus blasii	Blasius's Horseshoe Bat	Near Threatened	low
Rhinolophus swinnyi	Swinny's Horseshoe Bat	Near Threatened	low
Miniopterus natalensis	Natal Long-fingered Bat	Near Threatened	low
Scotophilus nigrita	Giant Yellow House Bat	Near Threatened	low
Cercopithecus mitis	Samango Monkey	Vulnerable	low
Cercopithecus mitis labiatus	Samango Monkey	Endangered	low
Manis temminckii	Ground Pangolin	Vulnerable	low
Graphiurus platyops	Rock Dormouse	Data Deficient	low
Mystromys albicaudatus	White-tailed Rat	Endangered	low
Tatera leucogaster	Bushveld Gerbil	Data Deficient	low
Lemniscomys rosalia	Single-striped Mouse	Data Deficient	moderate
Dasymys incomtus	Water Rat	Near Threatened	low
Grammomys dolichurus	Woodland Mouse	Data Deficient	low
Otomys slogetti	Sloggett's Rat	Data Deficient	low
Panthera pardus	Leopard	Near Threatened	low
Panthera leo	Lion	Vulnerable	low
Leptailurus serval	Serval	Near Threatened	moderate-low
Acinonyx jubatus	Cheetah	Vulnerable	low
Felis nigripes	Black-footed Cat	Vulnerable	low
Crocuta crocuta	Spotted Hyaena	Near Threatened	low
Parahyaena brunnea	Brown Hyaena	Near Threatened	low
Paracynictis selousi	Selous's Mongoose	Data Deficient	low
Rhynchogale melleri	Meller's Mongoose	Data Deficient	low
Canis adustus	Side-striped Jackal	Near Threatened	low
Lycaon pictus	African Wild Dog	Endangered	low
Mellivora capensis	Honey Badger	Near Threatened	moderate-low
Poecilogale albinucha	African Striped Weasel	Data Deficient	moderate-low
Hydrictis maculicollis	Spotted-necked Otter	Near Threatened	low
Loxodonta africana	African Savanna Elephant	Vulnerable	low
Diceros bicornis	Black Rhinoceros	Critically Rare	low
Ceratotherium simum	White Rhinoceros	Near Threatened	low
Hippopotamus amphibius	Common Hippopotamus	Vulnerable	low
Raphicerus sharpei	Sharpe's Grysbok	Near Threatened	low
Ourebia ourebi	Southern Oribi	Endangered	low
Hippotragus equinus	Roan Antelope	Vulnerable	low
Hippotragus niger	Southern Sable Antelope	Vulnerable	low
Damaliscus lunatus	Western Tsessebe	Endangered	low

In addition to the above-mentioned Red Data species of Mpumalanga, 31 animal taxa (some overlap does occur) have protected status (NEMBA) within Mpumalanga (www.speciesstatus.sanbi.org). The estimated PoC for these species are as follows (refer **Table 13**):

- 28 species have a low PoC;
- 1 species has a moderate-low PoC; and
- 2 species have a moderate PoC.

Table 13: Protected animal species of Mpumalanga

Species Details			***Probability Assessment***
Binomial Name	***Colloquial Name***	***NEMBA status***	
Aonyx capensis	African Clawless Otter	protected	moderate
Atelerix frontalis	South African Hedgehog	protected	moderate
Bucorvus leadbeateri	Southern Ground-Hornbill	protected	low
Ceratogyrus bechuanicus	Starbust Horned Baboon Spider	protected	low
Ceratotherium simum	White Rhinoceros	protected	low
Circus ranivorus	African Marsh Harrier	protected	low
Connachaetus gnou	Black Wildebeest	protected	low
Crocuta crocuta	Spotted Hyaena	protected	low
Dromica species	Flightless Tiger Beetle species	protected	low
Felis nigripes	Black-footed Cat	protected	low
Graphipterus assimilis	Velvet Ground Beetle	protected	low
Harpactira gigas	Transvaal Banded Baboon Spider	protected	low
Hydrictis maculicollis	Spotted-necked Otter	protected	low
Leptailurus serval	Serval	protected	moderate-low
Loxodonta africana	African Savanna Elephant	protected	low
Manticora species	Monster Tiger Beetle species	protected	low
Megacephala asperata	Tiger Beetle	protected	low
Megacephala regalis	Tiger Beetle	protected	low
Neotis denhami	Denham's Bustard	protected	low
Nigidius auriculatus	Stag Beetle	protected	low
Oonotus adspersus	Stag Beetle	protected	low
Oonotus interioris	Stag Beetle	protected	low
Oonotus rex	Stag Beetle	protected	low
Oonotus sericeus	Stag Beetle	protected	low
Parahyaena brunnea	Brown Hyaena	protected	low
Prosopocoilus petitclerci	Stag Beetle	protected	low
Prothyma guttipennis	Tiger Beetle	protected	low
Pterinochilus breyeri	Malelane Golden-brown Baboon Spider	protected	low
Pterinochilus nigrofulvus	Transvaal Golden Baboon Spider	protected	low
Raphicerus sharpei	Sharpe's Grysbok	protected	low
Redunca arundinum	Southern Reedbuck	protected	low

None of these species was recorded during the survey period, but some species are likely to persist in the region.

8.4 FAUNAL HABITAT TYPES

Animals of terrestrial as well as aquatic ecosystems are closely linked to, and significantly influenced by, plant community structures and species diversities. For example, many aquatic macro invertebrates find refuge in extensive reedbeds that are frequently found within lowland wetland ecosystems (Sychra *et al* 2010). Furthermore, the structure and age of vegetal formation of ponds and impounds play a significant role in selecting species traits related to the population dynamics and feeding habits of invertebrates (Céréghinoa *et al* 2008). Similarly, terrestrial animals' ecological reactions depend on plant community structure; studies on arthropod species richness have indicated that for spiders local processes are important, with assemblages in a particular patch being constrained by habitat structure (Borgesa & Browna, 2004). Likewise, plant community structure is often influenced by primary consumers; herbivores are known key drivers of ecosystem function and nutrient dynamics within grazed plant communities (Duncan, 2005).

As a result, faunal community structure and ecological diversity cannot be viewed is isolation without initially considering vegetation habitat diversity. Therefore, plant communities or macro habitat types described in this document (refer **Section 7.5**) are regarded as being representative of faunal habitats within the study site for the purposes of this EIA assessment.

8.4.1 Transformed Habitat

Transformed faunal habitat is devoid of natural (original) natural habitat; natural vegetation has been removed and replaced by various substitutes of either a sterile or an artificial nature. These substitutes include agricultural lands, stands of exotic trees and human structures such as buildings, roads, mining areas, etc. These transformed habitat types have lost the ability to function ecologically and bear no biological resemblance to the original faunal habitat associated with the Mesic Highveld Grassland Bioregion's (Mucina and Rutherford, 2004) grasslands and associated wetlands. These areas have little or no conservation value and it is highly unlikely that any threatened faunal taxa would persist in these areas, other than potentially just passing through. Most of these areas are however situated in close proximity to sensitive habitat. It is therefore important to note that, although utilisation of these transformed areas is unlikely to lead to a loss of biodiversity or have a significant adverse impact on faunal assemblages currently persisting in the area, adverse impacts are likely to impact on nearby sensitive habitat.

8.4.2 Wetland Habitats

Wetland habitats of the study site comprise parts of permanent or temporary surface water and vegetation associated with such areas. The wetland faunal habitats of the study site include:

- Channelled valley bottom; and
- Mesic grassland.

Compared to terrestrial grassland, wetland habitat is relatively unique and uncommon, locally as well as on a larger scale. Because of this unique and scarce nature of wetland habitat, areas of temporary and permanent surface water are at risk when changes in land use are considered, particularly transformative activities such as mining, agriculture and urban land uses. Wetlands often host a variety of sensitive and threatened faunal taxa; obligate faunal wetland species are often included in conservation categories because of pressures on freshwater ecological systems of South Africa and especially the Mesic Highveld Grassland Bioregion of the country.

Conservation important fauna taxa that are likely to persist in the wetlands of the study site include:

- Marsh Sylph (*Metisella meninx* – Vulnerable);
- Serval (*Leptailurus serval* – Near Threatened); and
- African Clawless Otter (*Aonyx capensis* – Protected).

The wetlands of the study site are considered to be of high conservation value; ecological functionality and biodiversity contribution and value of these wetlands are high and in dire need of formal protection, on a local and larger scale.

8.4.3 Natural Grassland Habitats

Natural grassland habitat of the study site comprises those parts that exhibit (to varying degrees) a significant proportion of the functional ecological characteristics of the original (Endangered) Rand Highveld Grassland (Mucina and Rutherford 2004). In other words, these areas constitute untransformed, functioning faunal grassland habitat characteristic of the Mesic Highveld Grassland Bioregion of South Africa. The natural (terrestrial) grassland habitats of the study site include:

- Degraded grassland; and
- Rocky grassland.

Ecological interaction of natural terrestrial faunal habitats is often very complex. Potentially, some grassland obligate species are limited to only natural grasslands and do not occur within the degraded grasslands. Others might be unaffected by slight habitat degradation (up to certain point). This acceptable level of habitat degradation being tolerated by fauna species is therefore species specific and problematic to predict.

Species loss rates compared to habitat degradation rates is also likely to vary between grassland habitat types. In a landscape matrix that comprises of fragments of natural, degraded and transformed terrestrial faunal habitats, it is particularly difficult to predict the quality and composition of faunal assemblages persisting in each fragment. Some fragments of a degraded (or even transformed) nature might (when considered in an isolated sense) be of a poor ecological status or low biodiversity value; but when considered within the landscape matrix in relevance to other, natural habitat fragments, these areas might be of considerable conservation or diversity value as a movement corridor or sink population source.

Conservation important and sensitive faunal taxa that are likely to persist in the study site include:

- Reddish-grey Musk Shrew (*Crocidura cyanea* – Data Deficient);
- South African Hedgehog (*Atelerix frontalis* –Protected);
- Single-striped Mouse (*Lemniscomys rosalia* – Data Deficient);
- Secretarybird (*Sagittarius serpentarius* – Near Threatened); and
- Lesser Kestrel (*Falco naumanni* – Vulnerable);

Natural terrestrial habitats of the study site are considered to be of high conservation value; the ecological functioning and biodiversity value of these grasslands are high, and any changes land use in the area have the potential to adversely impact on a number of sensitive and threatened faunal taxa.

8.5 FAUNAL HABITAT SENSITIVITY ASSESSMENT

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

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

Table 14: Faunal Habitat Sensitivities for the study site

Unit	*Habitat Type*	*ST*	*DV*	*LN*	*RD*	*SE*	*Ave*	*Sensitivity Class*
Transformed	Transformed areas	1	1	1	1	1	10%	low
Wetlands	Channelled valley bottom	8	8	8	8	9	82%	high
	Mesic grassland	8	7	8	8	9	80%	high
Grasslands	Degraded grassland	5	4	6	3	5	46%	medium
	Rocky grassland	9	8	8	6	9	80%	high

Faunal habitat sensitivities of the study sites are similar to the floristic sensitivity; for an illustration, the reader is referred to **Figure 10**.

8.6 DISCUSSION

Despite the small size and spatial presence of the study site within a landscape characterised by residential development, remaining natural habitat of the site is regarded pristine, comprising of rocky grassland and wetland habitat types. The status of these remaining natural habitats is highly representative of typical (pristine) faunal habitats of the grasslands and wetlands of the Rand Highveld Grassland ecological type. The diversity of insects, frogs, reptiles, birds and mammals recorded in the study site attest to the high biodiversity and natural status of both wetland and terrestrial (mostly rocky) habitat of the study site, but does indicate the impact of surrounding landscape transformative activities (to a limited extent).

Although no Red Data species were recorded in the study site during the brief field investigation, natural rocky grassland, mesic grassland and channelled valley bottom habitats of the study site are considered to be of high biodiversity values, exhibiting high faunal sensitivities pertaining to activities that may lead to degradation and/or transformation of these habitats. These habitats are currently under significant threat in the region (Mesic Highveld Bioregion of Mpumalanga) – a fact confirmed by the Mpumalanga Biodiversity Plan (the area is categorised as 'Highly Significant, also included in an Ecological Corridor).

Connectivity with other natural faunal habitats (both terrestrial and wetland) of this site is high, increasing the biodiversity value and sensitivity of the study site. Important, connectivity with the Olifants River – Witbank Dam wetland system is also established and the site will undoubtedly provide valuable sink habitats for some

of the wetland species persisting in this system. Additionally it will also act as an important ecological buffer between the current residential developments in the area and this significant wetland system.

In conclusion, the study site exhibits significant attributes of high faunal sensitivity. Despite surrounding developments having adverse impacts on faunal assemblages and composition, remaining habitat is highly representative of pristine regional habitat types. Data and visual observations indicate that remaining natural habitat (regional) are characterised by severe degradation and transformation, with high levels of habitat fragmentation and isolation. Sensitive habitat characterising this site is therefore not abundantly encountered in the region. The inclusion of this portion of pristine grassland in adjacent areas of conservation will therefore be regarded a positive contribution towards conservation efforts on a local scale. Potential and likely impacts of development of these portions of natural habitat are regarded significant and severe on a local scale. Impacts are also regarded significant on a larger scale, considering the proximity of conservation important areas.

Alternatively, the concept of a Biodiversity Offset should be investigated whereby another suitable portion of grassland (similar status and sensitivity) is included within existing conservation efforts (preferably local).

9 ECOLOGICAL IMPACT ASSESSMENT

The impact assessment is aimed at presenting a description of the nature and extent of identified impacts on the ecological environment. These tabular assessments are presented in **Section 9.3** in the form of an Impact Rating Matrix for expected impacts within the development area.

Direct or primary impacts from proposed development will result from any activity that involves land clearance. Direct impacts are usually readily identifiable, while indirect or secondary impacts can result from social or environmental changes induced by mining operations and are often harder to identify and assess. Cumulative impacts occur where projects take place in landscapes that are already influenced by other habitat transformation activities.

9.1 IDENTIFICATION OF IMPACTS

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study site since the proposed development is largely destructive, involving the alteration of natural habitat or degradation of habitat that is currently in a climax status.

Impacts resulting from the proposed development on floristic and faunal attributes of the study site are largely restricted to the physical effects of habitat clearance loss of habitat. 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 relevant to this particular type of development:

- Impacts on flora species of conservation importance (including habitat suitable for these species);
- Impacts on fauna species of conservation importance (including habitat suitable for these species);
- Impacts on/ loss/ degradation of natural/ sensitive/ protected habitat types;
- Displacement of fauna species, human-animal conflicts & interactions;
- Impacts on ecological connectivity and ecosystem functioning;
- Indirect impacts on surrounding habitat;
- Cumulative impacts on conservation obligations & targets (including national and regional);
- Cumulative increase in local and regional fragmentation/ isolation of habitat; and
- Cumulative increase in environmental degradation, pollution.

9.2 NATURE OF IMPACTS

Impacts that are likely to result from the development 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 ecological environment.

9.2.1 Impacts on flora species of conservation importance (including suitable habitat)

Development activities frequently result in direct impacts or destruction of conservation important plant species, communities of these species, areas where these species are known to occur or areas that are considered particularly suitable for these species. Plant species of conservation importance, 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 being included in conservation categories. 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 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.

The presence of several plants of conservation importance was established during the brief survey period; also, all natural habitat of the study site is considered suitable for a number of other taxa that were not recorded during the survey. This impact will therefore be severe and will have significant bearing on the estimation of impact significance. Exclusion of red data habitat is the only sensible manner in which this impact can be mitigated, effectively implying sterilising the entire site in terms of development potential.

9.2.2 Impacts on fauna species of conservation importance (including suitable habitat)

Likewise, animal taxa of conservation importance generally do not contribute significantly to the species richness of a region, but do contribute significantly to the ecological diversity of a region as their presence usually provides an indication of a relatively pristine landscape. Because animals are mobile and ultimately able to migrate away from impacts, developments rarely affect them directly. However, significant impacts result from losses and degradation of suitable habitat that is available to them. This represents a significant direct impact on these animals and assemblages. Additional faunal aspects that will be affected include

migration patterns and suitable habitat for breeding and foraging purposes. These requirements are frequently stricter compared to most generalist fauna taxa and impacts on red data habitat are therefore likely to be more significant than for most other, common fauna species. Consequently, a higher conservation obligation is placed on these areas. Even slight changes to habitat that is suitable for these species are therefore likely to have significant effects on the presence and status of these taxa.

The presence of Red Data fauna species within the study site was established during the survey period. Considering the brief period over which the survey was conducted, and taking cognisance of the habitat status and availability, the likelihood that other conservation important species would occur in the study site is regarded high. Exclusion of red data habitat is the only sensible manner in which this impact can be mitigated, effectively implying sterilising the entire site in terms of development potential.

9.2.3 Impacts on/ loss/ degradation of natural/ sensitive/ protected habitat types

The loss or degradation of natural vegetation or habitat that are regarded sensitive as a result of restricted presence in the larger region, 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, pans 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.

Natural habitat of the study site as well as surrounding areas will be affected adversely by direct impacts resulting from developmental activities. Also of importance is the loss of habitat that are not necessarily considered suitable for Red Data species, but where high endemic species richness is likely to be recorded.

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 and faunal assemblages that persist in these areas as they contribute significantly to the biodiversity of a region.

9.2.4 Displacement of fauna species, human-animal conflicts & interactions

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 domestic cats and dogs, escalation in numbers of exotic and non-endemic species, 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.

The presence of personnel within the development area during construction period and residents subsequent thereto, 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 habitat 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 and residents frequently results in the unnecessary killing of these animals.

9.2.5 Impacts on ecological connectivity & ecosystem functioning

The landscape is characterised by highly transformed and fragmented habitat. Therefore, the ecological connectivity that natural habitat provides within this regional setting of habitat fragmentation and isolation, is particularly important in the effective functioning of the regional and local ecological processes. Evidence obtained during the investigation period revealed that the biodiversity noted within both the terrestrial grassland types and wetland related habitat is much higher than would be expected when looking at the study site in isolation, providing insight into the regional importance of these habitat types. It is therefore reasonable to assume that the animals that utilises these habitat types migrate extensively across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals. In order to ensure the consistent presence of animals within this system on a local and regional scale, it is critical that the basic characteristics of the system, such as a natural species composition, physiognomy, aquatic principles, contributions from surrounding habitat types, etc. are preserved. This is also particularly relevant for plant species of conservation consideration that could potentially occupy the area.

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.

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 site will likely affect the migration pattern of some species on larger scale. Particular reference is made to the disruption of migration patterns of flightless animals.

9.2.6 Indirect impacts on surrounding habitat

Surrounding areas and species present in the direct vicinity of the study site could potentially be affected by indirect impacts resulting from construction and operational activities. This indirect 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.

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 controlled and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor.

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.

9.2.7 Cumulative impacts on conservation obligations & targets (including national & regional)

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. The current conservation status is based on regional information relating to the status and availability of remaining natural habitat and is included in the 'Endangered' category.

It has been established that the available infobase inaccurately displays the status and availability of natural grasslands. Poor quality (degraded) grasslands, and cultivated pastures are frequently included in this category. Additionally, developments that have taken place subsequent to the compilation of the VEGMAP database have resulted in further decimation of natural grasslands, contributing to this cumulative impact. Ultimately, the current estimation of conservation level is therefore likely to be an underrepresentation of the

conservation requirements that need to be applied to these vegetation types. The continued conservation of any area that is representative of these regional vegetation types should therefore be prioritised.

The presence of the existing development activities within the Bankenveld Conservancy bears evidence of the importance of this area in terms of local and regional conservation efforts.

9.2.8 Cumulative 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 endemic biodiversity 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 imply that the viable population of plants 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.

9.2.9 Cumulative Increase in Environmental Degradation & Pollution

Cumulative impacts associated with this type of development could 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. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

The nature of the development is such that pollution and degradation of the surrounding areas could reasonably be expected. This is evident from similar surrounding developments.

9.3 ECOLOGICAL IMPACT RATING TABLES

POTENTIAL ENVIRONMENTAL IMPACT PRIOR TO MITIGATION	ENVIRONMENTAL SIGNIFICANCE					
	M	D	S	P	TOTAL	SP
Direct Impacts on biodiversity (ecology)						
Direct impacts on flora species of conservation importance	10	5	3	5	90	High
Direct impacts on fauna species of conservation importance (including habitat suitable for these species)	10	5	3	5	90	High
Impacts on/ loss/ degradation of natural/ sensitive/ protected habitat types	8	5	3	5	80	High
Displacement of fauna species, human-animal conflicts & interactions	6	5	3	5	70	High
Indirect Impacts on biodiversity (ecology)						
Impacts on ecological connectivity and ecosystem functioning	8	5	3	5	80	High
Indirect impacts on surrounding habitat	6	5	3	4	56	Medium
Cumulative Impacts on biodiversity (ecology)						
Cumulative impacts on conservation obligations & targets (including national & regional)	8	5	3	5	80	High
Cumulative increase in local and regional fragmentation/ isolation of habitat	6	5	2	5	65	High
Increase in environmental degradation, pollution (soils, surface water)	6	4	3	4	52	Medium

POTENTIAL ENVIRONMENTAL IMPACT AFTER MITIGATION	ENVIRONMENTAL SIGNIFICANCE					
	M	D	S	P	TOTAL	SP
Direct Impacts on biodiversity (ecology)						
Direct impacts on flora species of conservation importance	10	5	3	4	72	High
Direct impacts on fauna species of conservation importance (including habitat suitable for these species)	10	5	3	4	72	High
Impacts on/ loss/ degradation of natural/ sensitive/ protected habitat types	8	5	3	5	80	High
Displacement of fauna species, human-animal conflicts & interactions	6	5	3	5	70	High
Indirect Impacts on biodiversity (ecology)						
Impacts on ecological connectivity and ecosystem functioning	8	5	3	4	64	High
Indirect impacts on surrounding habitat	6	5	3	4	56	Medium
Cumulative Impacts on biodiversity (ecology)						
Cumulative impacts on conservation obligations & targets (including national & regional)	8	5	3	5	80	High
Cumulative increase in local and regional fragmentation/ isolation of habitat	6	5	2	5	65	High
Increase in environmental degradation, pollution (soils, surface water)	6	4	2	4	48	Medium

9.4 DISCUSSION

The evaluation of impacts resulting from the proposed development on this site was made with the following assumptions:

- Wetland habitat, as defined and delineated by the wetland ecologist, as well as applicable buffer zones, will be excluded from the proposed development. As such, only terrestrial habitat will be utilised for the development;
- Evaluation of the significance of impacts prior to mitigation assumes the complete destruction of all terrestrial habitat; which is a reasonable assumption considering the nature of residential developments; and
- Evaluation of the significance of impacts subsequent to mitigation measures assumes the implementation of all recommended generic and site-specific mitigation measures, **excluding** the implementation of an Offset strategy.

The significance of impacts on sensitive habitat types of the site is evident. It is important to note that the significance of perceived and likely impacts resulting from the proposed development cannot be ameliorated to an acceptable level by the implementation of all possible and sensible mitigation measures. Development of this portion of land will lead to inevitable loss of natural habitat. It is therefore critical to note that the implementation or suggestion of a Biodiversity Offset strategy is not regarded as a mitigation measure as the impacts on the site will remain of a similar nature and extent. An offset strategy should be considered and evaluated by the authorities as a contribution to conservation efforts on a local and regional scale. Aspects that should be considered during a suitable offset assessment include (*inter alia*):

- Evaluation of Offset Adequacy and Site selection;
- Relating impacts significance to a local and regional context; and
- Offset measurement and Compensation Strategies.

9.5 RECOMMENDED MITIGATION MEASURES

Mitigation measures are aimed at providing protection of remaining natural habitat within the proposed site (mostly wetland related habitat), as well as adjacent natural habitat.

9.5.1 General Aspects

Mitigation Measure 1 - Exclude all wetland related habitat and required buffer zones from the proposed development (as per guidelines and recommendations included in the wetland ecological report);

Mitigation Measure 2 - Conduct a search and rescue operation for all conservation important plants on the site. This operation should be conducted during the austral summer period when vegetative and reproductive growth is evident;

Mitigation Measure 3 - Provide an opportunity for local 'muthi' collectors to remove plants of medicinal value from the site prior to vegetation clearance;

Mitigation Measure 4 - Prevent any influx of run-off water (from residences) or effluent into wetland habitat. Run-off water from gardens typically contains seeds of exotic and garden-variety plants that pose a threat to wetland vegetation and ecology. Run-off water should be diverted to storm water management services and infrastructures;

Mitigation Measure 5 - Prevent contamination of natural wetland habitat as well as adjacent terrestrial grassland habitat from any source of pollution, effluent, etc.;

Mitigation Measure 6 - Appoint an Environmental Control Officer (ECO) prior to commencement of construction phase. Responsibilities should include, but not necessarily be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting to authorities, etc.;

Mitigation Measure 7 - 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 natural habitat and effects of the development on the natural environment;

9.5.2 Environmental Control Officer

Mitigation Measure 8 - Have overall responsibility for the implementation of the EMP;

Mitigation Measure 9 - Ensure that the developer and contractors are aware of environmental specifications, legal constraints and general standards and procedures;

Mitigation Measure 10 - Ensure that all stipulations within the EMP are communicated and adhered to by the developer and contractors;

Mitigation Measure 11 - 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 12 - 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 13 - Ensure that periodic environmental performance audits are undertaken on the project implementation. Results of periodic audits and performance monitoring should be communicated to relevant authorities on a frequent basis (quarterly);

Mitigation Measure 14 - Convey the contents of the EMP to the site staff and discuss the contents in detail with the Project Manager and Contractors;

Mitigation Measure 15 - Take appropriate action if the specifications contained in the EMP are not followed;

Mitigation Measure 16 - Monitor and verify that environmental impacts are kept to a minimum, as far as possible;

Mitigation Measure 17 - 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.

9.5.3 Fences & Demarcation

Mitigation Measure 18 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel, vehicles, providing boundaries for construction sites

Mitigation Measure 19 - 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;

9.5.4 Fire

Mitigation Measure 20 - 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 21 - Prevent all open fires;

Mitigation Measure 22 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

Mitigation Measure 23 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

Mitigation Measure 24 - 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; and

9.5.5 Roads & Access

Mitigation Measure 25 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 26 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 27 - Dust control on all roads should be prioritised;

Mitigation Measure 28 - No roads should be allowed within ecologically sensitive areas.

9.5.6 Workers & Personnel

Mitigation Measure 29 - Provide sufficient on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 30 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

9.5.7 Vegetation Clearance & Operations

Mitigation Measure 31 - The landowner must immediately take steps to remove alien vegetation as per Conservation of Agricultural Resource Act. This should be done based on an alien invasive management strategy that should be compiled by a suitable ecologist. The plan must make reference to:

- 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 11of 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 32 - Only areas as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 33 - 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 or dumped in adjacent areas;

Mitigation Measure 34 - All vegetation not required to be removed will be protected against damage;

Mitigation Measure 35 - 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 36 - No spoil material will be dumped outside the defined site;

Mitigation Measure 37 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 38 - 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;

9.5.8 Waste

Mitigation Measure 39 - A Waste Management Plan will be developed and implemented for the duration of the project. This should be part of the responsibilities of the ECO;

Mitigation Measure 40 - 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 41 - Prevent and advocate against the indiscriminate disposal of rubbish, litter or rubble;

Mitigation Measure 42 - The burning of general waste material under any circumstances is not to be allowed;

Mitigation Measure 43 - 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, or disposed of at a license facility suitable for the type of waste;

Mitigation Measure 44 - A stormwater management plan will be compiled that will address, inter alia, capturing and storage of stormwater;

Mitigation Measure 45 - 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 46 - No wastewater or water containing any chemical or pollutant should be released from, or escape as effluent, from the site;

9.5.9 Animals

Mitigation Measure 47 - No animal may be hunted, trapped, snared or captured for any purpose whatsoever. Fences and boundaries should be patrolled weekly in order to locate and remove snares/ traps;

Mitigation Measure 48 - Speed of vehicles should be limited to allow for sufficient safety margins;

Mitigation Measure 49 - Dangerous animals should be handled by a competent person;

Mitigation Measure 50 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction;

Mitigation Measure 51 - Sensitize all personnel to the presence, characteristics and behaviour of animals on the site;

Mitigation Measure 52 - Include suitable procedures in the event of encountering potentially dangerous animals on the site;

Mitigation Measure 53 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum;

Mitigation Measure 54 - No domestic pets should be allowed on the site.

10 PHOTOGRAPHIC RECORDS

Photo 1: Example of *Gladiolus vinosomaculatus*

Photo 2: Typical nature of rocky grassland habitat

Photo 3: Example of *Lapeirousia sandersonii*

Photo 4: Example of mesic grasslands, note locally dominant stands of *Hyparrhenia hirta*

Photo 5: Example of mesic grasslands, pristine status

Photo 6: Example of *Boophone disticha*

Photo 7: Example of habitat transformation and degradation

11 APPENDIX 1: FLORISTIC DIVERSITY OF THE SITE

*** indicates exotic or invasive nature**
Species indicted in **bold** refer to conservation important plants

Species Name	Growth Form	Family	Status/ Uses	Common Name
Acacia karroo	Tree	Fabaceae	Edible parts, dyes and tans, medicinal uses, firewood	Sweet Thorn (e), Soetdoring (a)
Acacia mearnsii	Tree	Fabaceae	Declared Invader - Category 2	Black Wattle (e), Swartwattel (a)
Acalypha angustata	Forb	Euphorbiaceae	None	Copper leaf (e), Katpisbossie (a)
Agrostis eriantha	Grass	Poaceae	None, indicator of wet soils	Large panicle Agrostis (e), Groot-pluim-agrostis (a)
Agrostis lachnantha	Grass	Poaceae	Indicator of wet soils	South African Bent Grass (e) Vinkagrostis (a)
Alternanthera pungens	Forb	Amaranthaceae	Weed, pioneer species	Khaki Weed (e), Dubbeltjie (a)
Amaranthus hybridus	Forb	Amaranthaceae	Naturalised exotic, edible parts	Pigweed (e), Misbredie (a)
Andropogon eucomus	Grass	Poaceae	Low grazing potential	Snowflake Grass (e), Kleinwitbaardgras (a)
Andropogon schirensis	Grass	Poaceae	Moderately palatable, Decreaser I	Stab Grass (e), Tweevingergras (a)
Anthospermum rigidum	Forb	Rubiaceae	None	--
Aristida aequiglumis	Grass	Poaceae	None	Krulgras (a)
Aristida junciformis	Grass	Poaceae	Thatching & weaving, unpalatable, Increaser IIc	Ngongoni three-awn (e), Ngongoni-steekgras (a)
Aristida stipitata	Grass	Poaceae	Poor grazing potential, indicator of poor habitat,	Long-awned Three-awn (e), Langnaaldsteekgras (a)
Asclepias aurea	Forb	Apocynaceae	None	Golden Star Drops (e)
Asclepias eminens	Forb	Apocynaceae	None	Large Turret Flower (e)
Asparagus species	Shrub	Liliaceae	None	Wild Asparagus (e), Katbos (a)
Aspidoglossum lamellatum	Forb	Apocynaceae	None	--
Becium obovatum	Forb	Lamiaceae	None	Cat's Whiskers (e), Katsnor (a)
Berkheya insignis	Forb	Asteraceae	Weed	--
Cosmos bipinnatus	Forb	Asteraceae	Weed, exotic (S. America), aesthetic uses	Cosmos (e), Kosmos (a)
Bidens pilosa	Forb	Asteraceae	Naturalised exotic, edible parts	Black-jack (e), Knapsekêrel (a)
Boophone disticha	**Geophyte**	**Amaryllidaceae**	**DECLINING STATUS, Poisonous, medicinal uses**	**Bushman Poison Bulb (e), Gifbol (a)**
Brachiaria serrata	Grass	Poaceae	Moderately palatable, indicator of good veld condition,	Black-footed Signal Grass (e), Swartvoetjiegras (a)
Brachystelma species	Forb	Apocynaceae	None	--
Bulbostylis contexta	Sedge	Cyperaceae	None	Geelhoutkop (a)
Campuloclinium macrocephalum	Forb	Asteraceae	Declared Invader - Category 1, Noxious weed	Pom Pom Weed (e), Pompom bossie (a)
Castalis spectabilis	Forb	Asteraceae	None	Bloubietou (e)
Chamaecrista comosa	Forb	Caesalpiniaceae	None	--
Chascanum hederaceum	Forb	Verbenaceae	None	--

Chenopodium album	Forb	Chenopodiaceae	Naturalised exotic, weed, edible parts	Common pigweed (e), Bloubossie (a)
Chironia palustris	Forb	Gentianaceae	Medicinal uses	Marsch Chironia (e), Bitterwortel (a)
Chlorophytum fasciculatum	Geophyte	Liliaceae	None	--
Cirsium vulgare	Forb	Asteraceae	Declared Invader - Category 1B, weed	Scottish thistle (e), Skotse dissel (a)
Commelina africana	Forb	Commelinaceae	Medicinal properties	Yellow Wandering Jew (e), Geeleendagsblom (a)
Conyza bonariensis	Forb	Asteraceae	Weed, indicator of disturbed areas	Flax-leaf Fleabane (e), Kleinskraalhans (a)
Conyza podocephala	Forb	Asteraceae	Weed, indicator of disturbed areas	Bakbossie (a)
Cordylogyne globosa	Forb	Apocynaceae	None	--
Crassula capitella	Succulent	Crassulaceae	None	--
Crassula setulosa	Succulent	Crassulaceae	None	--
Ctenium concinnum	Grass	Poaceae	Low grazing potential	Sickle Grass (e), Sekelgras (a)
Cucumis zeyheri	Forb	Cucurbitaceae	Edible parts	Wild Cucumber (e), Wildekomkommer (a)
Cyanotis speciosa	Forb	Commelinaceae	Medicinal properties	Doll's powder puff (e), Bloupoeierkwassie (a)
Cymbopogon pospischilii	Grass	Poaceae	Aromatic grass, unpalatable, Increaser I	Narrow-leaved turpentine grass (e),
Cynodon dactylon	Grass	Poaceae	Indicator of disturbed areas, grazing potential	Common Couch Grass (e), Gewone kweekgras (a)
Cyperus digitatus	Sedge	Cyperaceae	None	--
Cyperus esculentus	Sedge	Cyperaceae	Weed, edible parts (tuber)	Yellow nutsedge (e), Geeluintjie (a)
Cyperus rupestris	Sedge	Cyperaceae	None	--
Cyperus solidus	Sedge	Cyperaceae	None	--
Cyperus species	Sedge	Cyperaceae	None	--
Datura stramonium	Forb	Solanaceae	Declared Invader - Category 1B, weed	Common thorn apple (e)
Dianthus mooiensis	Forb	Capparaceae	None	Wild Pink (e), Wildeangelier (a)
Dicoma anomala	Forb	Asteraceae	Medicinal uses	Maagbitterwortel (a)
Digitaria monodactyla	Grass	Poaceae	Palatable grazing, Increaser IIb	One-finger Grass (e), Eenvingergras (a)
Diheteropogon amplectens	Grass	Poaceae	Moderately palatable, Decreaser	Broad-leaved Bluestem (e), Breëblaarblougras (a)
Diospyros lycioides	Shrub	Ebenaceae	Medicinal uses, edible parts, dyes	Star Apple (e), Bloubessie (a)
Dipcadi species	Geophyte	Liliaceae	None	--
Elephantorrhiza elephantina	Shrub	Fabaceae	Medicinal uses, poisonous parts, dyes & tanning	Eland's Bean (e), Elandsboontjie (a)
Elionurus muticus	Grass	Poaceae	Unpalatable, Increaser IIb	Wire Grass (e), Koperdraad (a)
Eragrostis capensis	Grass	Poaceae	Moderate grazing potential	Heart-seed love grass (e), Hartjiesgras (a)
Eragrostis chloromelas	Grass	Poaceae	Edible parts, Increaser IIb	Curly leaf (e), Krulblaar (a)
Eragrostis curvula	Grass	Poaceae	Edible parts, indicator of degraded areas	Weeping love grass (e), Oulandsgras (a)
Eragrostis gummiflua	Grass	Poaceae	Unpalatable, low grazing potential, Increaser IIc	Gum grass (e), Gomgras (a)
Eragrostis nindensis	Grass	Poaceae	Increaser IIc	Wether Love Grass (e), Hamelgras (a)
Eragrostis plana	Grass	Poaceae	Weaving, unpalatable, indicator of degraded areas,	Tough love grass (e), Taai-pol eragrostis

Eragrostis racemosa	Grass	Poaceae	Palatable grazing, Increaser IIb	Narrow heart love grass (e), Smalhartjiesgras (a)
Eriosema cordatum	Forb	Fabaceae	None	--
Eriospermum abyssinicum	Geophyte	Liliaceae	Medicinal uses	--
Eulalia villosa	Grass	Poaceae	Unpalatable, Increaser 1	Golden Velvet Grass (e), Geelfluweelgras (a)
Euphorbia clavarioides	Succulent	Euphorbiaceae	None	Vingerpol (a)
Euphorbia striata	Forb	Euphorbiaceae	None	Milkweed (e), Melkgras (a)
Euryops laxus	Forb	Asteraceae	None	Resin Bush (e), Harpuisbos (a)
Felicia muricata	Forb	Asteraceae	None	Wild Aster (e), Blouheuning (a)
Fimbristylis species	Sedge	Cyperaceae	None	--
Fuirena pubescens	Sedge	Cyperaceae	None	--
Gazania krebsiana	Forb	Asteraceae	Medicinal uses, food source	Butter flower (e), Botterblom (a)
Gladiolus ecklonii	**Geophyte**	**Iridaceae**	**None**	**Common Speckled Gladiolus (e), Spikkel Gladiolus**
Gladiolus vinosomaculatus	**Geophyte**	**Iridaceae**	**None**	**Gladiola**
Gnidia capitata	Forb	Thymelaeaceae	Poisonous extracts	Kerrieblom (a)
Gnidia sericocephala	Forb	Thymelaeaceae	None	--
Gnidia species	Forb	Thymelaeaceae	None	--
Gomphrena celosioides	Forb	Amaranthaceae	Weed, South America	Bachelor's button (e), Mierbossie (a)
Haplocarpha scaposa	Forb	Asteraceae	None	Tonteldoosbossie (a)
Hebenstretia comosa	Forb	Selaginaceae	None	Katstert (a)
Helichrysum aureonitens	Forb	Asteraceae	Medicinal properties	--
Helichrysum chionosphaerum	Forb	Asteraceae	None	--
Helichrysum coriaceum	Forb	Asteraceae	None	Vaalteebossie (a)
Helichrysum dasymallum	Forb	Asteraceae	None	--
Helichrysum nudifolium	Forb	Asteraceae	None	Hottentot's tea (e), Hottentotstee (a)
Helichrysum rugulosum	Forb	Asteraceae	None	--
Helichrysum setosum	Forb	Asteraceae	None	Yellow Everlasting (e), Geelsewejaartjie (a)
Helichrysum species	Forb	Asteraceae	None	--
Heteropogon contortus	Grass	Poaceae	Moderate grazing potential, irritant	Spear grass (e), Assegaaigras (a)
Hilliardiella oligocephala	Forb	Asteraceae	Medicinal uses	Bitterbossie (a) (previous Vernonia oligocephala)
Hyparrhenia filipendula	Grass	Poaceae	Moderate palatability, Increaser I	Red Thatching Grass (e), Rooitamboekiegras (a)
Hyparrhenia hirta	Grass	Poaceae	Thatching & weaving	Thatch Grass (e), Dekgras (a)
Hyparrhenia tamba	Grass	Poaceae	None	Berggras (a)
Hypericum aethiopicum	Forb	Hypericaceae	Poisonous characteristics, medicinal uses	Small hypericum (e), Vlieëpisbossie (a)
Hypoxis iridifolia	Geophyte	Hypoxidaceae	None	--
Hypoxis obtusa	Geophyte	Hypoxidaceae	None	--

Hypoxis rigidula	Geophyte	Hypoxidaceae	None	Farmer's String (e), Botterblom (a)
Indigofera zeyheri	Forb	Fabaceae	None	--
Ipomoea bathycolpos	Forb	Convolvulaceae	None	Veldsambreeltjies (a)
Ipomoea crassipes	Forb	Convolvulaceae	Medicinal uses, food source	Leavy-flowered Ipomoea (e), Wildewinde (a)
Ipomoea ommanneyi	Forb	Convolvulaceae	Medicinal uses	Ox Patato (e), Beespatat (a)
Isolepis cernua	Sedge	Cyperaceae	None	--
Justicia anagalloides	Forb	Acanthaceae	None	--
Kyllinga alba	Sedge	Cyperaceae	Medicinal uses	White Buttonsedge (e), Witbiesie (a)
Kyphocarpa angustifolia	Forb	Amaranthaceae	None	Silky Burweed (e)
Lactuca inermis	Forb	Asteraceae	None	--
Lapeirousia sandersonii	Geophyte	Iridaceae	None	Autumn painted petals (e), Blou-angelier (a)
Ledebouria ovatifolia	Geophyte	Liliaceae	None	--
Ledebouria revoluta	Geophyte	Liliaceae	Edible parts	--
Ledebouria species	Geophyte	Liliaceae	None	--
Leersia hexandra	Grass	Poaceae	None, hostplant for Metiselle meninx	Wild rice grass (e), Wilderysgras (a)
Leonotis ocymifolia	Forb	Lamiaceae	Medicinal uses, colours & dyes	Minaret Flower (e), Wildedagga (a)
Lippia javanica	Shrub	Verbenaceae	Medicinal uses	Fever Tea (e), Beukesbossie (a)
Lopholaena coriifolia	Shrub	Asteraceae	None	Pluisbossie (a)
Lotononis calycina	Forb	Fabaceae	None	--
Lotononis foliosa	Forb	Fabaceae	Traditional uses	Bookleaved Lotononis
Loudetia simplex	Grass	Poaceae	Unpalatable, poor grazing potential	Common Russet Grass (e), Stingelgras (a)
Melinis repens	Grass	Poaceae	Poor grazing potential, Increaser IIc	Natal Red Top (e), Natal-rooipluim (a)
Microchloa caffra	Grass	Poaceae	Low grazing potential, Increaser Iic	Pincushion Grass (e), Elsgras (a)
Monocymbium ceresiiforme	Grass	Poaceae	Unpalatable, indicator of sour soils, Decreaser	Boat Grass (e), Bootjiegras (a)
Monopsis decipiens	Forb	Lobeliaceae	Medicinal uses	Butterfly Lobelia (e), Skoenlapperplant (a)
Monsonia angustifolia	Forb	Geraniaceae	None	Crane's Bill (e), Angelbossie (a)
Nidorella anomala	Forb	Asteraceae	None	--
Nidorella hottentotica	Forb	Asteraceae	None	--
Oldenlandia herbacea	Forb	Rubiaceae	None	False Spurry (e)
Oxalis obliquifolia	Geophyte	Oxalidaceae	None	Oblique-leaved Sorrel (e), Skuinsblaarsuring (a)
Oxygonum dregeanum	Forb	Polygonaceae	None	--
Panicum aequinerve	Grass	Poaceae	None	--
Panicum coloratum	Forb	Poaceae	Palatable grazing grass, Decreaser	White Buffalo Grass (e), Witbuffelgras (a)
Panicum natalense	Grass	Poaceae	Decreaser	Natal Panicum (e), Suurbuffelsgras (a)
Parinari capensis	Forb	Chrysobalanaceae	Edible parts	Dwarf Mabola (e), Grysappeltjie (a)

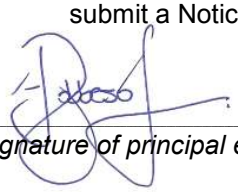
Paspalum dilatatum	Grass	Poaceae	Moist places, palatable, Increaser IIB	Common Paspalum (e), Gewone Paspalum (a)
Paspalum distichum	Grass	Poaceae	Palatable grazing, sometimes problematic weed	Couch Paspalum (e), Kweekpaspalum (a)
Pearsonia cajanifolia subsp. *cajanifolia*	Shrub	Fabaceae	None	--
Pearsonia sessilifolia	Forb	Fabaceae	None	Silwerertjietee (a)
Pelargonium luridum	Geophyte	Geraniaceae	Medicinal uses, traditional uses	Stalked-flower Pelargonium (e), Wildemalva (a)
Pellaea calomelanos	Fern	Adianthaceae	Medicinal properties	Hard Fern (e), Hardevaring (a)
Pennisetum clandestinum	Grass	Poaceae	Invader (E. Africa), palatable grazing	Kikuyu Grass (e), Kikoejoegras (a)
Pentanisia angustifolia	Forb	Rubiaceae	None	--
Perotis patens	Grass	Poaceae	Indicator of poor management, Decreaser IIc	Cat's Tail (e), Katstertgras (a)
Persicaria lapathifolia	Hydrophilic	Polygonaceae	Indicator of moist conditions, Naturalised exotic	Spotted Knotweed (e), Hanekam (a)
Peucedanum magalismontanum	Forb	Apiaceae	Edible parts	Wild Parsely (e), Wildepietersielie (a)
Phragmites australis	Hydrophilic	Poaceae	Thatching, traditional uses, medicinal properties	Common Reed (e), Fluitjiesriet (a)
Pollichia campestris	Shrub	Illebracaceae	Edible parts	Waxberry (e), Teesuiker (a)
Protea welwitschii	Shrub	Proteaceae	None	Cluster-head Sugarbush (e), Kleinsuikerbos (a)
Psammotropha myriantha	Forb	Aizoaceae	None	--
Pseudognaphalium luteo-album	Forb	Asteraceae	Weed (Europe)	Jersey Cudweed (e), Roerkruid (a)
Pygmaeothamnus chamaedendrum	Forb	Rubiaceae	None	Sand Apple (e), Goorappel (a)
Raphionacme hirsuta	Forb	Periplocaceae	Edible parts	Khadi-root (e), Khadiwortel (a)
Raphionacme species	Forb	Periplocaceae	None	--
Richardia brasiliensis	Forb	Rubiaceae	None	Mexican Richardia (e), Meksikaanse Richardia (a)
Rotheca hirsuta	Forb	Lamiaceae	None	--
Schizachyrium sanguineum	Grass	Poaceae	Palatable grass, thatching, Increaser I	Red Atumn Grass (e), Rooiherfsgras (a)
Schkuhria pinnata	Forb	Asteraceae	Medicinal uses, weed (S. America)	Dwarf Marigold (e), Bitterbossie (a)
Searsia lancea	Tree	Anacardiaceae	Edible parts, tanning	Common Karree (e), Gewone Karree (a)
Searsia magalismontana	Shrub	Anacardiaceae	None	Mountain Wild Current (e), Bergtaaibos (a)
Searsia pyroides	Shrub	Anacardiaceae	Edible parts, Medicinal uses	Common wild currant (e), Gewone taaibos (a)
Selaginella dregei	Hydrophilic	Selaginaceae	Medicinal uses	Resurrection Plant (e)
Selago densiflora	Forb	Selaginaceae	None	--
Senecio erubescens	Forb	Asteraceae	None	--
Senecio inornatus	Forb	Asteraceae	None, indicator of moist conditions	--
Senecio polyodon var. *polyodon*	Forb	Asteraceae	None	--
Senecio venosus	Forb	Asteraceae	None	--
Seriphium plumosum	Shrub	Asteraceae	Invasive properties	Bankrupt bush (e), Bankrotbos (a)
Setaria nigrirostris	Grass	Poaceae	Indicator of moist conditions, clayey soils, palatable,	Black-seed bristle grass (e), Swartsaadmannagras (a)
Setaria sphacelata	Grass	Poaceae	Edible parts, palatable, Decreaser	Common bristle grass (e), Gewone Mannagras (a)

Sida alba	Forb	Malvaceae	None	Spiny Sida (e), Stekeltaaiman (a)
Solanum lichtensteinii	Forb	Solanaceae	None	Bitter apple (e), Bitter appel (a)
Solanum mauritianum	Shrub	Solanaceae	Declared Invader - Category 1B	Bugweed (a), Groot Bitterappel (a)
Solanum nigrum	Forb	Solanaceae	Weed	Black Berry (e), Nastergal (a)
Solanum sisymbriifolium	Forb	Solanaceae	Declared Invader - Category 1B	Wild tomato (e), Doringbitterappel (a)
Sphenostylis angustifolia	Forb	Fabaceae	None	Wild sweetpea (e), Wilde-ertjie (a)
Sporobolus africanus	Grass	Poaceae	Palatable, indicator of degraded areas	Ratstail Dropseed (e), Fynsaadgras (a)
Sporobolus pectinatus	Grass	Poaceae	Unpalatable grazing	Fringed Dropseed (e), Kammetjiesgras (a)
Stachys species	Forb	Lamiaceae	None	--
Striga bilabiata	Parasite	Scrophulariaceae	None	Small Witchweed (e), Pienkheksebos (a)
Syncolostemon pretoriae	Forb	Lamiaceae	None	--
Tagetes minuta	Forb	Asteraceae	Essential oils, colours & dyes	Khaki Weed (e), Kakiebos (a)
Tephrosia capensis	Forb	Fabaceae	None	--
Tephrosia lupinifolia	Forb	Fabaceae	None	Vingerblaar-ertjie (a)
Teucrium trifidum	Shrub	Lamiaceae	Medicinal uses	Koorsbossie (a)
Themeda triandra	Grass	Poaceae	Palatable grazing, Decreaser	Red grass (e), Rooigras (a)
Trachypogon spicatus	Grass	Poaceae	Moderate palatability, Increaser I	Giant Spear Grass (e), Bokbaardgras (a)
Trichoneura grandiglumis	Grass	Poaceae	None	Small Rolling Grass (e), Kleinrolgras (a)
Trifolium africanum	Forb	Fabaceae	Weed of damp and disturbed places	Wild clover (e), Wildeklawer (a)
Tristachya leucothrix	Grass	Poaceae	Moderate palatable grazing, Increaser I	Hairy trident grass (e), Harige-drieblomgras (a)
Tristachya rehmannii	Grass	Poaceae	Unpalatable, traditional uses	Broom trident grass (e), Besemdrieblomgras (a)
Typha capensis	Hydrophilic	Typhaceae	Cosmopolitan weed, edible parts, medicinal uses	Bulrush (e), Papkuil (a)
Urelytrum agropyroides	Grass	Poaceae	Unpalatable, Increaser I	Quinine Grass (e), Varkstertgras (a)
Verbena bonariensis	Forb	Verbenaceae	Declared Invader - Category 1B, Weed (S. America)	Purple Top (e), Blouwaterbossie (a)
***Watsonia* species**	**Geophyte**	**Iridaceae**	**None**	**--**
Xerophyta retinervis	Geophyte	Velloziaceae	Medicinal uses	Monkey's Tail (s), Bobbejaanstert (a)
Xysmalobium undulatum	Shrub	Apocynaceae	Medicinal uses, diarrhoea, colic	Bitterhout (a)
Ziziphus mucronata	Shrub	Rhamnaceae	Edible parts, medicinal uses	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)
Zornia linearis	Forb	Fabaceae	None	Narrow-leaved Catterpillar Bean (e)

12 APPENDIX 2: 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:

3rd November 2013

Date:

13 APPENDIX 3: 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 the interpretation of information available to them at the time of compiling this report.
- Due care and diligence is exercised by the authors, consultants and/or specialist investigators in rendering services and preparing this document. BEC, the consultants and/or specialist investigators accepts no liability for conclusions, suggestions, limitations and recommendations made in good faith, based on available information, or based on data that was obtained from surveys.
- The client, by accepting this document, indemnifies BEC, its members, consultants and/or specialist investigators against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by BEC and by the use of the information contained in this document.
- Results presented in this report are based on a snapshot investigation of the study site 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 site.
- This report is based on surveys that were conducted during a time that reflects an early summer period; although vegetation was found to be in a vegetative state, many plants could not be identified accurately due to the lack of reproductive material.
- 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.

14 APPENDIX 4: 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 out 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, include:

Table 15: Legislative guidance for this project

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.

Table 15: Legislative guidance for this project	
Convention on International Trade in Endangered Species of Wild Life and Fauna	International agreement between governments, drafted because of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Environmental Conservation Act (No. 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
Mineral and Petroleum Resources Development Act (Act No.28 of 2002) (MPRDA)	Compilation of Environmental Impact Assessment (EIA) and Environmental Management Programme (Reports) (EMPR).
Mpumalanga Environmental Management Act (Act No. 10 of 1998)	
Mpumalanga Tourism and Parks Agency Act (Act No. 5 of 2005)	To provide for the establishment of the Mpumalanga Tourism and Parks Agency and for the management thereof by a Board; to provide for the sustainable development and improvement of the tourism industry in Mpumalanga; to provide for conservation management of the natural resources of Mpumalanga; to confer powers and functions upon the Agency; to provide for the registration of certain persons and entities directly involved in tourism; to provide for transitional arrangements; and to provide for matters incidental thereto
Mpumalanga Parks Board Act of 1995	
National Veld & Forest Act Fire Act (Act No. 101 of 1998)	To prevent and combat veld, forest and mountain fires throughout the Republic, to provide for a variety of institutions, methods and practices for achieving the purpose.
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: Biodiversity Act (Act No. 10 of 2004)	To provide for matters relating to threatened or protected species regulations
National Environmental Management 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.
White Paper on Conservation and Sustainable Use of South Africa's Biological Diversity (July 1997)	Identifies a number of strategies to be developed to give effect to the specific policies, including the enhancement of the protected area network, development of specific strategies such as conservation and sustainable use of reptiles and amphibians. Promotes a "Prosperous, environmentally conscious nation, whose people are in harmonious co-existence with the natural environment, and which derives lasting benefits from the conservation and sustainable use of its rich biological diversity"

15 APPENDIX 5: METHOD STATEMENT

In order to address existing information gaps and satisfy requirements for EIA investigations, an over-arching approach was followed to allow for the capture of maximum data and adequate subsequent analysis thereof during the allotted timeframe. This approach is based on a single summer survey. Botanical and faunal data were captured in point samples (releveès) that was placed in a stratified random means across the entire study site. Care was taken to ensure that all identified macro habitat types were sampled adequately during the allotted timeframe.

Subsequent to the data analysis process, an impact assessment process was conducted during which the nature and extent of the proposed development on the natural environment was assessed.

Floristic and faunal sampling of the study site was conducted between the 24th and 25th January 2013.

15.1 ASSESSMENT PHILOSOPHY

Inherent characteristics of a project of this nature imply that no method will be foolproof. These shortcomings are typical of EIA type investigations and stems from the use of databases with a high degree of paucity and the lack of site-specific detail that could be obtained from limited site surveys that were conducted over a short period and during a single (part) season. This is also a limitation of all scientific studies; it simply is not possible to know everything or to consider every aspect to a molecular level of detail. However, to present an objective opinion of the biodiversity sensitivity of the study site and how this relates to the suitability/ unsuitability of the study site 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 analysis and interpretation of collated data; 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 mining operation and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity for the study site;
- Highlight flora and fauna species of conservation importance that are likely to occur within the study site;
- Estimate the level of potential impacts of the construction, operation and decommissioning of the proposed development on the biological resources of the study site; and
- Apply the Precautionary Principal throughout the assessment[7].

15.2 FLORISTIC ASSESSMENT

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

15.2.1 Sampling Approach

The number of sample plots to be distributed in a given area depends on various factors, such as the scale of the classification, environmental heterogeneity and the accuracy required for the classification (Bredenkamp 1982). Stratification of sample plots was therefore based on visual observations made during the initial site investigation as well as aerial imagery. The Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964) was followed; this is a standardised and widely used sampling technique for general vegetation surveying in South Africa. During the surveys, all plant species within in sample plots were identified and recorded. In addition, a suitable selection of the following biophysical attributes was recorded within each relevè:

- Altitude- and longitude positions for each relevè - obtained from a GPS;
- Soil characteristics, including colour, clay content, etc;
- Topography (crests, scarps, midslopes, footslopes, valley bottoms, floodplains or drainage lines);
- Altitude, slope and aspect;
- Rockiness, estimated as a percentage;
- Rock size; and
- General observations (including the extent of erosion, utilisation, disturbances of the vegetation management practices, etc).

In addition to species recorded within the sample plots, general observations were made in order to present a comprehensive species list that will include taxa that, because of low abundance levels, are unlikely to be captured within the sample areas (relevèes). Particular reference is made to Red Data plants, which normally do not occur at great densities.

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

15.2.2 Floristic 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 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 the following attributes:

- The confirmed presence of flora species of conservation importance, the known presence of flora species of conservation importance or the presence of protected flora species (provincially or other legislation);
- Conservation status of the regional vegetation type;
- The observed ecological status, based on degradation gradients, utilisation, habitat fragmentation and isolation, etc.
- The observed (or potential) floristic diversity, compared to surrounding areas and also compared to a pristine status of the particular habitat type within the regional vegetation type; and
- The functionality of the habitat type in a larger landscape that may, or not, be dominated by degradative and transformative anthropogenic activities.

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.

In addition to the general floristic attributes that are being considered when estimating the sensitivity of floristic habitat types, additional (regional) attributes are also taking cognisance of during the estimation process. The aim of this exercise is to present an opinion on the inherent floristic sensitivity of macro habitat types of the study site. These issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. The application of these criteria is a matter of professional judgement. These criteria are ranked as follows:

- Threatened and/or Protected-:
  - plant species **(YES)**;
  - ecosystems **(YES)**;
- Critical conservation areas, including:
  - areas of high biodiversity **(YES)**;
  - centres of endemism **(YES)**;
- Important Ecological Processes, including:
  - Corridors **(YES)**;
  - Mega-conservancy networks (**NO)**;
  - Rivers and wetlands **(YES)**; and
  - Important topographical features **(YES)**.

15.3 FAUNAL ASSESSMENT

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.).

Field investigations commonly employed for EIA studies are normally limited by time and budget and scientific approaches generally have to be adapted to allow for limitations that are normal to EIA type investigations. Ecology and biodiversity are growing fields of science and much is still unknown. Limited information pertaining to mammals and birds exist for the study site. Similarly, information on herpetofauna and invertebrates of the region and farms is lacking in detail and significant information gaps exist in this regard.

For these reasons, the following EIA study methods were implemented to gain an understanding of the ecology of the study site as well as the biodiversity contribution of the study site within a larger topographical context.

15.3.1 Invertebrates

Invertebrates are by far the most abundant animals present anywhere. They are extremely useful bio-indicators and include meaningful surrogates, flagships and diversity indicators. Invertebrate sampling was conducted by means of compiling a general species inventory, using visual observation and active searches for scorpions, butterflies (using a hand-held net) and beetles (under rocks, hand-netting, etc.).

15.3.2 Herpetofauna

Frogs were recorded using species-specific calls of males as identification; also, active searches for active adults during early evenings. Snakes, lizards and other reptiles were sampled by active searches in likely habitats (under rocks, inactive termitaria, etc.)

15.3.3 Birds

Recording the avifaunal diversity of the study site included three components:

- Visual sightings;
- Audio observations; and
- Habitat assessments.

While most bird species of any given area is normally visible and readily distinguishable using visual observation methods, other bird species are cryptically coloured and can only be identified using sound. The calls of most cryptic bird species are species-specific and are useful in compiling a species inventory list. Binoculars were used to assist in identifying smaller and more cryptic species.

Ideally, seasonal collation of presence records are needed to create an “avifauna image” of the study site that supports bird communities in the area. Since this is rarely accomplished in reality, brief habitat assessments are employed to create a “model” of the bird communities likely to be found in the study site. Comprehensive data is fortunately available on the birds of Southern Africa, including distribution records, habitat requirements, etc. By assessing the available habitat within the study site (with focus on habitat characteristics available, diversity and quality of habitats), the potential presence (PoC) of bird species (with

particular reference to Red Data birds) are assessed. The final stage of the avifaunal study utilises the image that was created of the avifaunal communities of the study site in assessing the impacts of the proposed project on the avifaunal component of the study site.

15.3.4 Mammals

Visual sightings as well as ecological indicators such as tracks, dung, calls and diggings were used to compile a species inventory of the mammals of the study site.

15.3.5 Ecology

Species inventory lists and indications of species richness and -diversity recorded with the aid of above-mentioned methods are used to interpret the relative ecological status of the study site/s and to compare areas and variations in faunal habitats present. These comparisons are done in collaboration with vegetation characteristics in order to gain an ecological understanding of the study site and the potential impacts of the study site/s.

15.3.6 Faunal Sensitivity

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

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

15.4 IMPACT EVALUATION

The impact assessment needs to be determined for the following variables and ranking scales:

Occurrence:

- Probability of occurrence (likelihood of the impact occurring), and
- Duration of occurrence.

Severity:

- Magnitude (severity) of impact; and
- Scale/extent of impact.

In order to assess relevant impacts, the following ranking scales are implemented:

Table 16: EIA Ratings used in this assessment

Magnitude	*Duration*	*Scale*	*Probability*
10 - Very high/ don't know	5 - Permanent	5 - International	5 - Definite/ don't know
8 - High	4 - Long term (ceases with the operational life)	4 - National	4 - Highly probable
6 - Moderate	3 - Medium term (5-15 years)	3 - Regional	3 - Medium probability
4 - Low	2 - Short Term (0-5 years)	2 - Local	2 - Low Probability
2 - Minor	1 - Immediate	1 - Site only	1 - Improbable
		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.

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