Appendix L: Biodiversity

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONTINUOUS ASH DISPOSAL FACILITY FOR THE MATIMBAPOWER STATION IN LEPHALALE, LIMPOPO PROVINCE

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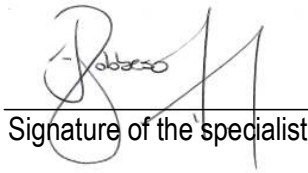
4.2 The specialist appointed in terms of the Regulations_

I, Riaan A. J. Robbeson (Pr.Sci.Nat.) declare that:

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing:
    - any decision to be taken with respect to the application by the competent authority; and
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

Bathusi Environmental Consulting cc

Name of company (if applicable):

2014 04 07

Date:

BEC Report Reference:	RHD – MCA – 2014/08
Version:	2014.07.18.5
Authority Reference	NA

Biodiversity Impact Assessment of the Proposed Continuous Ash Disposal Facility & Linear Infrastructure Route for Matimba Power Station, Limpopo Province©

compiled by

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July 2014

I PROJECT DETAILS

Client:	Royal HaskoningDHV, on behalf of Eskom Holdings SOC Limited
Report name:	Biodiversity Impact Assessment of the Proposed Continuous Ash Disposal Facility & Linear Infrastructure Route for Matimba Power Station, Limpopo Province
Report type:	Strategic Biodiversity Impact Assessment Report
BEC Project number:	RHD – MCS – 2014/08
Report Version:	2014.07.18.5
Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.) - Bathusi Environmental Consulting

II SPECIALIST INVESTIGATORS

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

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

The following specialists contributed to this report:

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Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	*667.08/08*
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1 EXECUTIVE SUMMARY

Ash produced from the Matimba Power Station is currently being disposed by means of 'dry ashing' approximately 3 km (three kilometres) south of the power station, on Eskom owned land. Approximately 6 million tons of ash is produced annually from the Matimba Power Station. The proposed ash disposal facility will ensure that the power station is able to accommodate the ashing requirements for the remaining life (approximately 44 years) of the power station. Results of the integrated scoping process yielded two alternative sites that are under assessment in the EIA phase. The first site alternative is situated adjacent to the existing ashing facility on the farm Zwartwater 507LQ. The second alternative site is situated on portions of four farms, namely:

- Ganzepan 446 LQ;
- Vooruit 449 LQ;
- Appelvlakte 448 LQ; and
- Droogeheuvel 447 LQ.

The aim of this EIA assessment is to evaluate the intrinsic biodiversity sensitivities of each of the sites and recommend a preferred option for the proposed project. Eskom has appointed Royal HaskoningDHV as the Environmental Assessment Practitioner (EAP) for the project. Bathusi Environmental Consulting cc was appointed as independent ecologists to conduct an ecological scoping/ screening assessment of the proposed site alternatives and the proposed linear infrastructure route and compile an impact identification report for the terrestrial biodiversity component of this project.

1.1 BIOPHYSICAL ASSESSMENT

The study area is situated in the Lephalale Municipality, which comprises approximately 1,960,140 ha, of which 94.4 % is regarded untransformed (BGIS, 2009). The immediate region is characterised by (mostly untransformed) savanna woodland, but recently have experienced significant development in terms of road networks, mining related land transformation and power stations with the associated infrastructure, such as power line servitudes, ashing facilities, water treatment plants, etc. Land use in the region varies between game farming and cattle farming; extremely little arable agriculture is practiced, mainly because of relative low rainfall and poor soils that predominate in the region.

Site Alternative 1 is situated within the Bd46 land type (catenas, including Hutton, Bainsvlei, Avalon and Longlands and valley bottoms occupied by gley soils) land types. Site Alternative 2 is situated within the Ah85 land type (yellow and red soils without water tables, including Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly soil forms). Fine-scaled variations are observed on ground level that is attributed to substrate conditions, to which the geology plays a determining part. Geology of the site alternatives comprises the Clarens Arenite formations.

Currently, there are nine declared land-based protected areas in the Lephalale Municipality, comprising a total of 89,406 ha (4.6 % of municipality). However, there are no biospheres, conservancies or other declared areas of conservation present in the immediate surroundings of the Site Alternatives. The closest area of conservation is the D'Njala Nature Reserve, situated approximately 14 km to the east. The site alternatives are situated within the Limpopo Catchment area. Major rivers of the surrounds include the Mogol River (approximately 13 km to the east of Site Alternative 1) and the Limpopo River (approximately 40 km to the northwest of Site Alternative 1). Other than small artificial impoundments, no permanent surface water is present within Site Alternative 1. The non-perennial Sandloopspruit is situated approximately 300 m to the

south of Site Alternative 1. Site Alternative 2 comprises two small artificial impoundments and the northern part of this site is regarded an alluvial plain.

1.2 BOTANICAL ASSESSMENT

Vegetation of the region is defined by Mucina and Rutherford (2006) as the Limpopo Sweet Bushveld. Although this vegetation type is regarded not threatened (Least Threatened), only 1 % is formally conserved in statutory conservation areas.

Information obtained from the SANBI database (POSA, 2012) indicates the known presence of approximately 311 plant species within the ¼-degree grid that is sympatric to the greater study region (2327DA). The high floristic diversity of the immediate region reflects the regional diversity context of the savanna biome. The 2013 survey yielded an Alpha Diversity of 164 taxa, which is regarded representative of floristic diversity on a regional scale. A basic synopsis of the growth forms recorded in the region reflects the savanna physiognomy of the region, which is dominated by a relative diverse woody layer, comprising of 52 species (small trees, shrubs, trees). Typically, the herbaceous layer is prominent and diverse; a total of 33 grass species (20.1 %) were recorded. The herbaceous layer is rich in species, comprising 62 species. The diversity of plants within the site alternatives is represented by 47 plant families, dominated by Poaceae (graminoids) and Fabaceae (legume family, 23 species).

The average number of species recorded in releveès during the survey period is 30.7 per sampling bout (std. dev. = 6.3). The lowest total was 15 (101A, Site Alternative 1), with 42 (217, Site Alternative 2) the highest number of individuals. The average number of species recorded on Site Alternative 1 is 27.9, while the average number of species recorded on Site Alternative 2 is 32.8. The higher alpha diversity of Site Alternative 2 is regarded a reflection of the degraded status of much of the vegetation, resulting from severe and sustained grazing pressure causing the proliferation of several weeds and invasive species that are not necessarily associated with the more pristine flora of Site Alternative 1.

The bootstrap analysis of the observed species revealed the following aspects:

- Additional sampling that takes consideration of seasonal and long-term climatic variation is likely to reveal a higher diversity of species within the study region;
- The actual number of species recorded during the sampling process is 164, while the predictors estimate a species richness of between 207 and 242 species, which correlates well with the recorded species richness of the relevant ¼-degree grid that is spatially represented in the site alternatives (311 species);
- The Shannon-Weiner diversity index (H') indicates that there is not a marked difference between the average values of Site Alternative 1 and Site Alternative 2 (3.01 vs 3.00);
- The Evenness (E) index indicates an average of 0.88 (± 0.06) for the dataset. Site Alternative 1 indicates a higher average value, namely 0.91 compared to Site Alternative 2 (0.86), indicating a degradation gradient with several weedy and poor quality species dominating the species composition. As a result of degradation and changes in species composition, the abundance values of species has become unstable. The species composition and dominance values recorded in Site Alternative 1 represents a more pristine environment; typically a higher number of co-dominant species will be recorded in a more pristine environment while a degraded habitat will comprise of a few species that tend to dominate exclusively while other species are represented by lower abundance values. Results of the Evenness Index clearly indicates the degraded nature of vegetation

on Site Alternative 2, this is also confirmed by the high average species diversity recorded in these areas as a result of the infestation by weedy and poor quality plants; and

- Simpson's Diversity Index indicates the degraded nature of Site Alternative 2, with an average value of 13.1, compared to the average value of Site Alternative 1 of 15.7. The prominence and dominance of weedy and poor quality species is indicated by high cover abundance values of these species, the species composition within these areas is typically composed of a few abundant (dominant) species while a high number of other species are recorded as occasional species with low cover abundance values. In contrast, more pristine woodland sample plots were characterised by a higher number of co-dominant species. No specific species were found to dominate exclusively in these areas and the general abundance values were in the lower categories.

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

- *Acacia erioloba* (Declining, Protected Tree);
- *Boscia albitrunca* (Protected Tree);
- *Combretum imberbe* (Protected Tree);
- *Sclerocarya birrea* (Protected Tree)
- *Securidaca longepedunculata* var. *longepedunculata* (Protected Tree); and
- *Spirostachys africana* (Provincially protected).

No threatened or Red Data plant species were recorded during the brief survey period. However, parts of both the proposed site alternatives comprise significant numbers of protected tree species. In particular, *Acacia erioloba, Boscia albitrunca* and *Spirostachys africana* were recorded in significant numbers. The submission of permit applications to authorities is therefore required. Suitable density surveys need to be conducted in order to determine the exact number and densities of protected species within the authorised footprint in order to facilitate permit applications.

Results of the TWINSPAN, indicates the following communities and variations (with floristic sensitivities):

- *Nymphaea – Schoenoplectus* Impoundments Community (medium-high floristic sensitivity);
  - *Typha capensis* Variation;
  - *Brachiaria nigropedata* Variation;
- *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland Community (medium-high floristic sensitivity);
  - *Croton gratissimus - Sclerocarya birrea* – Gravel Plains Variation;
  - *Acacia nigrescens – Melhania forbesii Woodland Variation*;
- *Vernonia* species - *Panicum maximum* Degraded Woodland Community (medium floristic sensitivity);
  - *Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation;
  - *Acacia mellifera – Acacia tortilis* Alluvial Plains Variation;
- *Portulaca – Oldenlandia* Sheetrock Community (medium-high floristic sensitivity); and
- Artificial woodland habitat (medium-low floristic sensitivity).

Site Alternative 1: Vegetation of this alternative is pristine and representative of the regional vegetation type. A high connectivity to adjacent pristine savanna habitat is noted to the south. Protected tree species are abundant within this area. Habitat located to the south of this site is regarded sensitive, including riparian woodlands. It is possible, although unlikely, that these sensitive habitat types could be affected adversely by the extension of the existing ashing facility. Loss of natural (pristine) habitat from development of the ashing facility is regarded more significant than for Site Alternative 2. A medium-high floristic sensitivity is therefore estimated for all natural vegetation of this site.

Site Alternative 2: Habitat of this unit is regarded slightly degraded due to persistent high grazing pressure. In particular, the herbaceous layer includes dominant weeds and indicator species of poor habitat conditions. Habitat diversity within this area is also lower compared to Site Alternative 1 and the loss of habitat from this site is therefore not regarded as significant. Ecological connectivity of this site is good; being surrounded by natural woodland habitat. However, visual observations indicate that similar poor habitat conditions prevail in surrounding areas. Importantly, no existing infrastructure is available for the transportation of ash to this area, implying that an additional conveyor section needs to be constructed. This will result in increased habitat fragmentation. This factor was included in the preference ranking for the respective sites. A medium floristic sensitivity is therefore estimated for all natural terrestrial vegetation of this site.

Upon consideration of all factors, Alternative 2 is therefore regarded more suitable compared to the Alternative 1. The potential loss of sensitive habitat from Alternative 1 will be more significant than for Alternative 2. Preference ranking ascribed to the various sites are therefore presented as follows:
Site Alternative 1 – 2 (Not preferred); and
Site Alternative 2 – 3 (Acceptable).

A technically feasibly linear infrastructure route has been proposed for Site Alternative 2, comprising a length of approximately 9.75 km, situated on portions of the following farms:

- Appelvlakte 448;
- Grootestryd 465; and
- Nelsonskop 454.

A basic field investigation revealed the presence of three distinct macro habitat types within the proposed conveyor line, namely:

- **Degraded Woodland** – A medium-low floristic sensitivity is ascribed to these parts, resulting from a sub-climax composition and the absence of plant taxa of conservation importance;
- **Natural Woodland** – Typical woodland habitat of the region; a medium floristic status is ascribed to this area, the presence of numerous protected species is however an aspect of importance, albeit typical of the natural woodlands of the region.
- ***Spirostachys africana* Woodland** – In addition, the particularly high density of the Provincially Protected tree *Spirostachys africana* and the affiliation with a mesic environment renders the floristic sensitivity of this unit moderately high. A realignment of the proposed line is recommended in order to avoid impacts on this woodland community.

Natural woodland varies considerably, which is mostly attributed to soil conditions and the prevalence of mesic environs. The presence and abundance of protected trees within the affected environment is generally an important consideration in the suitability of an area for development. The largest extent of the proposed conveyor line exhibit floristic attributes of a moderate sensitivity. Protected trees are indicated to abound throughout the region and impacts on protected trees within the natural woodlands of the area are unavoidable. However, a particularly high density of *Spirostachys africana* is recorded in a portion of the proposed line and is likely to result in a significant impact. A realignment is therefore recommended in order to ameliorate this potential impacts to a lower significance. The application of generic mitigation measures are expected to reduce the significance of other impacts to an acceptable level.

The recommended realignment should follow the existing Grootegeluk – Matimba conveyor line and divert eastwards towards Site Alternative 2 immediately south of Grootegeluk Mine. This recommended deviation

from the existing Grootegeluk – Matimba conveyor line must take place as far north as possible in order avoid the Nelsonskop topographical feature as this represents a particularly significant topographical and environmentally sensitive feature.

1.3 FAUNAL ASSESSMENT

Savannas of Limpopo have experienced recent impacts resulting from anthropogenic activities. The presence of minerals such as coal has led to significant transformation, degradation and fragmentation of the region's grasslands (Balmford *et. al.,* 2012). It is therefore important to view the respective site alternatives on an ecologically relevant scale; consequently, all sensitive animal species (specific faunal groups) known from the Limpopo Province were included in this assessment. Animals known to be present in the ¼-degree grid 2327DA were considered potential inhabitants of the site alternatives (all species known from the Limpopo Province were included in the assessment to limit the known effects of sampling bias).

Previous and on-going studies in the immediate vicinity of the site alternatives during the past years, revealed a total of at least 332 animal species in the site alternatives and immediate vicinity (approximately an area of 100 km²) surrounding the alternatives. This diversity includes eighteen Red Data species and two Alien and Invasive species.

A total of 98 animal species were recorded during these EIA surveys, including:

- 22 invertebrate species;
- 1 frog species;
- 3 reptile species;
- 53 bird species; and
- 19 mammal species.

The diversity of animals recorded in the site alternatives included three Red Data species, namely:

- Tawny Eagle (*Aquila rapax,* Temminck, 1828);
- Leopard (*Panthera pardus,* Linnaeus, 1758); and
- Brown Hyaena (*Parahyaena brunnea,* Thunberg, 1820).

A total of 164 Red Data animals are known to occur in the Limpopo Province (dragonflies, damselflies, butterflies, frogs, reptiles, birds and mammals). An assessment of the PoC for these animals yielded the following probabilities:

- 119 species have a low PoC;
- 16 species have a moderate-low PoC;
- 9 species have a moderate PoC;
- 2 species have a moderate-high PoC; and
- 15 species have a high PoC.

In addition to the above-mentioned Red Data species of Limpopo, 5 animal taxa (some overlap does occur) have protected status (NEMBA) within Limpopo (www.speciesstatus.sanbi.org). PoC for these species was estimated as follows:

- 3 species have a low PoC;
- 1 species has a moderate PoC; and
- 1 species has a moderate-high PoC.

Faunal sensitivity of respective habitat types are largely based on habitat status, diversity, linkage, the (potential) presence of RD species and the presence of sensitive habitat types. The following results were estimated for the respective communities:

- Artificial woodland — low faunal sensitivity
- *Nymphaea* - *Schoenoplectus* impoundments — medium-high faunal sensitivity
- *Kyphocarpa* - *Eragrostis* woodland — medium-high faunal sensitivity
- *Portulaca* - *Oldenlandia* sheetrock community — high faunal sensitivity
- *Vernonia* - *Panicum* degraded woodland — medium faunal sensitivity

The presence of at least ninety-eight animal species in the site alternatives (confirmed during the April 2013 field investigation) attest to the untransformed nature of the faunal habitats of the greater region. The ecological functionality, integrity, faunal biodiversity and general sensitivity of the site alternatives is underlined by the confirmed presence of three Red Data species in the study area as well as the confirmed presence of eighteen Red Data species in the immediate vicinity.

The region in which the site alternatives are located has been significantly altered in recent times and continues to experience very high land use change pressures. Consequently, the general sensitivities of faunal habitats and faunal communities of the region, increases almost on a daily basis.

Site Alternative 1 is located next to the existing ashing facility. The eastern third of the study area is characterised by artificial faunal woodland habitat (low faunal sensitivity). The remaining (approximately) two thirds of Site Alternative 1 include *K. angustifolia – E. rigidior* Woodland (medium-high faunal sensitivity), *Nymphaea – Schoenoplectus* impoundments (medium-high faunal sensitivity) and *Portulaca – Oldenlandia* sheetrock faunal habitat (high faunal sensitivity). A higher habitat diversity is associated with this site; while the status of the habitat is also in a better condition.

Site Alternative 2 is situated northeast of the Grootegeluk opencast coalmine. Most of Site Alternative 2 is characterised by *Vernonia* species – *P. maximum* degraded woodland faunal habitat (medium faunal sensitivity). Some areas of artificial woodland habitat (low faunal sensitivity) is evident, also two small *Nymphaea – Schoenoplectus* impoundments (medium-high faunal sensitivity). Site Alternative 2 does not include any faunal habitat fragments of high faunal sensitivity. Lower habitat diversity and variability is associated with Site Alternative 2, hence a moderate faunal sensitivity is ascribed to this option.

Preference ranking ascribed to the various sites are therefore presented as follows:
Site Alternative 1 – 2 (Not preferred); and
Site Alternative 2 – 3 (Acceptable).

Three faunal habitats have been identified for the area proposed for the linear infrastructures route line between Matimba Power Station and Site Alternative 2, namely:

- Degraded Woodland (medium-low faunal sensitivity);
- Natural Woodland (medium faunal sensitivity); and
- *Spirostachys africana* Woodland (high faunal sensitivity).

Based on the faunal habitat status, diversity, ecological connectivity, Red Data hosting ability and inherent sensitivity, different faunal sensitivities are assigned to the three faunal habitats of the site alternatives. The Degraded Faunal Woodland and Natural Faunal Woodland habitats is not deemed sensitive and it is not

considered likely that any animal species, assemblage or community will be significantly adversely affected by the construction and operation of the proposed conveyor line.

However, the *Spirostachys africana* Woodland faunal habitat type is likely to include unique and sensitive faunal communities within the general arid landscape of the region and is thus regarded sensitive in terms of faunal attributes. This habitat is deemed unsuitable regarding the construction and operation of a conveyor line and it is proposed that it should be excluded from the proposed line. In order to mitigate these impacts, a potential realignment is proposed that will lead to the north before deviating from the existing Grootegeluk – Matimba conveyor line.

1.4 ECOLOGICAL IMPACT ASSESSMENT

The impact assessment is aimed at presenting a description of the nature, extent and significance of identified impacts on the ecological environment. No impacts were identified that could lead to a beneficial impact on the ecological environment of the site alternatives since the proposed development is largely destructive, involving the alteration or degradation of habitat that is currently in a climax (natural) status. The following impacts were identified as relevant to this proposed 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 sensitive or protected habitat types (including loss and degradation);
- 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.

Impacts associated with the proposed development clearly falls within three categories, namely:

- Direct, immediate and highly significant impacts, also of a permanent nature;
- Indirect, referred and moderate significant impacts; and
- Cumulative, permanent and highly significant impacts.

1.4.1 Proposed Ashing Facility

Destruction of habitat as well as the accompanying loss of common and, more importantly, conservation important species, will lead to site-specific and local (5-10km) effects on biodiversity. Activities that cause these impacts are most significant during the site preparation and construction phases when vegetation is removed, soils stripped and the site prepared for the operational phase. The loss of species and habitat during this phase of the project is significant and impossible to mitigate against. It is important to understand that effects of these initial activities on the natural environment are irreversible.

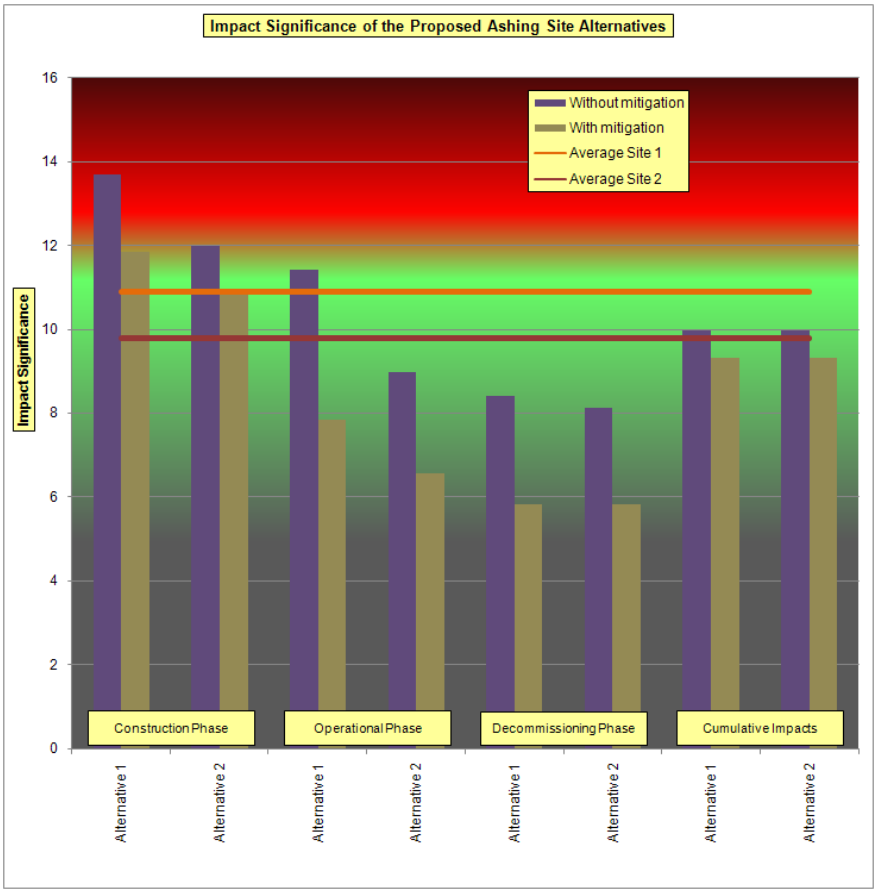
Subsequent to the site preparation phase, actual construction and operational activities are expected to result in indirect and referred impacts on the surrounding biological and ecological environment. Significance of these impacts is mostly of a moderate significance and is generally effectively ameliorated by means of the implementation of generic and some site-specific mitigation measures, although rarely achieved successfully. Containment of impacts to the construction / operational site and preventing the spread thereof into adjacent natural habitat should be the major objective of the EMPr during this stage of the project.

Lastly, cumulative impacts of the project and impacts on the ecological and biological environment during and subsequent to decommissioning of the project will result in significant and lasting impacts on the ecological environment. The immediate area as well as the larger region is characterised by moderate levels of habitat loss and fragmentation. Cumulative impacts of habitat destruction and the associated loss of species are regarded severe on a local and regional scale. Ample evidence of anthropogenic encroachment is present in the immediate surrounds and is causing widespread, uncontrolled and irreversible impacts on the natural savannas of this region.

The known and potential presence of conservation important plant and animal taxa in a specific area normally dictates the suitability of a site for a development. In this particular case, conservation important taxa are known to persist, or are highly likely to persist, on all of the alternatives. The importance of this aspect was definitely not discarded and the recommendation of Site Alternative 2 as the (slightly) preferred option is partly based on the lowest potential for conservation important taxa to persist within this area. The suitability of Site Alternative 2 is slightly challenged by the need for a conveyor connection to the source of the ash. Such a linear infrastructure will undoubtedly increase local and regional habitat fragmentation levels, impact adversely on movement and migration corridors as well as crossing and effects on sensitive species and habitat types. Additionally, conservation important taxa are known to occur throughout the region.

Results of the impacts assessment clearly indicate that expected and likely impacts within both of the proposed site alternatives are regarded severe, particularly direct impacts associated with the construction phase. Site Alternative 1 constantly exhibits a higher sensitivity towards the proposed development.

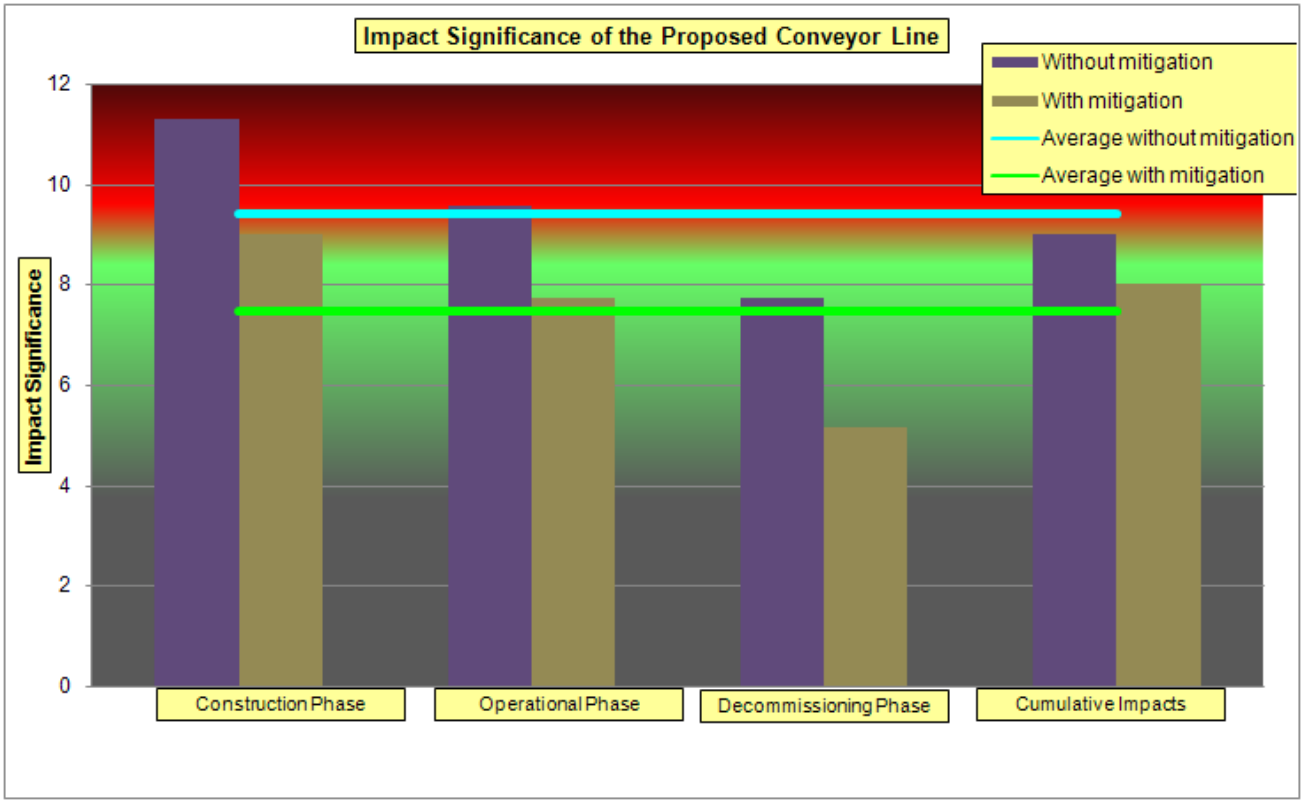
Ultimately, both site alternatives exhibit aspects of biodiversity importance, but expected and likely impacts associated with the development and operation on Alternative 1 is regarded more significant than for Alternative 2.



1.4.2 Proposed Conveyor Line

Destruction of habitat as well as the accompanying loss of common and, more importantly, conservation important species, will lead to site-specific and local (5-10km) effects on biodiversity. Activities that cause these impacts are most significant during the site preparation and construction phases when vegetation is removed, soils stripped and the site prepared for the operational phase. Loss of species and habitat during the construction phase of the project is unavoidable. The implementation of generic mitigation measures are expected to ameliorate impacts to an acceptable significance.

While numerous protected trees occur throughout the greater region, parts of the proposed conveyer line are characterised by an exceptional density of the Provincially Protected tree *Spirostachys africana;* significant impacts on protected tree species are expected. This impact can only be ameliorated with a recommended realignment of the proposed conveyor route. This realignment of the proposed conveyor route therefore represents the most significant mitigation measures for this aspect of the proposed development.



2 TERMS OF REFERENCE

Objectives of this Biodiversity Impact Assessment are to establish the presence / absence of ecologically sensitive areas or species within the identified site alternatives and linear infrastructure route to alternative site 2. Secondly, in order to assist with, and guide, the planning 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 each of the site alternatives 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 site alternatives 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, 2004 (Act No. 10 of 2004), focused on the preservation of biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. The CBD not only considers the protection of threatened species and ecosystems, but also recognizes the importance of using resources sustainably, of ensuring equity in the exploitation of such resources, and of the need for sustainable development in developing countries. This concept seeks to ensure that social and economic development follows a path that enhances the quality of life of humans whilst ensuring the long-term viability of the natural systems (resources) on which that development depends (United Nations Conference on Environment and Development, in Rio de Janeiro, Brazil 1992). In southern Africa, acceptance of the concept of sustainable development has been marked by the ratification of international conventions by most countries, particularly the Convention on Biological Diversity, Ramsar Convention and CITES, as well as the development of SADC-based protocols on environmental issues. However, severe capacity constraints in most countries have made it difficult to translate these policies and concepts into practice.

Transformative developments, such as mining and discard activities are often viewed as more damaging to the environment than other developments. The biodiversity conservation performance of these types of developments 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, it is due to the very nature of transformation developments. Losses and impacts associated with these developments therefore require vigilance to ensure that the heritage of future generations – the biological as well as cultural heritage – is not adversely affected by the activities of today. Achieving a balance while doing this requires better understanding and recognition of conservation and development imperatives by all stakeholders, including governments, business and conservation communities.

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

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

4 PROJECT SYNOPSIS

Matimba Power Station, located in the Limpopo Province near Lephalale, is a 3,990 MW installed capacity base load coal fired power station, consisting of six units. Ash is generated as a by-product due to the combustion of coal from the power station. This ash is currently being disposed by means of 'dry ashing' approximately 3 km (three kilometres) south of the power station, on Eskom owned land.

With the promulgation of the National Environmental Management Waste Act, Act 59 of 2008, Eskom would like to align its continued ashing activities with the requirements of the waste licensing processes.

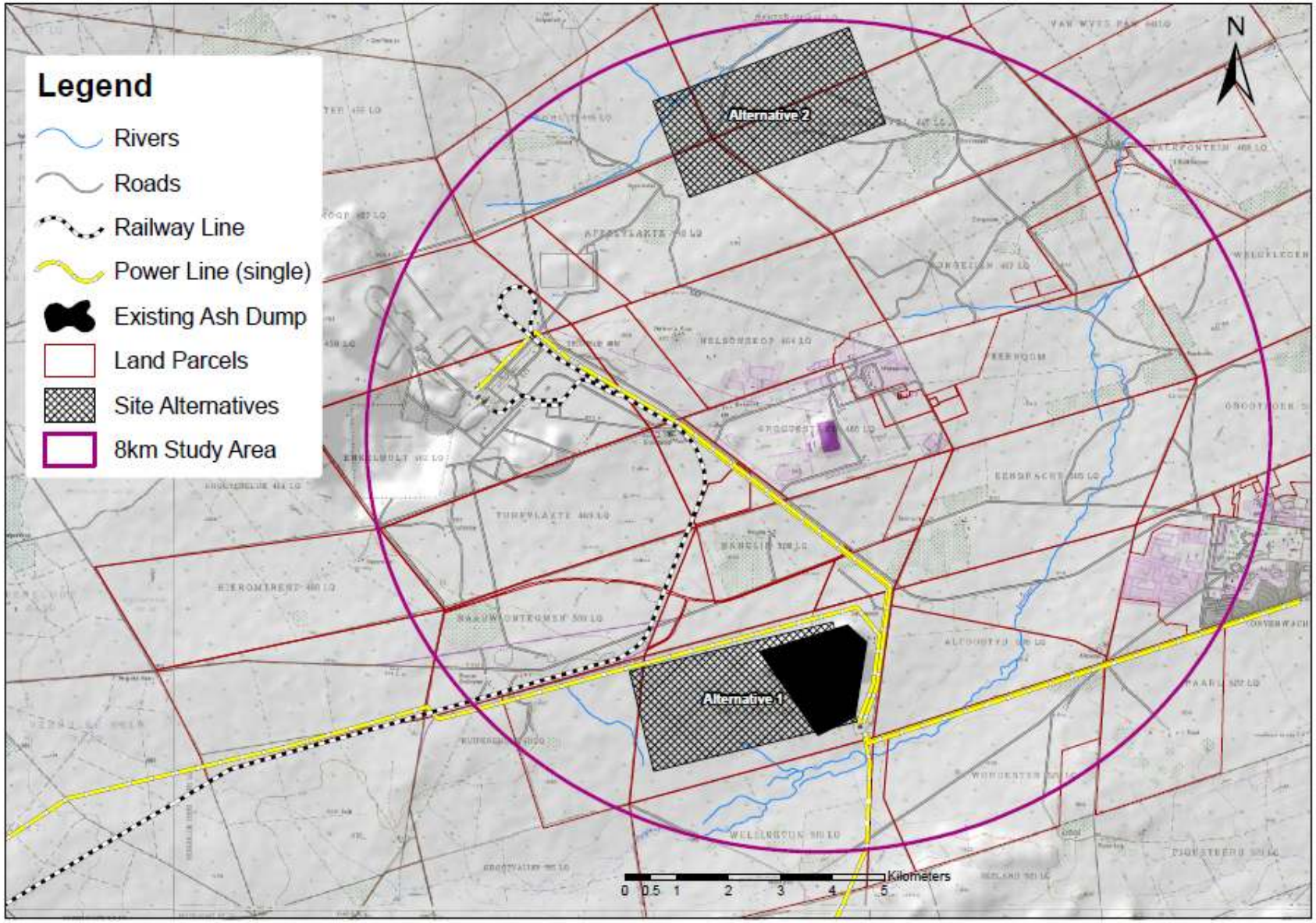
The proposed continuous ashing facility requires the following specifications:

- capacity of airspace of 297 million m³ (remaining); and
- ground footprint of approximately 650 ha (Remaining fenced, including pollution control dams and other infrastructure).

The proposed ash disposal facility will ensure that the power station is able to accommodate the ashing requirements for the remaining life (approximately 44 years) of the power station. Two technically and environmentally feasible alternatives sites were identified during a holistic scoping assessment, which evaluated all land within an 8 km radius from the Matimba Power Station. The identified site alternatives are illustrated in **Figure 1**.

These alternative sites and linear infrastructures route to Site 2 were subjected to a detailed EIA investigation in order to present an opinion on the suitability and intrinsic biodiversity sensitivities of the proposed sites and to recommend a suitable option for the proposed development.

Figure 1: The geographical placement of the two site alternatives



5 BIOPHYSICAL ATTRIBUTES OF THE SITE ALTERNATIVES & IMMEDIATE REGION

5.1 LOCATION

The proposed site alternatives are situated within the proximity of Matimba Power Station, which is located approximately 10 km west of Lephalale, Limpopo Province. The Medupi Power Station, that is currently being constructed, is situated approximately 1 km to the northwest of Site Alternative 1. The existing ash disposal facility is currently being served by a conveyor line that transports the ash from the Matimba Power Station. Site Alternative 1 is situated on the farm Zwartwater 507 LQ, while Alternative 2 is situated 8.7 km to the north, placed across portions of the following four farms:

- Ganzepan 446 LQ;
- Vooruit 449 LQ;
- Appelvlakte 448 LQ; and
- Droogeheuvel 447 LQ.

The regional location of the site alternatives is illustrated in **Figure 2**. A composite Google Earth image of the region is presented in **Figure 3**.

5.2 LAND COVER & LAND USE OF THE REGION

Land use often determines land cover; it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land. Land cover categories of the general region are illustrated in **Figure 4**. For the purpose of this assessment, land cover are loosely categorised into classes that represent natural habitat and land cover categories that originated from habitat degradation and transformation on a local or regional scale. Areas that are characterised by high levels of transformation and habitat degradation are generally more suitable for development purposes as it is unlikely that biodiversity attributes of conservation 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.

The character of the general region is typified by significant recent developments. The result is nodal type developments dispersing from a central area. Historically the larger region was characterised by natural woodland and savanna habitat with extremely limited transformation levels. Land use in the region varies between game farming and cattle farming that utilised the natural savanna habitat. Extremely little arable agriculture is practiced, mainly because of relative low rainfall and poor soils that predominate in the region. Recent mining developments and associated infrastructure developments such as power stations, a more defined and intricate road infrastructure, housing, residential developments and a significant expansion of Lephalale, resulted in large-scale transformation of natural habitat of the region.

The immediate region is characterised by mostly untransformed savanna woodland, but recently (past 10 years) have seen significant development in terms of road networks, mining related land transformation and power stations with the appurtenant infrastructure, such as power line servitudes, ashing facilities, water treatment plants, etc. Significant increases in habitat transformation, fragmentation and isolation have been noted in recent time.

The site alternatives are situated in the Lephalale Municipality, which comprises approximately 1,960,140 ha, of which 94.4 % is regarded untransformed (BGIS, 2009).

5.2.1 Annotations on Habitat Fragmentation

Habitat fragmentation is the emergence of discontinuities (fragmentation) in an organism's preferred environment/ habitat and can be caused by geological processes that slowly alter the layout of the physical environment or by human activity such as land conversion, which can alter the environment on a much faster time scale. The former is thought to be one of the major causes of speciation, while the latter is causative in extinctions of many species.

Habitat fragmentation caused by humans occurs when native vegetation is cleared for human activities such as agriculture, rural development or urbanization. Remaining habitat fragments are therefore rarely representative samples of the initial landscape. Habitats, which were once continuous, become divided into separate fragments. After intensive clearing, remaining fragments tend to be small islands isolated from each other by crop land, pasture, roads, pavement or even barren land. The term habitat fragmentation includes six discrete phenomena:

- Reduction in the total area of the habitat;
- Increase in the amount of edge;
- Decrease in the amount of interior habitat;
- Isolation of one habitat fragment from other areas of habitat;
- Breaking up of one patch of habitat into several smaller patches; and
- Decrease in the average size of each patch of habitat.

One of the major ways that habitat fragmentation affects biodiversity is by reduction of available habitat for plants and animals. Plants and other sessile organisms in these areas will be directly affected while mobile animals (especially birds and mammals) retreat into remnant patches of suitable habitat, leading to crowding effects and increased competition.

Species that are able to migrate between fragments may use more than one fragment while others must make do with what is available in the single fragment in which they ended up. Area size is therefore one of the primary determinants of the species richness of a fragment. The size of the fragment will influence the number of species that are present when the fragment was initially created, and will influence the ability of these species to persist in the fragment. Small fragments of habitat can only support small populations of plants and animals and small populations are ultimately more vulnerable to extinction. Minor fluctuations in climate, resources or other factors, that would be unremarkable and quickly corrected in large populations can be catastrophic in small, isolated populations. Fragmentation of habitat is therefore an important cause of species extinction.

Population dynamics of subdivided populations tend to vary asynchronously. In an unfragmented landscape, a declining population can be "rescued" by immigration from a nearby expanding population, but in fragmented landscapes, the distance between fragments may prevent this from happening. Additionally, unoccupied fragments of habitat that are separated from a source of colonists by some barrier are less likely to be repopulated than adjoining fragments.

Additionally, habitat fragmentation leads to edge effects. Microclimatic changes in light, temperature, and wind could alter the ecology around the fragment, and in the interior and exterior portions of the fragment. Fires become more likely in the area as humidity drops and temperature and wind levels rise. Exotic and pest species may establish themselves easily in such disturbed environments and the proximity of domestic animals often upsets the natural ecology. In addition, habitat along the edge of a fragment has a different

climate and favours different species from the interior habitat. The existence of viable habitat is critical to the survival of any species, and in many cases, the fragmentation of any remaining habitat can lead to difficult decisions for conservation biologists. Given a limited amount of resources available for conservation is it preferable to protect the existing isolated patches of habitat or to buy back land to get the largest possible continuous piece of land. It is however an ongoing debate and is often referred to as SLOSS (Single Large or Several Small).

5.2.2 Annotations on Habitat Isolation

Habitat isolation is defined as the extent to which a parcel of land or habitat of a certain species, or community of species, is separated from other similar habitat, species or communities, where the distance of separation might be larger than what is acceptable for species that occupy an area in order to successfully navigate in order to feed, propagate or inhabit. The degree of habitat isolation experienced by individuals of a given species depends on many factors. For example, above a particular level of habitat loss the physical distances between habitats patches increase exponentially. For many species, rate of movement between patches of suitable habitat can be reduced as a result. Spatial scale, mobility and mode of movement (e.g. flying versus crawling) are key issues associated with considerations of the impacts of habitat subdivision and habitat isolation. The spatial scales of which a species moves and over which it perceives its environment will strongly influence the extent to which a given modified landscape is, or is not, negatively subdivided or isolated for that taxon. For example, for some small mammal and flightless insect species, a road may effectively subdivide and isolate the populations on either side of it, whereas such a road would have very limited or no impact on more mobile species.

Many of the warnings associated with the themes of habitat loss and habitat degradation are also relevant to considerations of habitat subdivision and habitat isolation. This is because, like habitat loss, what constitutes habitat subdivision and habitat isolation, is species specific. For example, isolation of vegetation patches defined from a human perspective may not lead to habitat isolation from the perspective of some species. Even in a landscape that is extensively modified by humans, the matrix may be highly permeable for some species. Hence, actual levels of habitat isolation might therefore actually be relatively low for these taxa and recolonization rates of patches can be high. For other species, the same matrix may be 'hostile', meaning that neighbouring patches, although being located relatively close together, are actually very isolated for the specific species.

The spatial isolation of habitat can impair dispersal movements between the natural territory and suitable habitat patches, which are typically made by juvenile or sub-adult animals attempting to establish new territories. This interruption to dispersal can reduce the genetic size of populations through impaired patterns of gene flow. Importantly, effective dispersal involves not only the movement of an individual, but also its successful reproduction in the receiving population. In some cases, males and females of a given species do not respond in the same way to habitat isolation. In addition, the recolonization of vacant territories in some habitat patches by individuals originating from other habitat patches is critical for maintaining the overall demographic size of a given species population. By affecting patterns of dispersal between patches, habitat isolation can have significant effects on the occupancy of otherwise suitable habitat patches, including protected areas like nature reserves. For example, population recovery after disturbance may be imparts by habitat isolation. Habitat isolation may shift a formerly contiguous and interacting population into a series of loosely connected subpopulations (i.e. metapopulation). A metapopulation is defined as a set of local populations, which interact via individuals moving between local populations. However, patchily distribution of populations of a species does not always conform to a true metapopulation structure.

Figure 2: Regional setting of the site alternatives

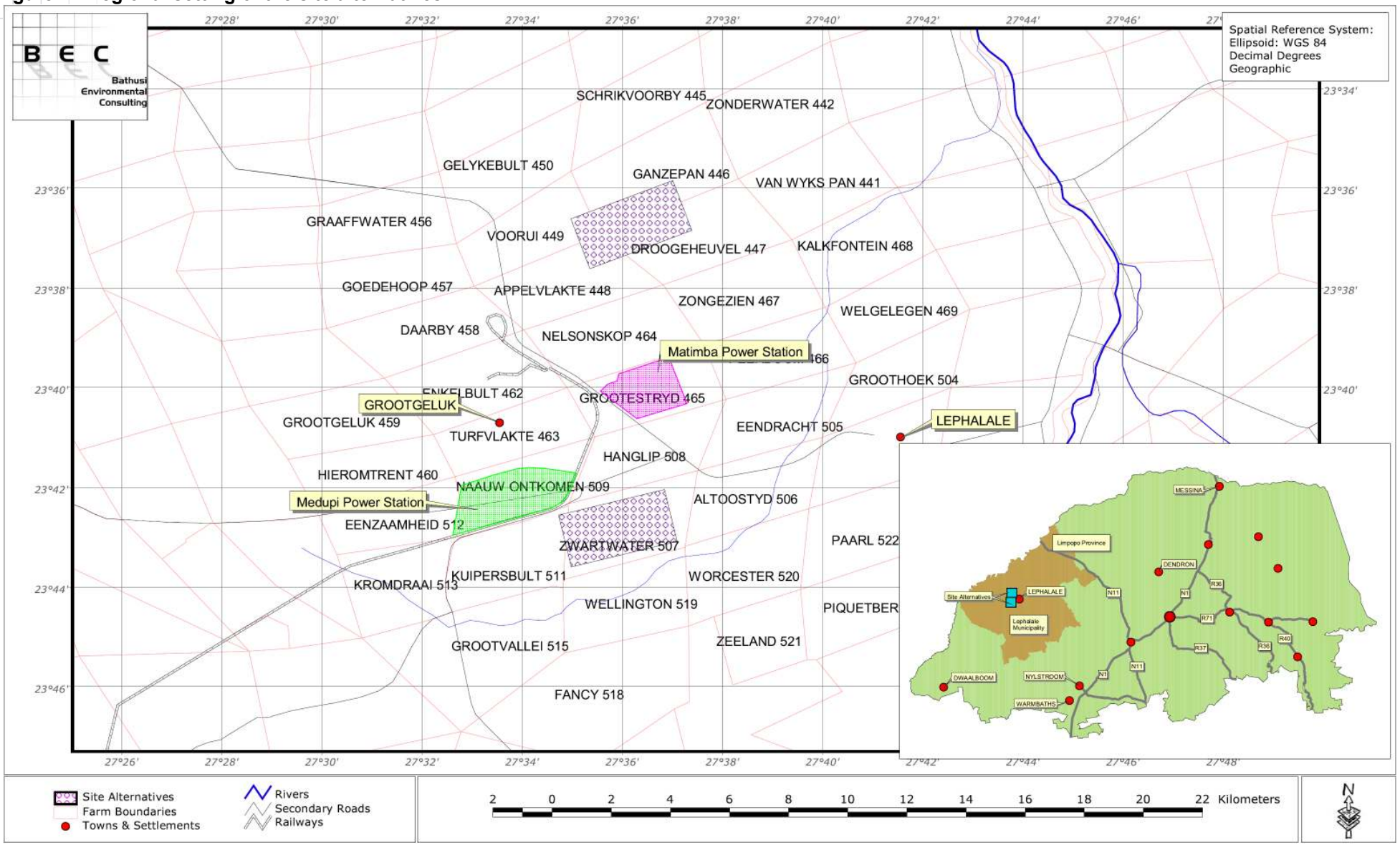


Figure 3: Composite aerial image of the site alternatives (courtesy of www.googleearth.com)

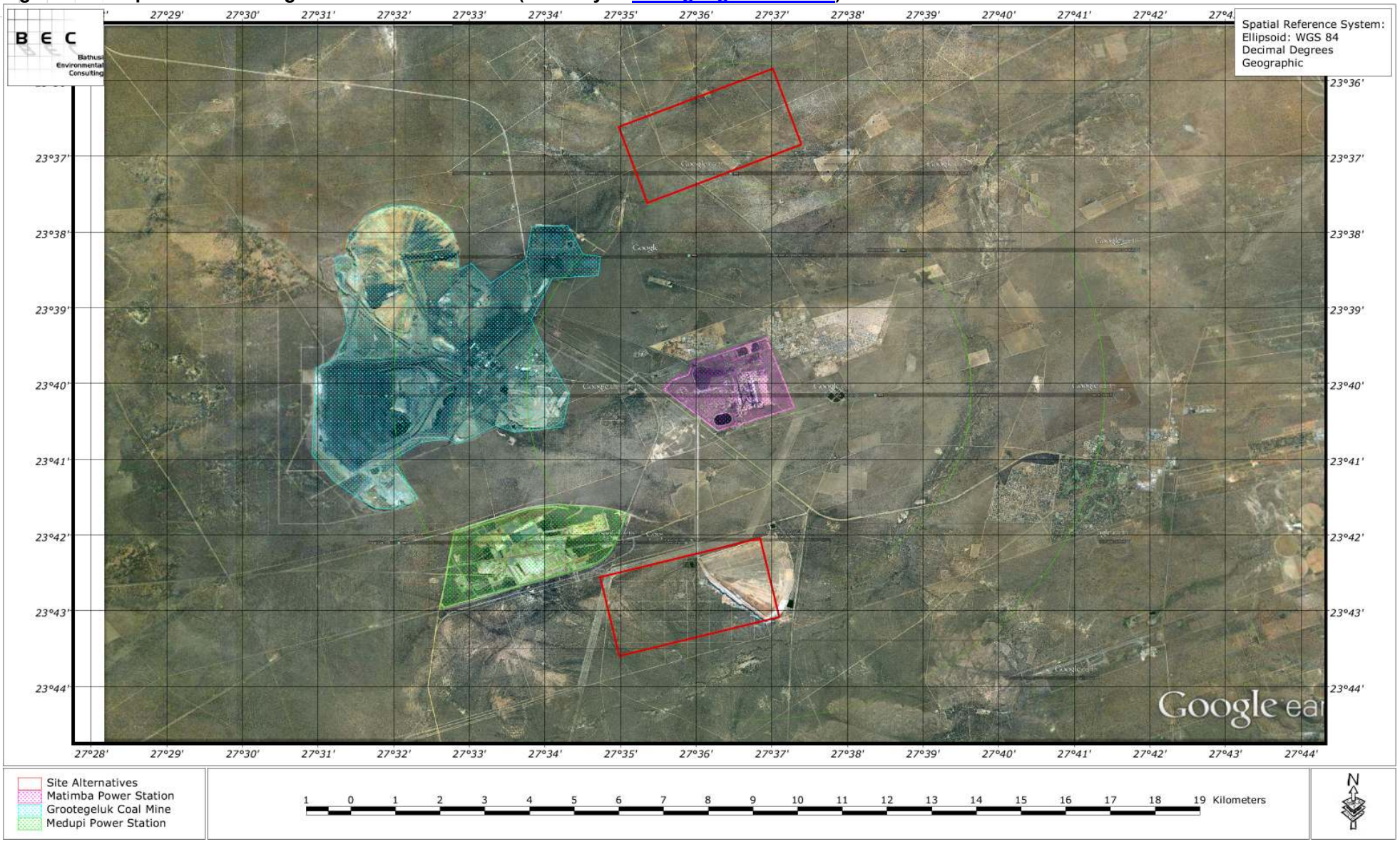
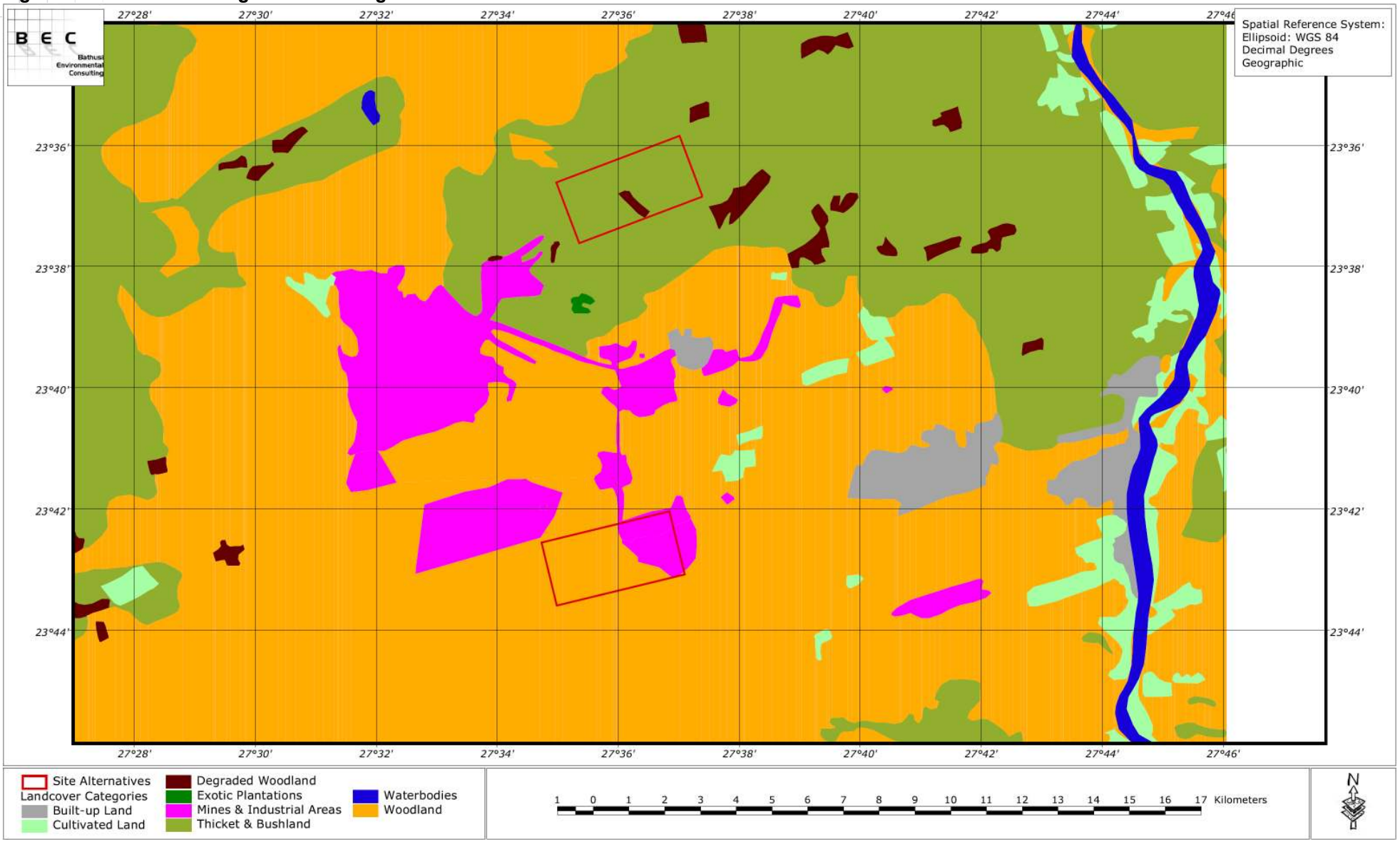


Figure 4: Land cover categories of the region



5.3 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 savanna vegetation.

The Site Alternatives are situated within the Ah85 (Site Alternative 2) and Bd46 (Site Alternative 1) land types (refer **Figure 5**).

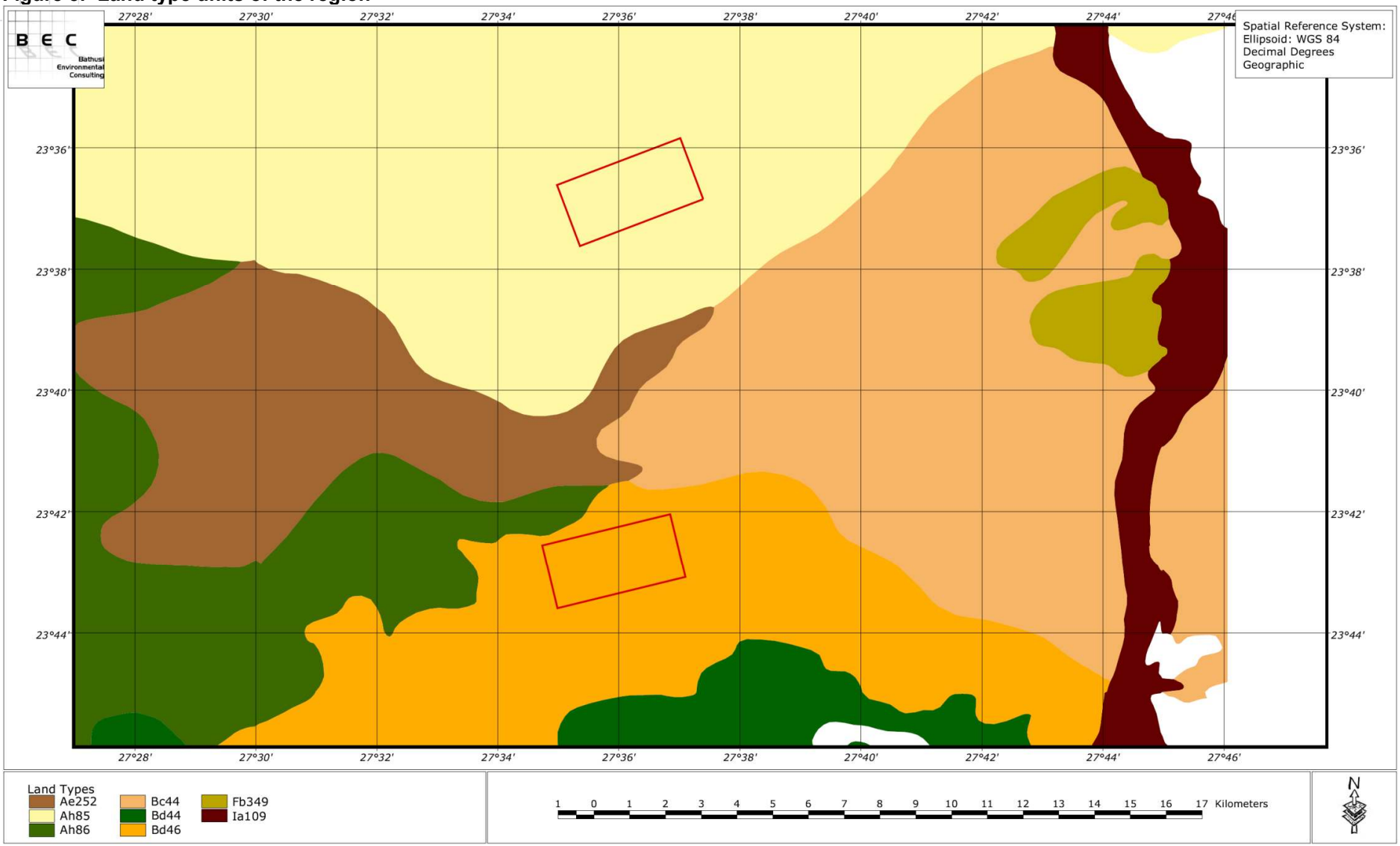
Map units Aa to Ai refer to yellow and red soils without water tables and belonging in one or more of the following soil form: Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly. The map units refer to land that does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40 % of the area. In red and yellow soils, high base status indicates land with red and yellow soils, each of which covers more than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than high base status red-yellow apedal soils (Land Type Survey Staff, 1987).

The B- group includes a large area of the South African interior that is occupied by a catena, which in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottoms are occupied by one or other gley soil. Soils with hard plinthite are common over sandstones in the moist climate zones in the eastern part of the country. Depending on the extent to which water tables have been operative over a landscape, Longlands, Avalon and related grey and yellow soils may predominate, even to the exclusion of red soils. Where water tables have not extended beyond the valley bottoms, red soils may predominate with plinthic soils restricted to narrow strips of land around valley bottoms or pans. For inclusion into Bc and Bd plinthic soils must cover more than 10 % of the area. Unit Bd indicates land in which the soils are generally eutrophic and red soils are not particularly widespread.

5.4 DECLARED AREAS OF CONSERVATION

Currently, there are nine declared land-based protected areas in the Lephalale Municipality, comprising a total of 89,406 ha, 4.6 % of municipality). However, there are no biospheres, conservancies or other declared areas of conservation present in the immediate surroundings of the Site Alternatives. The closest area of conservation is the D'Njala Nature Reserve, situated approximately 14 km to the east.

Figure 5: Land type units of the region



5.5 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 alternative sites are situated within the Limpopo Catchment area. Major rivers of the surrounds include the Mogol River (approximately 13 km to the east of Site Alternative 1) and the Limpopo River (approximately 40 km to the northwest of the preferred site). Other than a small artificial impound, no temporary or permanent area of surface water is present within Site Alternative 1. However, the non-perennial Sandloopspruit is situated approximately 300 m to the south; thus within the 5 km buffer zone.

The rainy season is generally from November to March, with the peak rainfall measured in January. The average annual rainfall at Matimba PS is 460 mm per annum. Rainfall is however slightly unreliable and rather severe drought conditions tend to occur about 12 % annually.

[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 area and general comments pertaining to this attribute are therefore included in this report.

5.6 TOPOGRAPHY, RELIEF & SLOPES

Topographical heterogeneity is recognised as a powerful influence contributing to the high biodiversity of southern Africa. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The species richness and biodiversity has been found to be significantly higher in areas of geomorphological heterogeneity.

Ridges and rocky outcrops are characterised by high spatial variability due to the range of differing aspects, slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. Temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes. Variation in aspect, soil drainage and elevation/altitude has been found to be especially important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity.

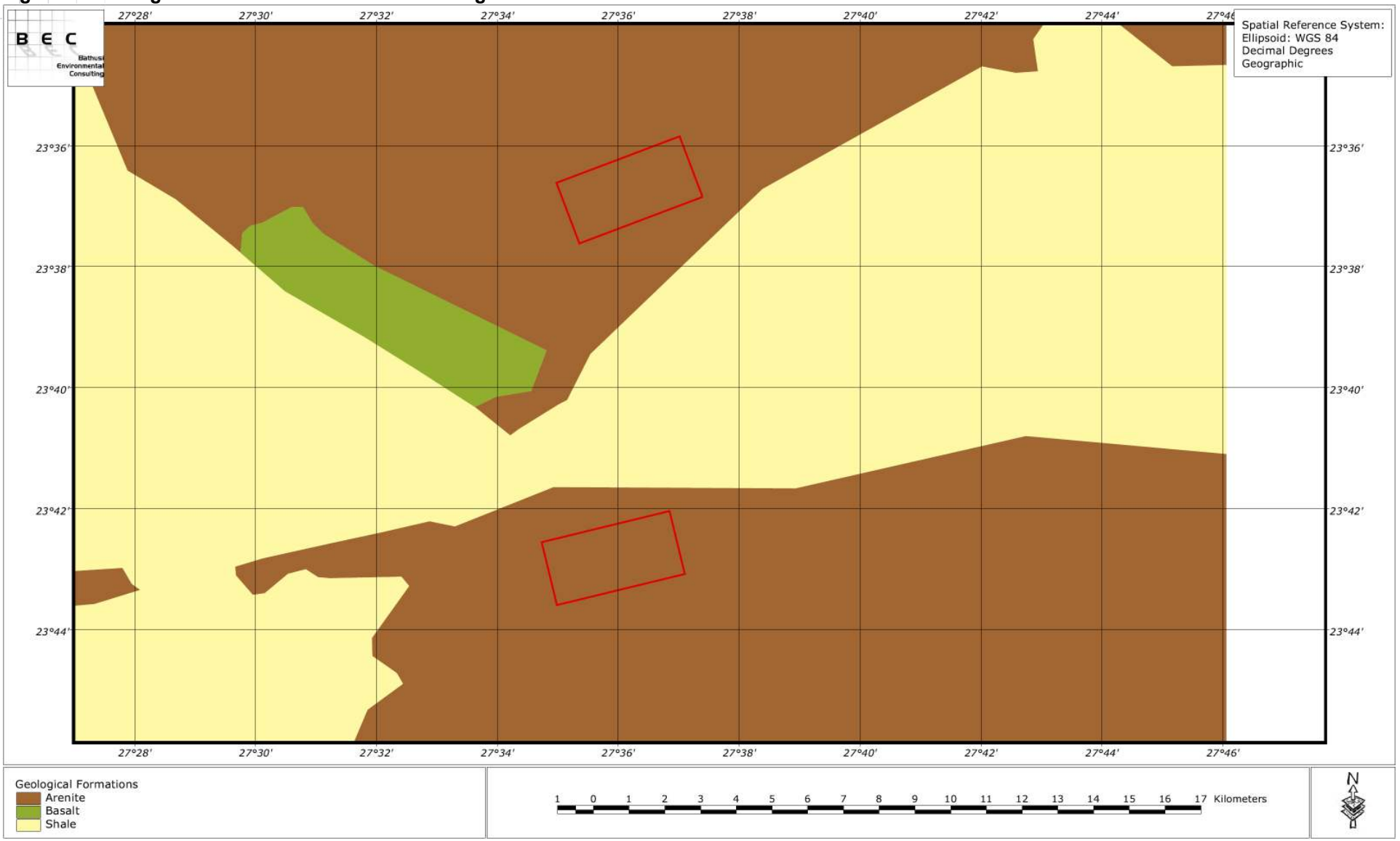
The site alternatives are situated approximately 900 m above sea level. Topography of the region is described as 'Plains'.

5.7 GEOLOGY

The geology of the site alternatives comprises the Clarens Arenite, which consists of fine-grained, Aeolian sandstones, which bear testimony of the fact that the Late Triassic desiccation reaches its climax in this formation. Near the base, it is somewhat argillaceous, pinkish and in places even deep red, but higher up it is white or yellowish. Bedding may be observed only at the base and at the top, and trough cross-bedding on a large scale is present in places. In the Waterberg Coalfields, the formation occupies extensive areas on both sides of the Mokolo River. The site is covered by a blanket of hillwash to depths of approximately 2 meters.

The major geological formations of the region are illustrated in **Figure 6**. It would appear as if the underlying geological patterns do not have a significant effect on the vegetation development as no particular and obviously dissimilar patterns are observed that would be resultant from geological boundaries. However, fine-scaled variations are observed on ground level that is attributed to substrate conditions, to which the geology plays a determining part.

Figure 6: Geological variations of the immediate region



6 BACKGROUND TO THE SAVANNA ECOLOGY

The Savanna Biome is the largest biome in southern Africa, covering about 46 % of its area. The term savanna is widely accepted as describing a vegetation type with a well-developed grassy layer and an upper layer of woody plants. Many environmental factors correlate with the distribution of different savanna vegetation types, including landform, climate, soil types, fire and a very specific fauna. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity (Knobel, 1999).

The diversity of African savanna is exceptional, comprising more than 13,000 plant species, of which 8,000 are savanna endemics. Specifically, dry savannas have more than 3,000. This diversity equals that of the South African grasslands and is exceeded only by the Fynbos Biome (Knobel 1999). Similarly, in respect of animal diversity, savannas are without peer, including approximately 167 mammals (15 % endemism), 532 birds (15 % endemism), 161 reptiles (40 % endemism), 57 amphibians (18 % endemism) and an unknown number of invertebrates (Knobel, 1999). Flagship species include the Starburst Horned Baboon Spider (Ceratogyrus bechuanicus), ground Hornbill (*Bucorvus leadbeateri*), Cape Griffon (*Gyps coprotheres*), Wild dog (*Lycaon pictus*), Short-Eared Trident Bat (*Cloeotis percivali*) and the White Rhino (*Ceratotherium simum*) (EWT, 2002).

Conservation within and of the savanna biome is good in principle, mainly due to the presence of a number of wildlife reserves. Urbanisation is not a threat, perhaps because the hot, dry climate and diseases prominent in the savanna areas have hindered urban development. Much of the area is used for game farming and the importance of tourism and big-game hunting in the conservation areas must not be underestimated. Savannas are the basis of the African wildlife and ecotourism industry and play a major role in the meat industry.

Surprisingly little is known about the vegetation as most studies have been done in nature reserves and game farms, but five major regions are present, three of which are represented in the immediate region. Sweet Bushveld occurs on fertile soils in the dry and hot valleys of the Limpopo River and the thorny, small-leaved vegetation is dominated by Acacia species that increase to dense, impenetrable thickets at the expense of the grass layer when overutilised. Mixed Bushveld varies from short, dense bushveld to a rather open tree savanna. On shallow, infertile soils the broad-leaved Red Bushwillow (*Combretum apiculatum*) dominates, whereas on deeper, leached soils the Silver Clusterleaf (*Terminalia sericea*) becomes dominant. The Waterberg moist mountain bushveld is a typical example of moist, infertile savanna. Due to the high proportion of unpalatable grasses, the area has become known as ‘sour bushveld’. An interesting phenomenon is the presence of many plant species showing affinities with the flora of the Drakensberg, which indicates an ancient link with this range (Knobel, 1999).

The vegetation that characterises this area has developed many survival strategies, including the ability to produce tannins that are triggered when the leaves are browsed, the production of toxic sap, the development of thorns or their adaptation to sourveld areas that are not generally favoured by grazers. The interaction of vegetation, fire and animals play important roles in maintaining savanna ecosystems (Knobel, 1999).

Over thousands of years, the savanna system and the antelope that inhabit them have developed side by side. Grasses, for example, have become well adapted to defoliation, as much a defensive response to constant pressure by grazers as to the regular veld fires that rage through the savanna in the dry seasons. The success of grasses has been a constantly renewed vast reservoir of food upon which large herds of

grazers flourish. The woody component is also constantly exploited by many browsers, and with so many herbivores present, the carnivore component of the complex ecological system has also flourished (Knobel, 1999).

The savanna biome is populated by a greater diversity of bird species than any other biome in South Africa. The presence of both woody plants and a well-developed herbaceous layer provides diverse sources of food and shelter for specialist and generalist bird species, including seedeaters, insectivores and diurnal and nocturnal birds of prey abound.

Much of the area is used for game farming and big game hunting, illustrating that utilisation and conservation of an area are not mutually exclusive. The savanna biome is the core of the wildlife, ecotourism and meat-production industries. Threats include rapidly expanding development of settlements for impoverished human populations and the associated need for firewood and building materials, diminishing water supply, agriculture and over-grazing (Knobel, 1999).

7 BOTANICAL ASSESSMENT

7.1 REGIONAL FLORISTIC TRAITS

7.1.1 Regional Floristic Ecology

Vegetation of the region is defined by Mucina and Rutherford (2006) as the Limpopo Sweet Bushveld. This vegetation type extends from the lower reaches of the Crocodile and Marico Rivers down the Limpopo River valley. It is short, open woodland dominated by *Acacia mellifera* and *Dichrostachys cinerea* as well as taller tree species such as *A. robusta*, *A. burkei* and *Terminalia sericea*. The high palatability of the graminoid composition renders this vegetation type highly suitable for game farming practices.

Although this vegetation type is regarded not threatened (Least Threatened), only 1 % is formally conserved in statutory conservation areas. Much is however contained within private nature reserves and game farms. Approximately 5 % is transformed by cultivation. Though limited by low rainfall, this is a good area for game and cattle farming due to the high grazing capacity of sweet veld. The Central Bushveld endemic herb *Piaranthus atrosanguinalis* occurs in this vegetation type. Noteworthy taxa include the following.

- **Tall Trees**

Acacia robusta and *A. burkei.*

- **Small Trees**

Acacia erubescens, A. fleckii, A. nilotica, A. senegal var. *rostrata, Albizia anthelmintica, Boscia albitrunca, Combretum apiculatum* and *Terminalia sericea.*

- **Tall Shrubs**

Catophractes alexandri, Dichrostachys cinerea, Phaeoptilum spinosum, Rhigozum obovatum, Cadaba aphylla, Combretum hereroense, Commiphora pyracanthoides, Ehretia rigida subsp. *rigida, Euclea undulata, Grewia flava* and *Gymnosporia senegalensis.*

- **Low Shrubs**

Acacia tenuispina, Commiphora africana, Felicia muricata, Gossypium herbaceum subsp. *africanum* and *Leucosphaera bainesii.*

- **Graminoids**

Digitaria eriantha subsp. *eriantha, Enneapogon cenchroides, Eragrostis lehmanniana, Panicum coloratum, Schmidtia pappophoroides, Aristida congesta, Cymbopogon nardus, Eragrostis pallens, E. rigidior, E. trichophora, Ischaemum afrum, Panicum maximum, Setaria verticillata, Stipagrostis uniplumis* and *Urochloa mosambicensis.*

- **Herbs**

Acanthosicyos naudinianus, Commelina benghalensis, Harpagophytum procumbens subsp. *transvaalense, Hemizygia elliottii, Hermbstaedtia odorata, Indigofera daleoides, Kleinia fulgens* and *Plectranthus neochilus.*

7.1.2 Regional Diversity

Information obtained from the SANBI database (POSA, 2012) indicates the known presence of approximately 311 plant species within the ¼-degree grid that is sympatric to the study sites (2327DA)[2]. The high floristic diversity of the immediate region reflects the regional diversity context of the savanna biome. However, the paucity of accurate floristic species richness is indicated by the absence of some common plant taxa from the data records. An appraisal of the growth forms (refer **Table 1**) reflects the diverse woodland physiognomy with 45 dwarf shrubs (14.5 %), 36 shrubs (11.6) and 11 tree species (3.5 %). A high diversity of herbs (118 species, 37.9 %) and grasses (35 species, 11.3 %) is represented.

Table 1: Growth forms of the region (2327DA)

Growth Form	*Number*	*Percentage*
Bryophyte	8	2.6 %
Climber	17	5.5 %
Cyperoid	8	2.6 %
Dwarf shrub	45	14.5 %
Forb	1	0.3 %
Geophyte	14	4.5 %
Graminoid	35	11.3 %
Herb	118	37.9 %
Hydrophyte	5	1.6 %
Parasite	1	0.3 %
Shrub	36	11.6 %
Succulent	9	2.9 %
Suffrutex	3	1.0 %
Tree	11	3.5 %
Bryophyte	8	2.6 %
Climber	17	5.5 %
Total	**311**	

7.1.3 Flora species of Conservation Importance of the Region

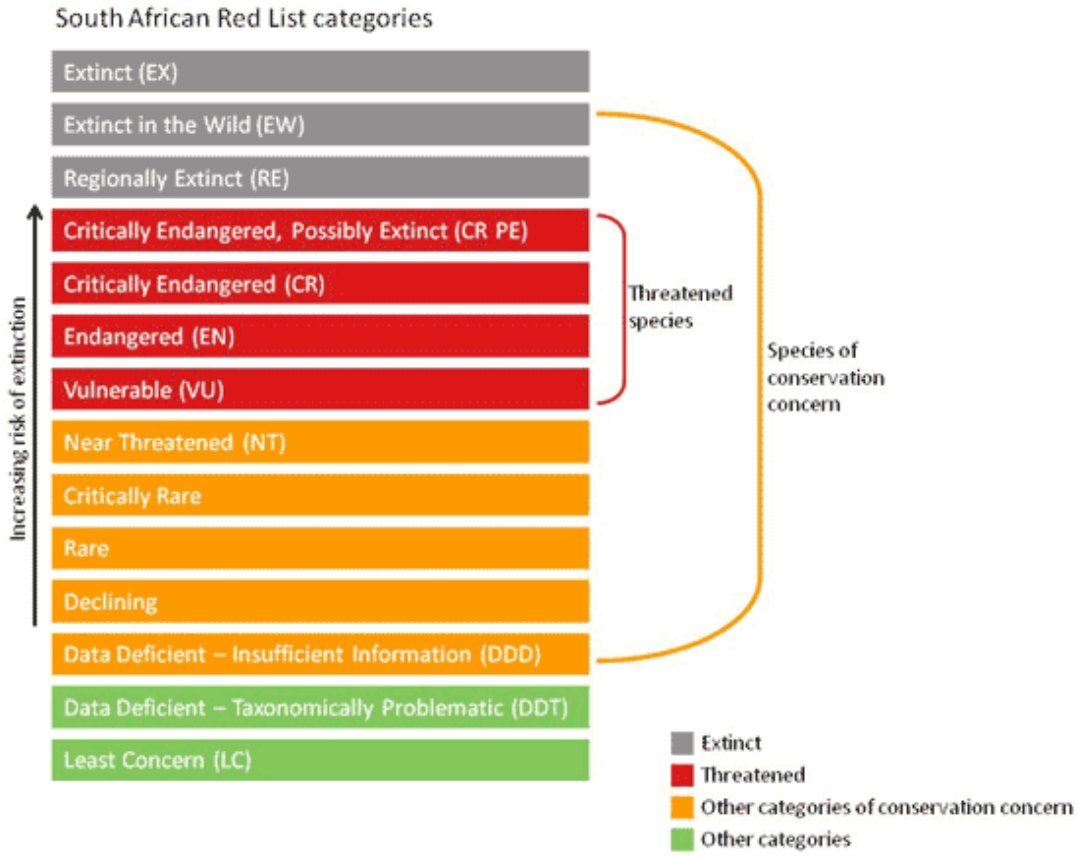
South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001, refer **Figure 7**), amended to include additional categories to indicate species that are of local conservation concern. The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). Species included in these categories are presented in **Table 2**. Taking the habitat that is available as well as the status thereof into consideration, it is regarded likely that plant species included in the Threatened category might be present within the immediate region, and possibly the site alternatives.

- A species is Data Deficient when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
- A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

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

- A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
- A species is Threatened when it is included in one of the Critically Endangered (Possibly Extinct), Critically Endangered, Endangered or Vulnerable categories

Figure 7: South African Red List Categories (courtesy of SANBI)



Red Data plant taxa known to occur in the ¼-degree grids that are spatially represented in the respective site alternatives include the following:

Table 2: Red Data plant taxa known to occur in the immediate region

Binomial Name	***Family***	***Status***
Acalypha caperonioides var. *caperonioides*	Euphorbiaceae	Data Deficient
Corchorus psammophilus	Malvaceae	Threatened
Crinum stuhlmannii	Amaryllidaceae	Declining
Eulalia aurea	Poaceae	Near Threatened
Euphorbia waterbergensis	Euphorbiaceae	Rare

In terms of the National Forests Act of 1998, certain tree species can be identified and declared as protected. All trees occurring in natural forests are also protected in terms of the Act. Protective actions take place within the framework of the Act as well as national policy and guidelines. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. In terms of the National Forests Act of 1998, protected tree species may not be "cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold, except under license granted by the Department of Water Affairs and Forestry (or a

delegated authority)". It is therefore necessary to conduct a survey that will determine the number and relevant details pertaining to protected tree species on the property for the submission of relevant permits to authorities prior to the disturbance of these individuals (refer **Appendix 7**).

In addition to the species currently captured in the SANBI infobase (POSA, 2011), the following protected trees and plants occur within the immediate region (refer **Table 3**).

Table 3: Protected plant species within the region of the site alternatives

Binomial Name	***Family***	***Status***
Acacia erioloba	Fabaceae	Declining, Protected tree
Adansonia digitata	Bombaceae	Protected tree
Ammocharis coranica	Amaryllidaceae	Protected species
Boscia albitrunca	Capparaceae	Protected tree
Combretum imberbe	Combretaceae	Protected tree
Duvalia polita	Apocynaceae	Protected species
Huernia transvaalensis	Apocynaceae	Protected species
Huernia zebrina	Apocynaceae	Protected species
Securidaca longipedunculata var. *longepedunculata*	Polygalaceae	Protected tree
Sclerocarya birrea subsp. *africana*	Anacardiaceae	Protected tree
Spirostachys africana	Euphorbiaceae	Provincially Protected tree

7.2 RECORDED PHYTODIVERSITY (2013)

Phytodiversity is a measure of the number and variety of plants within a given area. Three main indices are used to indicate floristic species richness and diversity in the sampled areas, namely:

- Species richness (Alpha diversity) refers to the number of species represented in a set or collection of individuals in each of the releveès. It is a simple count of species, and it does not take into account the abundance of the species or their relative abundance distributions. EstimateS analyses are implemented to present an estimation of the expected species richness of the areas, based on collated data from the 2013 surveys;
- The Shannon-Weiner diversity index presents an opinion on how species are distributed in an ecosystem or a community, taking cognisance of the species richness and relative abundance of each species in a community. Making use of the Shannon-Weiner values, the Evenness Index compares releveès by controlling for the number of species found within the communities; and
- The Simpsons Diversity Index quantifies the biodiversity of a habitat or relevè. It takes into account the number of species present (species richness), as well as the abundance of each species (Evenness).

7.2.1 Species Richness – Alpha Diversity

The survey yielded an Alpha Diversity of 164 taxa, which is regarded representative of floristic diversity on a regional scale, but also reflects seasonal constraints of the survey. 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 site alternatives reflects the major physiognomic variations that are present in the site alternatives (refer **Table 4**). The woodland physiognomy is dominated by a relative diverse woody layer, comprising of 52 species (small trees, shrubs, trees (31.7 %). Typically, the herbaceous layer is prominent and diverse. A total of 33 grass species (20.1 %) were recorded. The herbaceous layer is rich in species, comprising a total of 62 species (37.8 %).

Table 4: Growth forms recorded in the site alternatives

Growth Form	*Number*	*Percentage*
Climbers	4	2.4 %
Dwarf shrubs	10	6.1 %
Ferns	1	0.6 %
Forbs	40	24.4 %
Geophytes	5	3.0 %
Grasses	33	20.1 %
Hydrophilics	3	1.8 %
Prostrate herbs	7	4.3 %
Sedges	3	1.8 %
Shrubs	19	11.6 %
Small trees	10	6.1 %
Succulents	6	3.7 %
Trees	23	14.0 %
Total	**164**	

The diversity of plants within the site alternatives is represented by 47 plant families (refer **Table 5**), dominated by Poaceae (graminoids) and Fabaceae (legume family, 23 species, 14.1 %).

Table 5: Plant families recorded in the site alternatives

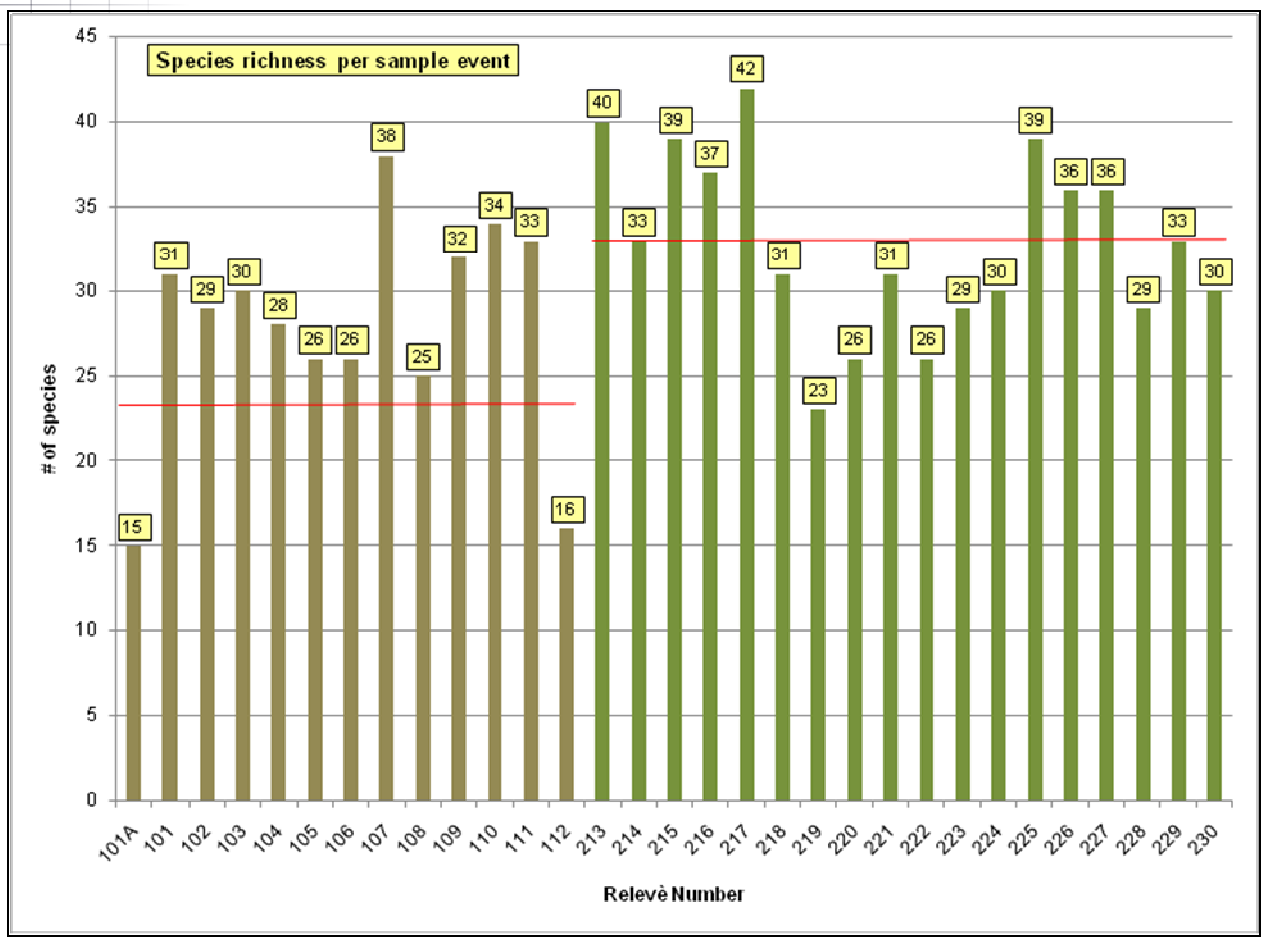
Family	*Number*	*Percentage*
Acanthaceae	2	1.2 %
Adianthaceae	1	0.6 %
Aizoaceae	1	0.6 %
Amaranthaceae	3	1.8 %
Amaryllidaceae	1	0.6 %
Anacardiaceae	4	2.4 %
Apocynaceae	4	2.4 %
Asphodelaceae	1	0.6 %
Asteraceae	9	5.5 %
Bignoniaceae	1	0.6 %
Boraginaceae	1	0.6 %
Burseraceae	2	1.2 %
Caesalpiniaceae	3	1.8 %
Capparaceae	4	2.4 %
Celastraceae	1	0.6 %
Combretaceae	5	3.0 %
Commelinaceae	2	1.2 %
Convolvulaceae	3	1.8 %
Crassulaceae	2	1.2 %

Cucurbitaceae	2	1.2 %
Cyperaceae	4	2.4 %
Ebenaceae	1	0.6 %
Ehretiaceae	1	0.6 %
Euphorbiaceae	4	2.4 %
Fabaceae	23	14.0 %
Flacourtiaceae	1	0.6 %
Geraniaceae	1	0.6 %
Gisekiaceae	1	0.6 %
Illebracaceae	1	0.6 %
Lamiaceae	1	0.6 %
Liliaceae	8	4.9 %
Loganiaceae	1	0.6 %
Malvaceae	9	5.5 %
Nymphaeaceae	1	0.6 %
Ochnaceae	1	0.6 %
Pedaliaceae	1	0.6 %
Periplocaceae	1	0.6 %
Poaceae	33	20.1 %
Polygalaceae	2	1.2 %
Portulacaceae	2	1.2 %
Rhamnaceae	1	0.6 %
Rubiaceae	3	1.8 %
Sapindaceae	1	0.6 %
Solanaceae	5	3.0 %
Sterculiaceae	1	0.6 %
Tiliaceae	3	1.8 %
Typhaceae	1	0.6 %

The average number of species recorded in releveès during the survey period is 30.74 per sampling bout (std. dev. = 6.3). The lowest total was 15 (101A, Site 1), with 42 (217, Site 2) the highest number of individuals (refer **Graph 1**).[3] [4] [5].

he average number of species recorded on Site 1 (relevèes 101A – 112) is 27.9, while the average number of species recorded on Site 2 is 32.78. The higher alpha diversity of Site 2 is regarded a reflection of the degraded status of much of the vegetation, resulting from severe and sustained grazing pressure causing the proliferation of several weeds and invasive species that are not necessarily associated with the more pristine flora of Site 1. The presence of weeds and poor quality species such as *Hibiscus* species, *Acrotome inflata, Solanum panduriforme* and *Vernonia* species generally indicates a poor habitat status.

[3] Please note that Site Numbers used in the following graphs refer the Site Alternatives. Site numbers 101 – 112 refer to Alternative 1m, site numbers 213 – 230 refer to Alternative 2.
[4] Releveès compiled in Alternative 1 are indicated in brown, releveès compiled in Alternative 2 are indicated in green,
[5] Please note ~~red~~ line that indicates the average value calculated for the respective site alternatives

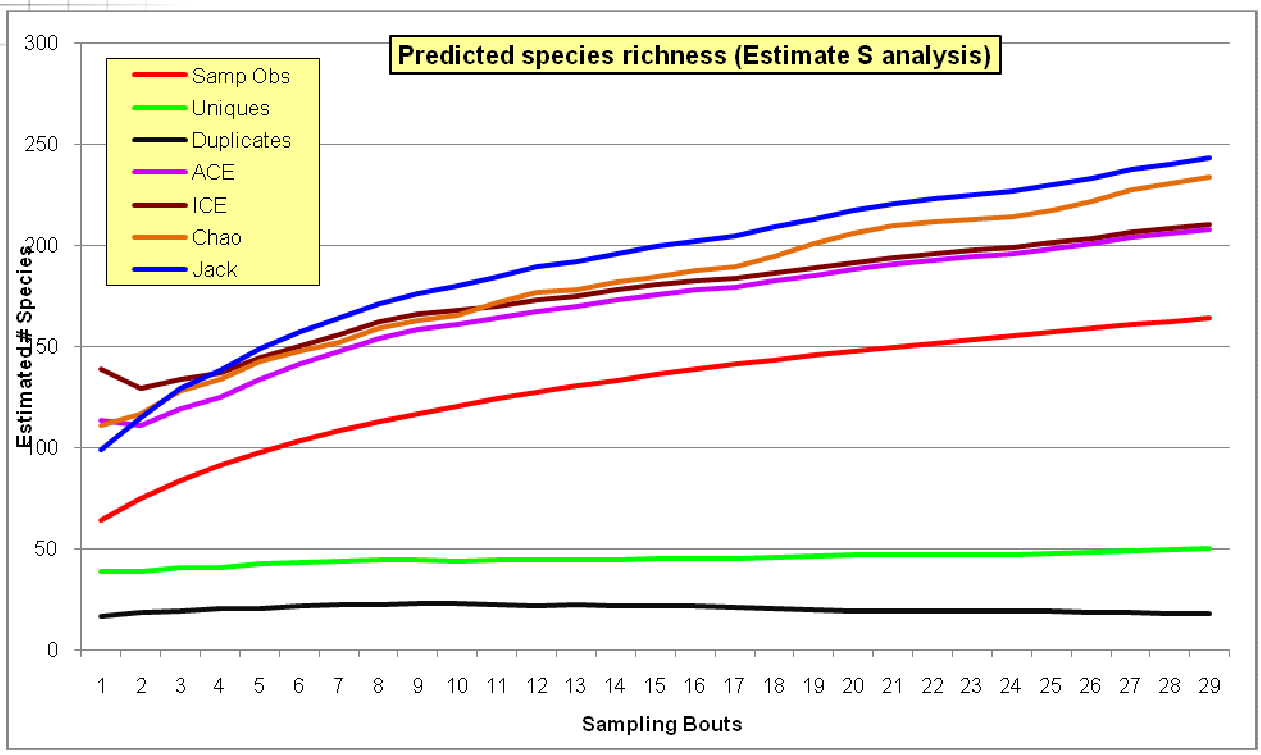


Graph 1: Alpha Diversity per sampling event

7.2.2 Species Diversity - Estimate-S Analysis

While Species richness provides an indication of the total number of species that were recorded within a certain area (community or habitat) and along a number of repetitions (relevèes/ sampling bouts), it does not provide any information on how well each of the species is represented in the sampled area. Species diversity is a measure of both the number of species (species richness) and the relative contribution of each of these species to the total number of individuals in a community (evenness). Evenness is also an important characteristic that is used to assess the status of an area/ community or habitat. Pristine areas are generally characterised by a high evenness with a number of co-dominant species. Forms of degradation or human related impacts generally affect the abundance levels of species, with poor quality species increasing while sensitive species will decrease in abundance or disappear altogether. This effect is easily observed in areas where high grazing pressure is sustained; poor quality species dominate the species composition and physiognomy and good quality grasses and forbs that are mostly associated with pristine conditions generally disappear.

EstimateS (Colwell, 2006) was used to analyse collated data. It is designed to determine the accuracy and comprehensiveness of the sampling procedure and, given the collated data, also provide an estimation of the number of species that should be present in the habitat. Species abundance values were replaced by presence/ absence indications prior to the analysis. Results are illustrated in **Graph 2**.



Graph 2: Estimate S analysis of predicted species richness based on recorded sampling bouts

- **Comments**

The X-axis represents the number of sampling events. The Y-axis represents species richness, or simply the number of species present or estimated.

The bootstrap analysis of the observed species revealed the following aspects:

- Sobs (# of species observed) – The number of species is only beginning to asymptote (levelling off). If the same species are being sampled throughout the sampling bouts, it is expected that the Sobs indicator will asymptote. In this particular case, the numbers continue to increase with each additional sampling event. It is therefore expected that, with additional sampling, the number of species identified within the study region will increase further.
- Uniques/ Duplicates - If we compare the ratio of uniques to duplicates, we are comparing the number of species that occurred once in the pooled sample plots to those that occurred twice. Simply put, if the number of uniques keeps on increasing, the expectation is that many new species are likely to be recorded. However, if the number of duplicates increases (usually when the uniques and duplicates lines cross), the sampling process is producing more of the same species instead of new ones. Evidence from Graph 2 indicates that there is still a marked difference between the number of uniques and duplicates, indicating that further sampling is expected to produce additional new species.
- Estimator Calculators – the variety of estimator (bootstrap) calculators (ACE, ICE, Chao, Jack) used in the analysis provides predictions of the estimated number of species that could be expected given the sampling bouts. These estimators generate predictions based largely on the total number of species found given a certain number of pooled samples and the ratio of uniques to duplicates found within the pooled sample. The actual number of species recorded during the sampling process is 163, while the predictors estimate a species richness of between 207 and 242 species, which correlates well with the recorded species richness of the relevant ¼-degree grid that is spatially represented in the site alternatives (311 species).

7.2.3 Shannon-Weiner Index (H')

The Shannon-Weiner diversity index (H') looks at how species are distributed in an ecosystem or a community. This index therefore considers both the species richness and the relative abundance of each species in a community to determine the uncertainty that an individual picked at random will be of a given species. H is calculated with the following formula, where p_i is the proportion of species belonging to the *i*th type of letter in the string of interest. In ecology, p_i is often the proportion of individuals belonging to the *i*th species in the dataset of interest:

$$H' = -\sum_{i=1}^{R} p_i \log p_i$$

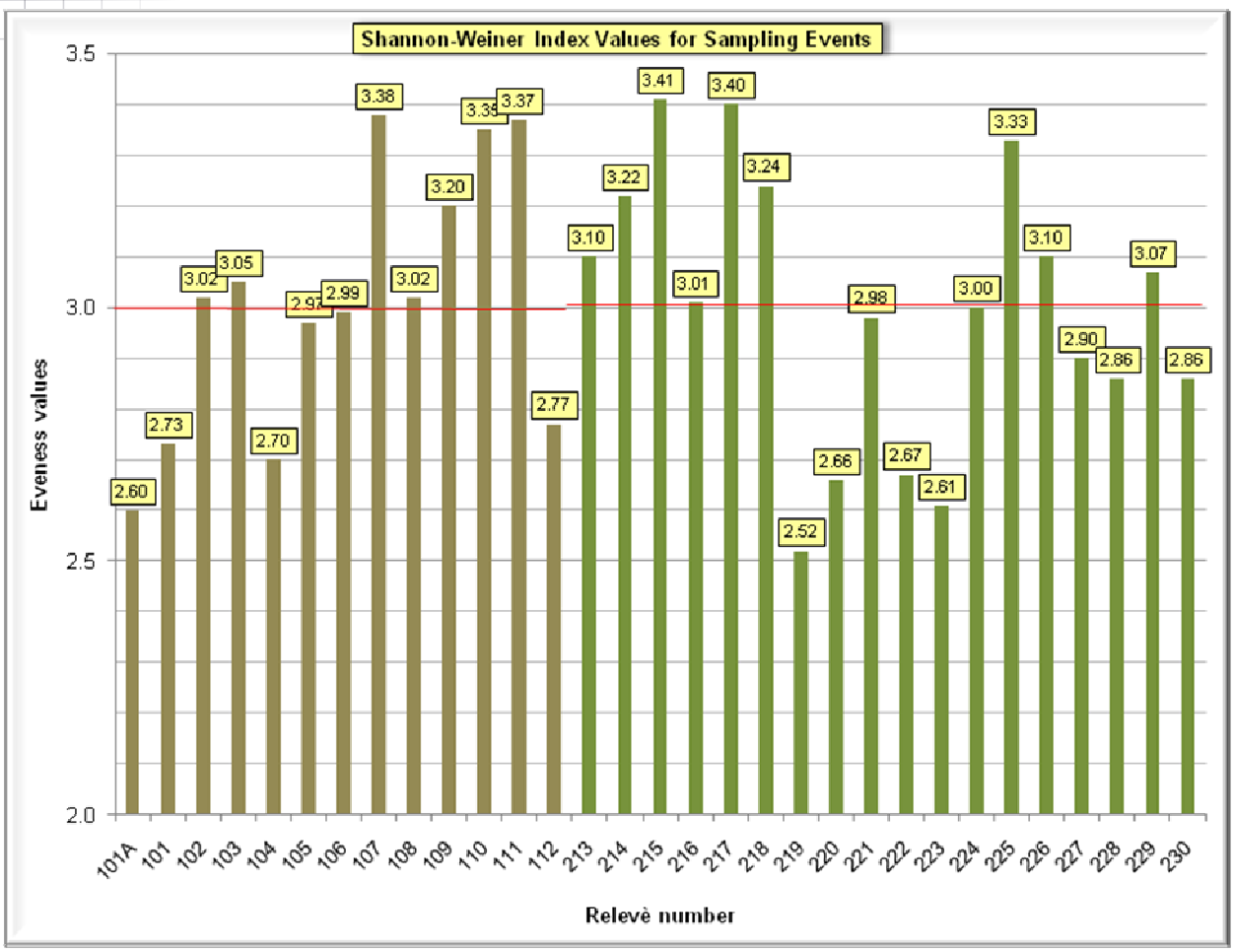
Biologically realistic H' values range from 0 (only one species present with no uncertainty as to what species each individual will be) to about 4.5 (high uncertainty as species are relatively evenly distributed). In general, it is thought that more disturbed and less stable environments should have lower H' values. The index is maximized when all species have the same number of species. Sampling bouts that display a high discrepancy between the numbers of individuals that inhabit a community will logically therefore display a low index value.

For this particular dataset, the average Braun-Blanquet values were used to calculate the index, as follows:

+ 2 %;
1 3 %;
2A 8 %;
2B 18 %;
3 38 %; and
4 63 %.

- **Comments**

There is not a marked difference between the average values of Alternative 1 and Alternative 2 (3.01 vs 3.00), illustrated in **Graph 3**.



Graph 3: Shannon-Weiner Index values for respective releveès

7.2.4 Evenness Index

Evenness (E) is an index that makes the H' values (Shannon-Weiner) comparable between releveès by controlling for the number of species found within the communities. H'max represents the highest possible value if you have a given number of species in a community (109 in this case) and each of the species was equally represented in the community. Therefore:

H'max = ln(S) (where S = total # of species)

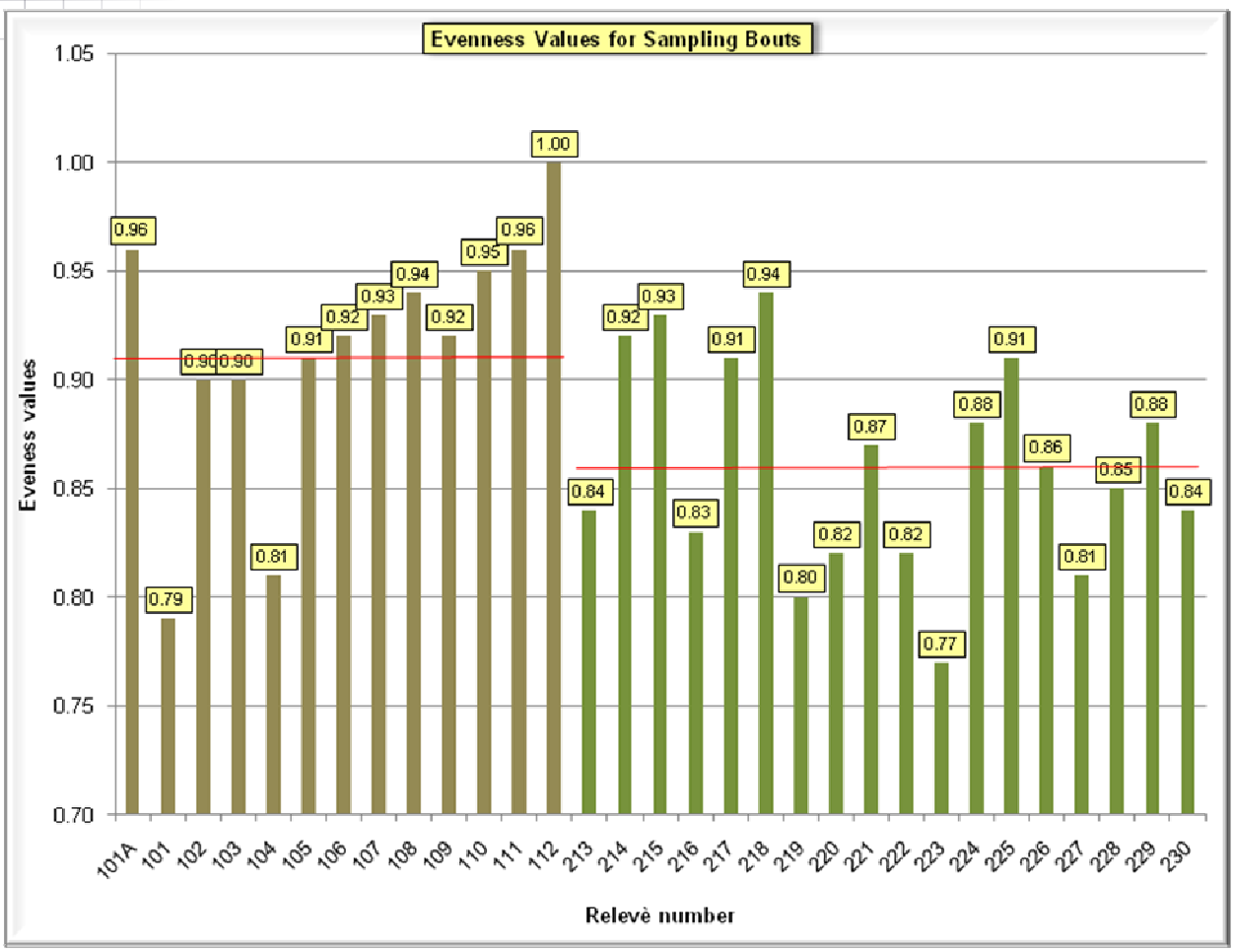
H'max = ln(109)

H'max = 4.6913

Evenness for each of the releveès is therefore calculated by the following formula:

E = H' / H'max

Evenness values of respective releveès are illustrated in **Graph 4**, note average values (red line) for site alternatives.



Graph 4: Evenness Index for the sampling plots

- **Comments**

An average of 0.88 (± 0.06) is calculated for the dataset. Typically, in areas that are disturbed, or where anthropogenic effects caused a disturbance in the species composition and abundance values, the Evenness will be characterised by low values.

When the respective alternatives are compared, it is evident that Alternative 1 indicates a higher average value, namely 0.91. The lower average value calculated for Alternative 2 (0.86) indicates a degradation gradient with several weedy and poor quality species dominating the species composition, hence the abundance values of species has become unstable due to the dominance of certain species. The species composition and dominance values recorded in Alternative1 represents a more pristine environment; typically a higher number of co-dominant species will be recorded in a more pristine environment while a degraded habitat will comprises of a few species that tend to dominate exclusively while other species are represented by lower abundance values.

Results of the Evenness Index clearly indicates the degraded nature of vegetation of Alternative 2, this is also confirmed by the high average species diversity recorded in these areas as a result of the infestation by weedy and poor quality plants.

7.2.5 Simpson's Diversity Index

Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present (species richness), as well as the abundance of each species (evenness). Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). The following formula is used to calculate Simpson's Index:

$$D = \frac{1}{\sum_{i=1}^{s} p_i^2}$$

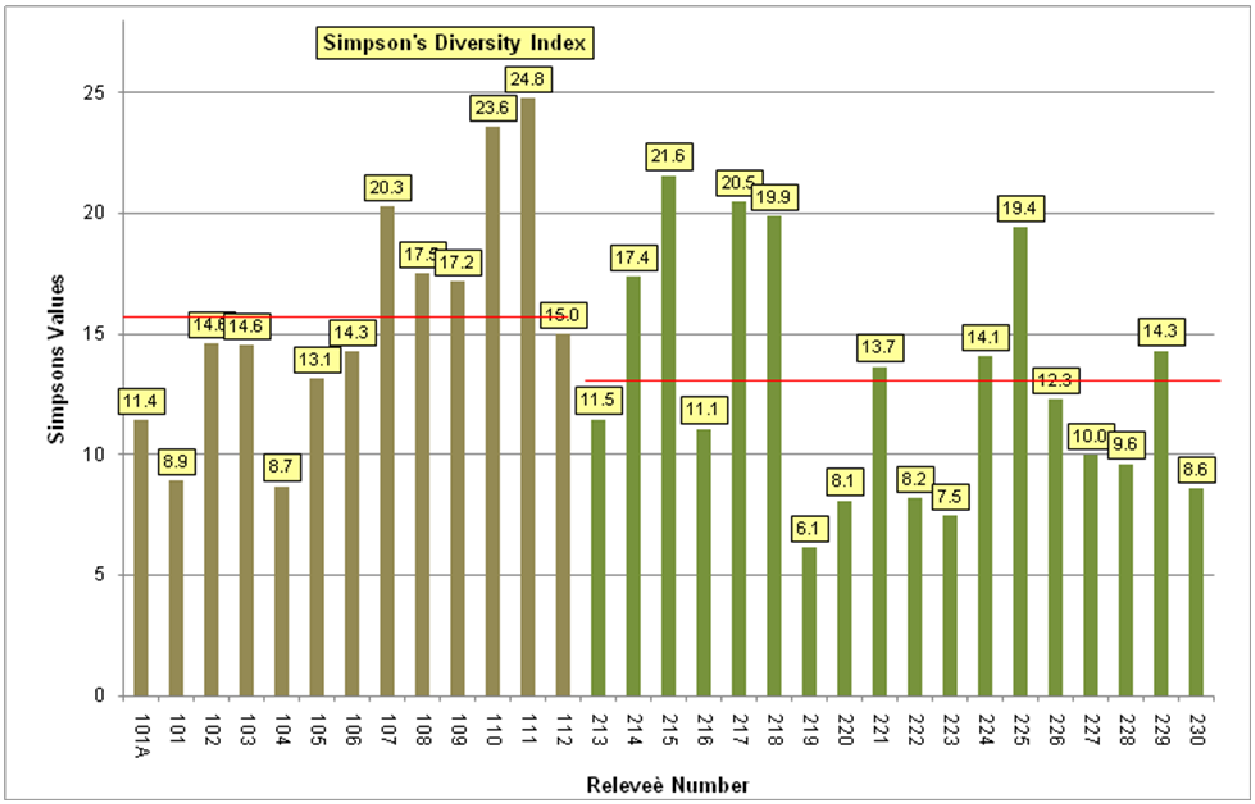
With this index, 0 represents infinite diversity and 1 no diversity. That is, the bigger the value of D, the lower the diversity.

- **Simpson's Index of Diversity: 1 - D**

The value of D, as calculated above is neither intuitive nor logical, so to counter this problem, D is often subtracted from 1. The value of this index still ranges between 0 and 1, but now, the greater the value, the greater the sample diversity.

- **Simpson's Reciprocal Index 1 / D**

Another way of overcoming the problem of the counter-intuitive nature of Simpson's Index is to take the reciprocal of the Index (1/D). The value of this index starts with 1 as the lowest possible value. This value would therefore represent a community containing only one species, while a higher calculated value would indicate a greater diversity. The maximum value is the number of species (or other category being used) in the sample. For example if there are five species in the sample, then the maximum value is 5.



Graph 5: Simpson's Diversity Index values for respective releveès

- **Discussion**

Similar to other calculated indices, the Simpsons Diversity Index indicates the degraded nature of Site Alternative 2, with an average value of 13.1, compared to the average value of Site Alternative 1 of 15.7 (refer **Graph 5**). The prominence and dominance of weedy and poor quality species is indicated by high cover abundance values of these species, the species composition within these areas is typically composed of a few abundant (dominant) species while a high number of other species are recorded as occasional species with low cover abundance values. In contrast, more pristine woodland sample plots were characterised by a higher number of co-dominant species. No specific species were found to dominate exclusively in these areas and the general abundance values were in the lower categories.

This assessment therefore clearly indicates the degraded nature of the vegetation in Site Alternative 2, while vegetation within Site Alternative 1 is regarded more pristine (less degraded).

7.3 PLANT SPECIES OF CONSERVATION IMPORTANT – SURVEY RESULTS (2013)

The following conservation important plant taxa were recorded during the survey period (refer **Table 6**).

Table 6: Plants of conservation consideration recorded in the site alternatives

Binomial Name	*Family*	*Status*
Acacia erioloba	Fabaceae	Declining, Protected Tree (National Forest Act, 1998)
Boscia albitrunca	Capparaceae	Protected Tree (National Forest Act, 1998)
Combretum imberbe	Combretaceae	Protected Tree (National Forest Act, 1998)
Sclerocarya birrea	Anacardiaceae	Protected Tree (National Forest Act, 1998)
Securidaca longepedunculata var. longepedunculata	Polygalaceae	Protected Tree (National Forest Act, 1998)
Spirostachys africana	Euphorbiaceae	Provincially protected

No threatened or Red Data plant species were recorded during the brief survey period. However, parts of both the proposed sites comprise significant numbers of protected tree species. In particular, *Acacia erioloba, Boscia albitrunca* and *Spirostachys africana* were recorded in significant numbers.

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 savanna regions of southern Africa. The site alternatives and the general surrounds are characterised by moderate to low levels of (recent) transformation that resulted from mining and industrial developments. Additionally, some degradation of remaining natural woodland is evident on a local, resulting from livestock farming and suboptimal management strategies (fire management) that tend to result in severe changes to the herbaceous layer. These changes are reflected in species changes of the grass sward, indicating a moderate divergence from the 'normal' composition of the primary woodland habitat (Limpopo Sweet Bushveld, Section 7.1). Remaining natural woodland of the site alternatives is however highly representative of the regional savanna vegetation, representing a primary climax status.

Locally, the development of vegetation patterns are likely to be driven by local soil characteristics and moisture content and inundation of the soils, generally reflected as mosaical gradients between woodland variations.

7.5 TWINSPAN RESULTS

Table 7: TWINSPAN analysis of floristic data

Taxon	101A	218	108	111	110	102	101	104	107	106	105	109	103	220	216	223	221	228	224	226	225	227	229	222	230	219	215	217	214	213	112	Grp
Typha capensis	1																															
Dactyloctenium aegyptium	1																															
Gomphrena celosioides	+																															A
Flaveria bidentis	+																															
Bidens pilosa	+																															
Alternanthera pungens	+																															
Brachiaria nigropedata		A																														
Eragrostis species		A																														
Acroceras macrum		A																														B
Litogyne gariepina		1																														
Aloe species		+																														
Miscanthus junceus		+																														
Nymphaea species	A	+																														
Schoenoplectus corymbosus	1	+																														C
Cyperus species	1	+																														
Schkuhria pinnata	+	+																														
Scirpus species	+	+																														
Chloris virgata	+	+											+																			
Croton gratissimus			A	A	A																											D
Crotalaria species			A	1	+																											
Ozoroa paniculosa			+	1	1																											
Kiggelaria africana			+	1	1																										+	
Ochna pulchra				1	A									+	+																	
Strychnos pungens				1	1																											
Ledebouria species				+	+																											
Sporobolus nitens				+	+								+																			
Pappea capensis			A																													
Acacia nigrescens						B	A	+	A			A	1																			E
Spirostachys africana							+		1	1		1	A																			
Sclerocarya birrea			1	1	1	+	+					1																					F
Melhania forbesii					1	+	A	+	1	1	+	1																					
Pogonarthria squarrosa					+	+	+	+	+	1		+					+			+											+	
Aristida stipitata					+			+	1	1		+															+	+				

Kyphocarpa angustifolia		+	+	+	+	+	+	+	+	+	+	+	+													+		+		G
Hirpicium bechuanense		+	A	+	+	+		+																	+				+		
Kalanchoe rotundifolia		+	+			+	+		+				+																	
Sida species		+						+	+		+		+																	
Acacia species		1							1		1	1	1																+	+	
Ziziphus mucronata		1					+				+	+																		
Stipagrostis uniplumis														+	+	1	1	1	1	A	1	A	B	1	A		+				H
Eragrostis pallens									+		+			1	B	+	1	+	A	A	A			1	1						
Hibiscus species														3	3			1	+		A	+	2			1		+			
Acacia erioloba															+	+	+	+	+	+		1	+		+	1	1				
Xenostegia tridentata														+		+	+	+	+		+		+	+	+					
Talinum crispalatum																			+		+	+			+					
Acacia erubescens				1	A	A	+	3		A	B	A		+	+	+	A	1	1	+	+	+	1		+		+				I
Perotis patens					+		+		1	1	1	+		A	A	1	+	+	+	+	+	+	+	1		1					
Malva species						+	+		+		+					A	A		B		+	+		B	1					
Aristida congesta			1			1					+	1	1	+			+			+	+	+	+		1		+				
Acacia mellifera		A									+				+		+									+	A	A	B	3	J
Acacia tortilis		A					+		+			1									+					+	A		A	1	
Boscia foetida		+							+				+														+	1	1		
Eragrostis porosa	+												+		+												+	1	+		+
Geigeria burkei		+												+													+	+		+	
Gymnosporia buxifolia				+																+								+	+	+	
Lycium cinereum																				+		+	+				+	1	1		
Urochloa mosambicensis																														1	
Aristida bipartita																														1	
Combretum imberbe																													+	1	
Vernonia species	+													1	A	1		+	A	A	A	A	+	+	+	1	+	+		+	K
Acrotome inflata				+	+				+							1	1	A	A	+	A		+	A		+	1	+		+	
Dactyloctenium giganteum						+										1	+		+	+		+	+		1	+	+	+			
Digitaria species						A				+				A	1		A	+	+		+							A			
Sansevieria aethiopica													+				+		+	+	+	+	+				+		+		
Tarchonanthus camphoratus																1							+		1		1	+	1	1	
Gisekia africana var. *africana*																		+				+			+	+	+	+	+		
Melolobium candicans																	+						+		+	+		+		+	
Grewia monticola															1	+		+	+		1	1		+			1		+		
Solanum panduriforme																		+			+		+			+		+	1		

Eragrostis lehmanniana			1				+		+	+		A	A			1		1		A	1	1	1	+	A	A	B	A	A	A		L
Euclea undulata					+		A	1	+	1	+		A					A	1	A	+	1	B	+	+		1	1	1			
Terminalia sericea						1		+	1	+	1	1	1	B	B		B	A		1	A					1		1		+		
Combretum hereroense							+	+	+			+				+		1	+			+	1						+	+		
Waltheria indica			1	+	1	+	+	+	1	1	1	+		A	A	3	B	A	A	A	A	A	A	3	1	A	A	+		+		M
Panicum maximum			A		A	B	3	B	B	A	A	B	B					A		A	1	B	1		A			B		1		
Grewia flava		1		1	1		+	A	1	1	1	1	1		+	+	+	A	+	A	1	A	A	A	1		A	1	A	A		
Combretum apiculatum			A	A	A	1	+	A		B	A	A	A	1	1		1	1	1	+							+	1				
Eragrostis rigidior				A	A	A	B	A	1	1	A		1							1	+						1	A	A	B		
Limeum fenestratum			+	+	+				+	+	1	+		+	+	+	+	+	+		+	+	+	+		+	+	+	+	+		
Hibiscus micranthus			+	+	+				+	+		+										+					+	+	+	+		
Hermannia tomentosa				+					+			+			+	+						+	+			1	+	+	+	+		
Tephrosia species					+	+		+	+	+	+	+					+			+	+	+						+				
Commiphora pyracanthoides		+	A	1	1	1	+						+		+	+	+			+	+	+		+			1	+	1	1		
Peltophorum africanum			1	1	1			+				1								1	+	1		+	1	+	+					
Zornia linearis																					+										+	N
Eragrostis gummiflua																															+		
Portulaca kermesina																															+		
Pellaea calomelanos																															+		
Oldenlandia herbacea																															+		
Indigofera species							+	+			+			+	+	B	B	+	B		A		+	+	1	3	1	+		+	+	O
Sesamum triphyllum			+					+	+	+		+		+	+	+	+	+	+	+	+		+	+	+	1	+	+			+		
Boscia albitrunca		+						+							+	+	+		+	1	+	+	+	+			1	+	+	+	+		
Evolvulus alsinoides					+					+				+		+			1	+	+	1	+		1		+	+			+		
Grewia flavescens			A	1	A	A	A	1	A	1	1	A	AB		+	3	B	3	B	3	B	3	B	A	3		1	A	A	B	+	P
Dichrostachys cinerea			A	A		A	3	B	A	1	1		2	A	+	1		1	1		B	3		A		1	1	B	1	1	+		

7.6 FLORISTIC COMMUNITIES & VARIATIONS

Results of the TWINSPAN (refer **Table 7**), indicates the following communities and variations:

- *Nymphaea – Schoenoplectus* Impoundments Community;
  - *Typha capensis* Variation;
  - *Brachiaria nigropedata* Variation*;*
- *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland Community;
  - *Croton gratissimus - Sclerocarya birrea* – Gravel Plains Variation;
  - *Acacia nigrescens – Melhania forbesii Woodland Variation*;
- *Vernonia* species - *Panicum maximum* Degraded Woodland Community;
  - *Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation;
  - *Acacia mellifera – Acacia tortilis* Alluvial Plains Variation;
- *Portulaca – Oldenlandia* Sheetrock Community; and
- Artificial woodland habitat.

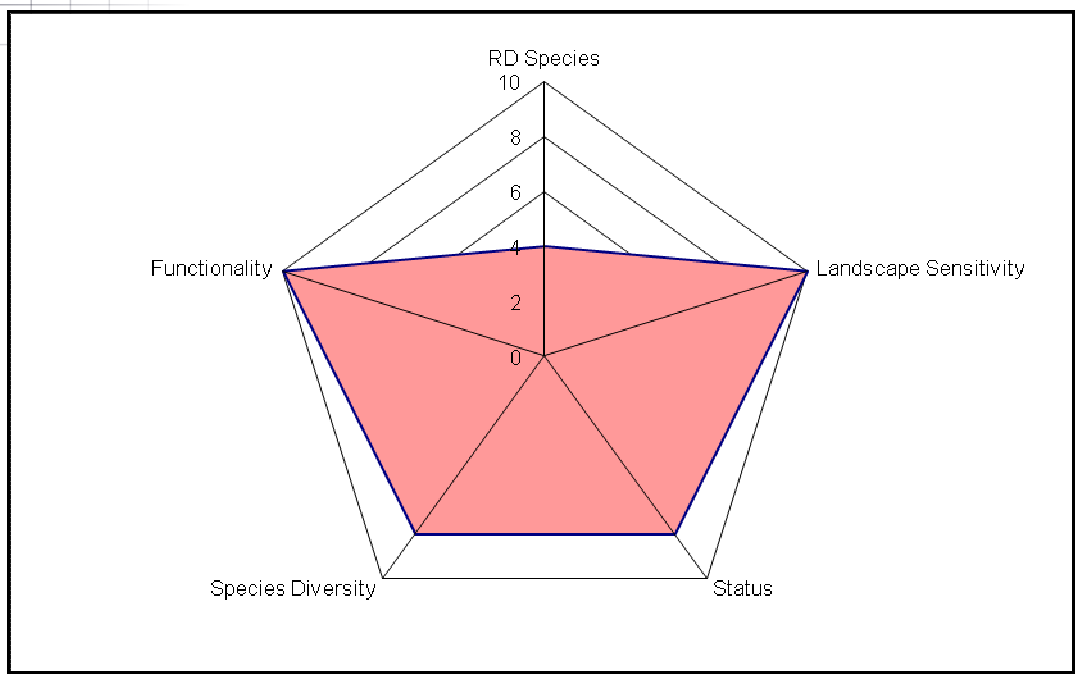
7.6.1 Nymphaea – Schoenoplectus Impoundments Community

Impoundments in the respective site alternatives are artificial, comprising depressions that were created within drainage lines and Alluvial Plains that are seasonally inundated through sheetflow. Soils are typically clayey in these areas, with a typically low water permeability of the topsoils. Water is consequently 'stored' in these artificial impoundments for prolonged periods and is utilised by animals throughout the year, particularly during the dry period of the year. Vegetation surrounding these areas, due to the increased utilisation factor, are frequently degraded, comprising *Acacia* species, *A. tortilis, A. mellifera, Boscia foetida, Ziziphus mucronata,* with a poorly developed and, frequently, depleted herbaceous layer with few grasses.

This community is represented by Species Groups A, B and C. Common and noteworthy species that are characteristic of this community include the hydrophilic taxa *Nymphaea* species, *Schoenoplectus corymbosus, Scirpus* species and *Cyperus* species, as well as the weed *Schkuhria pinnata* and the grass *Chloris virgata* (Species Group C). It is also distinguished from the terrestrial vegetation types by the absence of common species of Species Groups M and P.

The vegetation of this community is determined by the prolonged presence of standing water, resulting in the development of an aquatic vegetation layer. Fringes are frequently inhabited by species associated with the ecotonal zones around areas of standing water, but mostly comprise weeds and forbs indicating a depleted vegetation cover. It is typical for variations within this community to exhibit dissimilar (unique) floristic compositions.

Although regarded as artificial habitat, the historic presence of these features has created permanent floristic variations that are no longer characterised by succession of the vegetation seres. A medium-high floristic sensitivity is therefore ascribed to these features due to the atypical nature of the vegetation that results in habitat diversity on a local scale (refer **Graph 6**).



Graph 6: Floristic Sensitivity rose for the *Nymphaea – Schoenoplectus* Impoundments

- ***Typha capensis* Variation**

This unit is encountered within Site Alternative 1, comprising two relative deep impoundments. Characteristic species of this variation are represented by Species Group A, comprising of the hydrophilic *Typha capensis,* the grass *Dactyloctenium aegyptium* and some forbs (weeds). It is distinguished from the *Brachiaria nigropedata* Variation by the absence of Species Group B, G and J.

- ***Brachiaria nigropedata* Variation**

This unit is present in Site Alternative 2 and represents a typical farm dam within a drainage line/ Alluvial Plains areas. Surrounding habitat is typically comprises of *Acacia* species and a depleted herbaceous layer is noted. The hydrophilic vegetation associated with the standing water comprises the grasses *Brachiaria nigropedata, Eragrostis* species, *Acroceras macrum, Miscanthus junceus* as well as the forbs *Litogyne gariepina* and *Aloe* species. Other noteworthy (non-characteristic) species include the weeds *Kyphocarpa angustifolia, Hirpicium bechuanense, Sida* species, the succulent *Kalanchoe rotundifolia* and the tree *Ziziphus mucronata*, *A. tortilis, A. mellifera, Boscia foetida.*

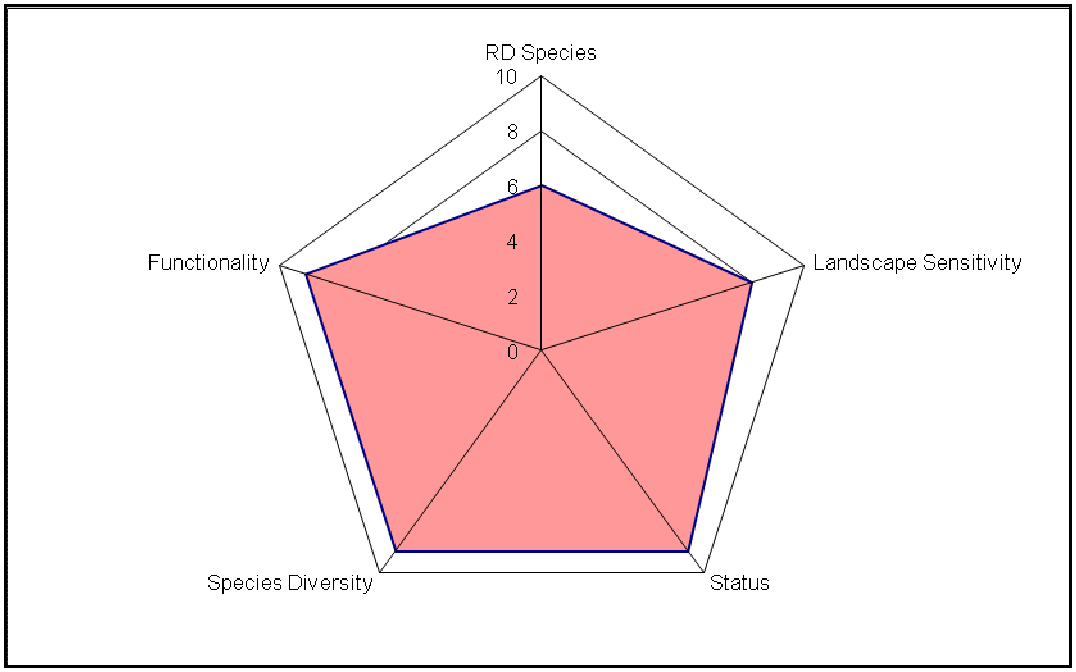
It is distinguished from the *Typha capensis* variation by the absence of Species Group A.

7.6.2 Kyphocarpa angustifolia – Eragrostis rigidior Woodland Community

This community represents natural terrestrial woodland habitat of Site Alternative 1 and is characterised by Species Groups D, E and F, including the characteristic tree *Sclerocarya birrea,* the forb *Melhania forbesii* and the grasses *Pogonarthria squarrosa* and *Aristida stipitata.* Relative low cover abundance values are however noted for these species. Non-characteristic Species Groups recorded in this unit include G, I, L and M. It is distinguished from terrestrial woodland of Site Alternative 2 by the TWINSPAN separation of Species Groups H, J and K.

This unit is representative of the regional vegetation and is in a pristine condition. Two separate variations are noted within this community, defined by local soil conditions. Gravel plains where stony/ rocky soils prevail are interspersed by deeper soils, notable with the absence of surface rock. The distribution of these variations are however mosaical and the delineation thereof from aerial photography is a matter of interpretation. Mapping efforts are not regarded particularly accurate; detailed soil sampling will aid in a more accurate mapping of the extent of these variations.

A medium-high sensitivity is ascribed to this community due to the pristine nature of the vegetation and the presence of several protected tree species occurring abundantly throughout this community (refer **Graph 7**).



Graph 7: Floristic Sensitivity rose for the *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland

- ***Croton gratissimus - Sclerocarya birrea* Gravel Plains Variation**

The stony nature of the soil conditions determines the extent of this variation as well as the predominantly broad-leaved nature of the woody species that characterise this variation. Sandy and stony soils are frequently nutrient poor with typical lower moisture retaining capabilities, which attributes for the absence of most microphyllous *Acacia* species in this unit. The only *Acacia* species recorded in this variation is *Acacia erubescens,* which occurs throughout most of the region and across a wide variety of habitat types; *Acacia* species are frequently associated with soil type characterised by relative high clay content and is frequently an indication of encroachment.

This variation is characterised by the presence of Species Group D and the absence of Groups E and L. Characteristic species include the trees *Croton gratissimus, Ozoroa paniculosa, Kiggelaria africana, Ochna pulchra* and *Strychnos pungens* as well as the geophyte *Ledebouria* species and the grass *Sporobolus nitens.* Other, non-characteristic species include the shrubs *Commiphora pyracanthoides, Grewia flavescens, Dichrostachys cinerea, Combretum apiculatum,* the grasses *Panicum maximum* and *Eragrostis rigidior* and the forb *Waltheria indica.* Most of these species are adapted to the slightly drier conditions that result from the sandy nature of the soils.

Indicator species of poor habitat conditions (*Hibiscus* species, *Vernonia* species, *Acrotome inflata*, *Indigofera* species) are generally absent from these areas, reflecting relative pristine habitat conditions.

- ***Acacia nigrescens – Melhania forbesii Woodland Variation***

Deep soils, without the incidence of surface outcrops or stony nodules, predominate in these areas. Variation in clay content of the soils is noted, but soils are generally sandy to sandy loam. Vegetation is typically closed woodland, in a good condition and representative of the regional vegetation.

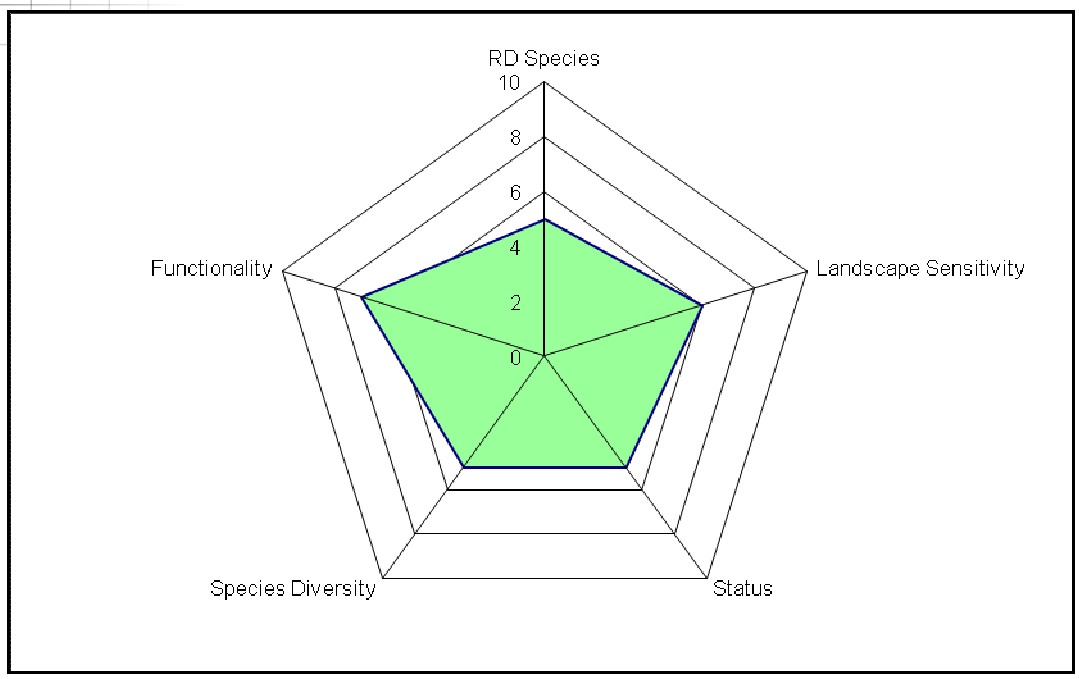
This unit is characterised by Species Group E, comprising of the trees *Acacia nigrescens* and *Spirostachys africana.* The prominence of both these species indicates an association with moist conditions, particularly *Spirostachys africana.* This variation is further distinguished from the *Croton gratissimus - Sclerocarya birrea* Gravel Plains Variation by the absence of Species Group D and the presence of Groups L and O. Non-characteristic species recorded in this unity include the trees *Acacia erubescens, Euclea undulata, Terminalia sericea, Grewia flava, Combretum apiculatum, Grewia flavescens, Dichrostachys cinerea,* the grasses *Pogonarthria squarrosa, Eragrostis rigidior* and the forbs *Kyphocarpa angustifolia* and *Waltheria indica.*

7.6.3 Vernonia species - Panicum maximum Degraded Woodland Community

This community is present within Site Alternative 2, comprising natural woodland, typical of the area. However, a high degradation factory is noted in this community and the subsequent variations, which is attributed to intensive grazing practices within floristically poor habitat. This community is characterised by Species Group K, and either Groups H and I or Group J. Characteristic species include the forbs *Vernonia* species, *Acrotome inflata, Sansevieria aethiopica, Gisekia africana* subsp. *africana, Melolobium candicans* and *Solanum panduriforme,* as well as the grasses *Dactyloctenium giganteum, Digitaria species* and the woody species *Tarchonanthus camphoratus.* This community is distinguished from the *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland Community of Site Alternative 1 by the absence of Species Groups D, E, F and G.

The non-characteristic weed species *Waltheria indica, Limeum fenestratum, Hibiscus micranthus* and *Sesamum triphyllum* are abundantly present in this community, reflecting the degraded nature of the vegetation. Other non-specific taxa include the grasses *Eragrostis lehmanniana* and *Panicum maximum,* the forbs *Indigofera* species, *Evolvulus alsinoides* and the woody species *Euclea undulata, Terminalia sericea, Grewia flava, Combretum apiculatum, Commiphora pyracanthoides, Grewia flavescens* and *Dichrostachys cinerea.*

A medium floristic status and sensitivity is ascribed to this community (refer **Graph 8**).



Graph 8: Floristic sensitivity rose for the *Vernonia species - Panicum maximum* Degraded Woodland

- ***Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation**

This unit is characterised by Species Group H and is distinguished from the *Acacia mellifera – Acacia tortilis* Alluvial Plains Variation by the absence of Group J, but also by the presence of the non-characteristic Group I, which is absent from the *Acacia mellifera – Acacia tortilis* Alluvial Plains Variation.

Biophysical conditions are typical for the region, deep sandy soils prevail on flat, or slightly undulating, plains. Due to a high utilisation factor, the herbaceous layer indicates an abundance of poor quality species, such as the forbs *Hibiscus* species, *Malva* species, *Vernonia* species, *Waltheria indica, Indigofera* species as well as the grass *Aristida congesta* subsp. *barbicollis.* The prominence of the palatable grazing grass species *Stipagrostis uniplumis* and *Panicum maximum* is probably a reason for the high grazing factor noted in these areas. The grasses *Eragrostis pallens* and *Perotis patens* typically occur in open areas where deep sandy soils predominate. The increase in abundance of these two grasses is directly related to the high grazing factor.

Degradation of the vegetation is also noted in the encroachment of the woody shrub *Grewia flavescens.*

- ***Acacia mellifera – Acacia tortilis* Alluvial Plains Variation**

This variation is characterised by the presence of Species Group J and is distinguished from the *Acacia nigrescens – Melhania forbesii* variation by the absence of Species Groups H and I. Soil conditions in these areas vary significantly from the *Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation because a higher clay content. Typically, these areas are analogous to alluvial plains. A flat topography and the absence of clearly defined waterlines result in sheetflow of water subsequent to raining events. Noteworthy microphyllous species, such as *A. mellifera, A. tortilis, Lycium cinereum* and *Boscia foetida* indicates a prolonged moist period subsequent to raining events. Similarly, the presence of other species, such as the grasses *Eragrostis porosa, Urochloa mossambicense*, the shrub *Tarchonanthus camphoratus* and the dwarf shrub *Geigeria burkei* indicates moist conditions.

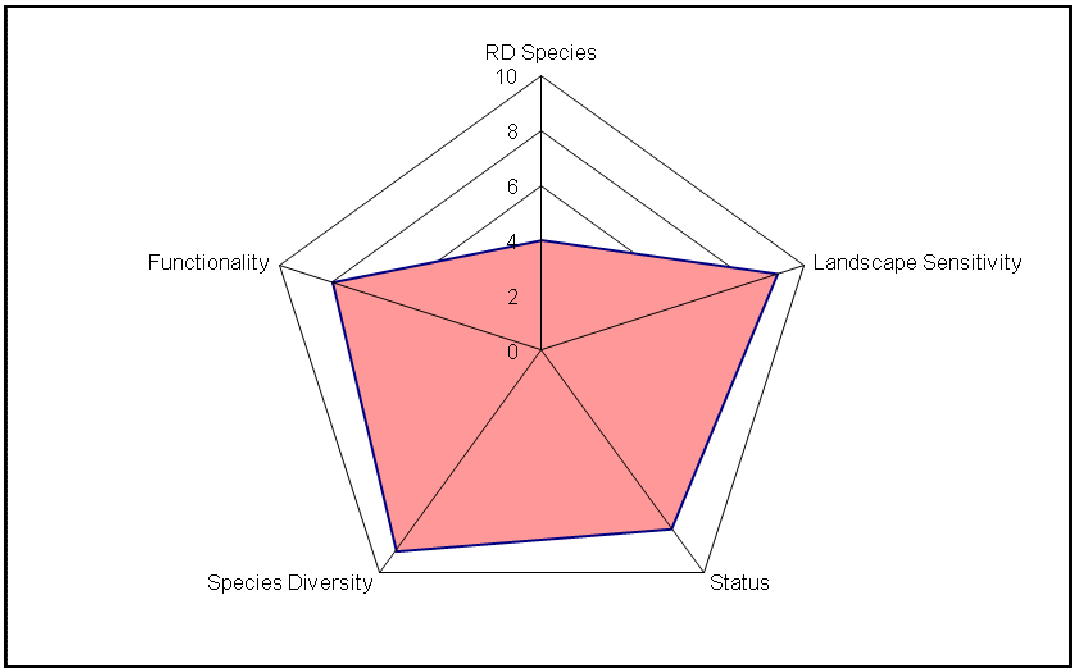
Non-characteristic noteworthy species include the woody species *Euclea undulata, Combretum apiculatum, Boscia albitrunca, Grewia flava, Commiphora pyracanthoides*, the forbs *Limeum fenestratum, Hibiscus micranthus, Hermannia tomentosa* and the grasses *Dactyloctenium giganteum, Eragrostis lehmanniana* and *E. rigidior* occur abundantly throughout this community.

A medium-high sensitivity is usually attributed to vegetation that is associated with moist conditions. Due to the slightly degraded nature of the vegetation, a medium sensitivity is ascribed to this variation.

7.6.4 Portulaca – Oldenlandia Sheetrock Community

A localised sheetrock outcrop is present in Site Alternative 1. This area, comprising approximately 2.5 ha, is typified by the extensive presence of sheetrock and little vegetation. Other than occasional shrubs and lithophytic plants, the floristic composition is entirely atypical to the surrounding natural vegetation. This unit is characterised by the presence of Species Group N, comprising of the forbs *Zornia linearis, Portulaca kermesina, Oldenlandia herbacea*, the grass *Eragrostis gummiflua* and the fern *Pellaea calomelanos.*

Due to the atypical nature of the habitat type, a medium-high sensitivity is ascribed to this unit (refer **Graph 9**).

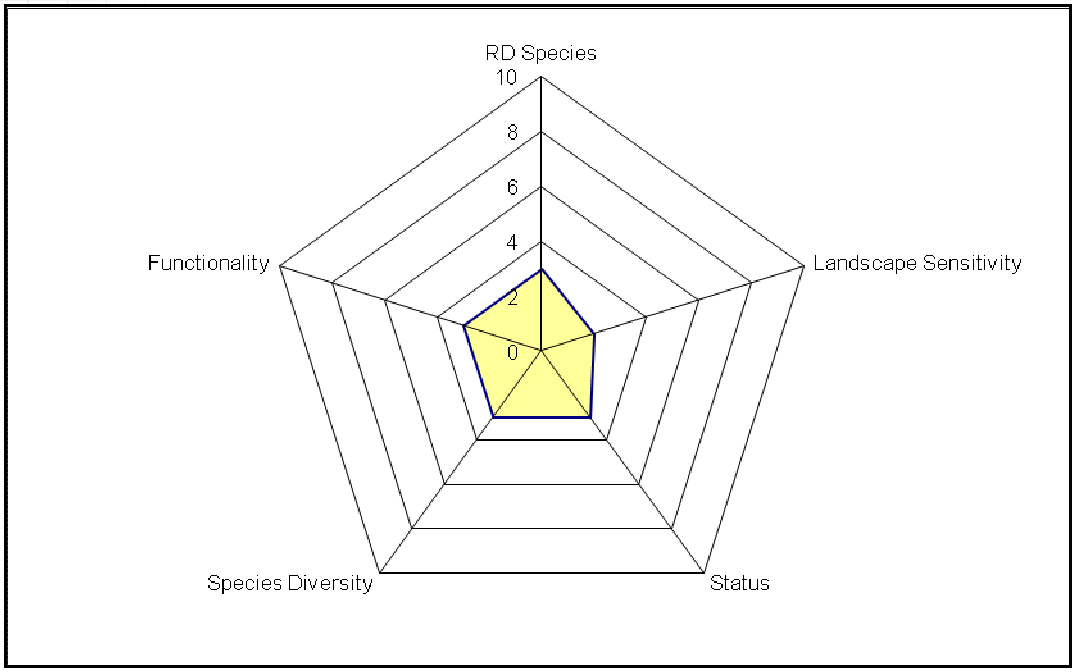


Graph 9: Floristic sensitivity rose for the *Portulaca – Oldenlandia* Sheetrock Community

7.6.5 Artificial Woodland Habitat.

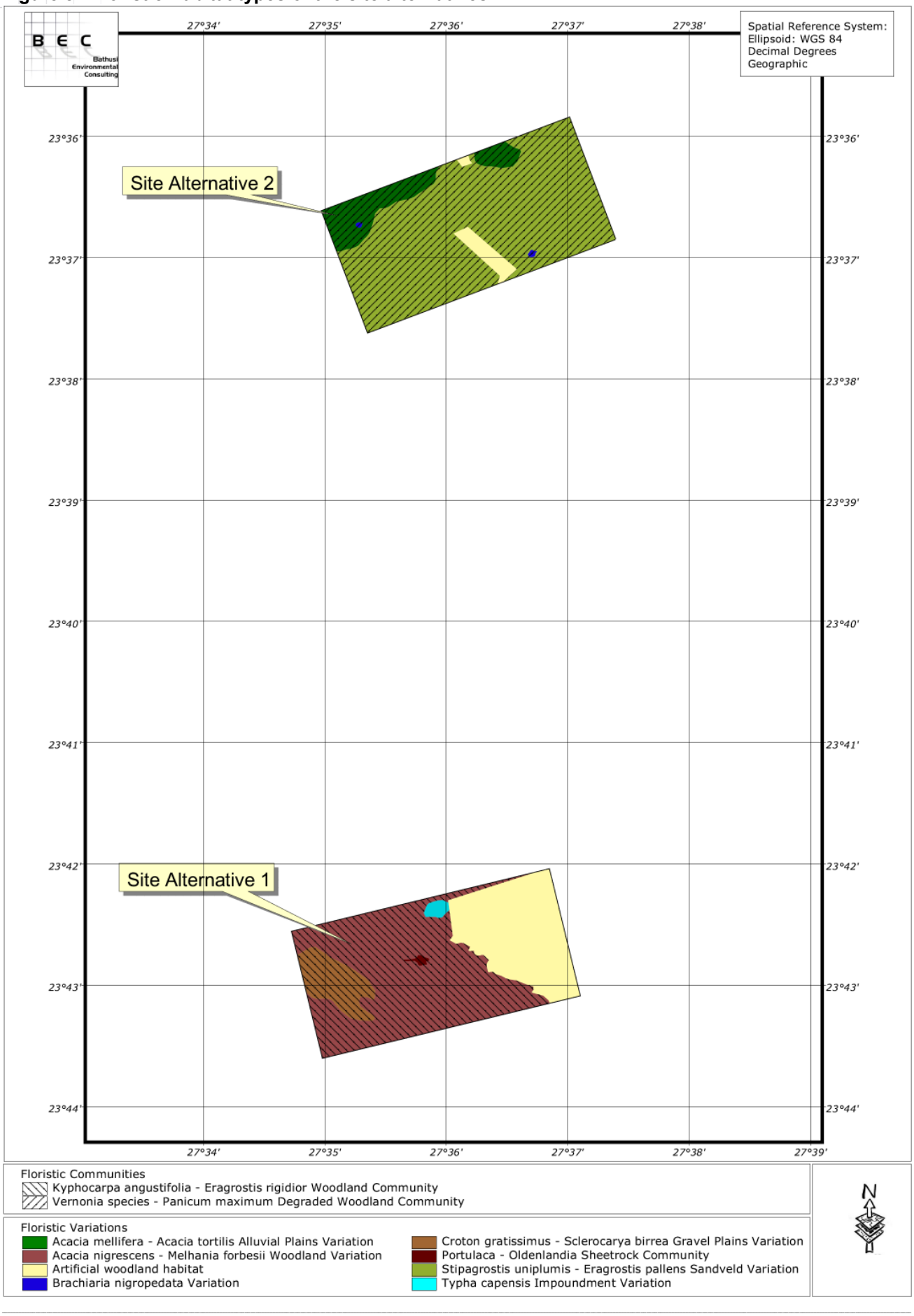
Localised areas of degraded woodland occur sporadically within the region, usually the result of historic agricultural practices in the case of Site Alternative 2 and the existing ashing facility in the case of Site Alternative 1. The natural woodland species have been removed for anthropogenic purposes and have subsequently been replaced by an artificial (sub-climax) floristic composition.

A medium-low floristic status is ascribed to these parts (refer **Graph 10**)



Graph 10: Floristic sensitivity rose for the Artificial Woodland Habitat

Figure 8: Floristic Habitat types of the site alternatives



7.7 FLORISTIC SENSITIVITY OF THE SITE ALTERNATIVES

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 calculated in **Table 8**. These estimations are used to ascribe a sensitivity index value to units of the respective variations, illustrated in **Figure 9**. 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).

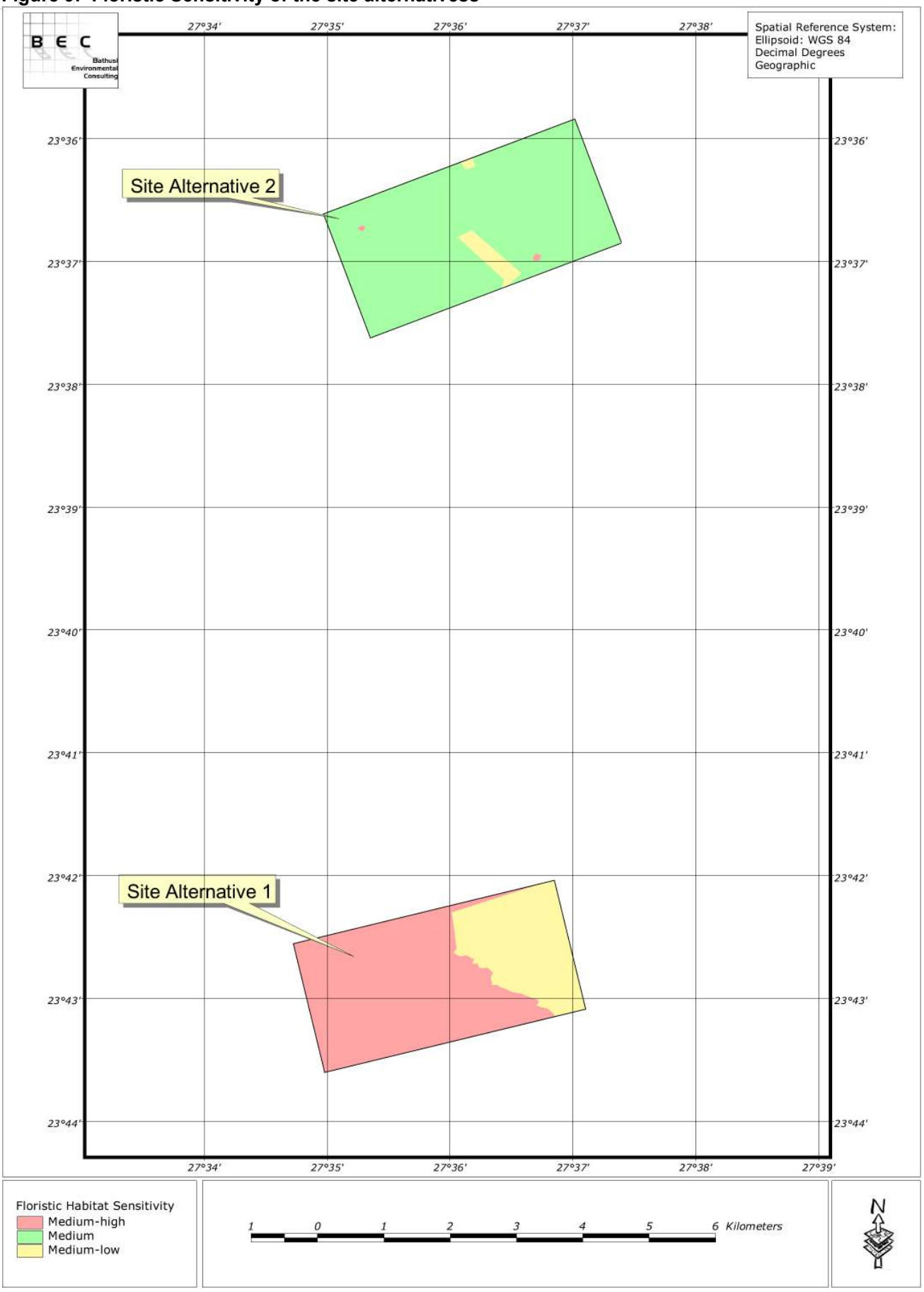
Table 8: Floristic sensitivity estimations for the respective habitat types								
Criteria	***RD species***	***Landscape sensitivity***	***Status***	***Species diversity***	***Functionality/ fragmentation***	***Total***	***Sensitivity Index***	***Sensitivity Category***
Community	**Criteria Ranking**							
Artificial Woodland Habitat	3	2	3	3	3	88	28 %	**medium-low**
Kyphocarpa angustifolia – Eragrostis rigidior Woodland	6	8	9	9	9	250	78 %	**medium-high**
Nymphaea – Schoenoplectus Impoundments	4	10	8	8	10	238	74 %	**medium-high**
Portulaca – Oldenlandia Sheetrock	4	9	8	9	8	229	72 %	**medium-high**
Vernonia species - *Panicum maximum* Degraded Woodland	5	6	5	5	7	174	54 %	**medium**

Please note for the comparative assessments, Artificial habitat of site Alternative 1 was not included in the calculations.

Table 9: Comparative extent of habitat types within each of the Alternative Sites				
Habitat	***Site Alternative 1***		***Site Alternative 2***	
	Extent	***(%)***	***Extent***	***(%)***
Acacia mellifera - Acacia tortilis Alluvial Plains Variation	--	-- ^	86.5 ha	11.8 %
Acacia nigrescens - Melhania forbesii Woodland Variation	432.2 ha	85.0 %	--	--
Artificial woodland habitat	--	--	25.0 ha	3.4 %
Brachiaria nigropedata Impoundment Variation	--	--	1.5 ha	0.2 %
Croton gratissimus - Sclerocarya birrea Gravel Plains Variation	66.2 ha	13.0 %	--	--
Portulaca - Oldenlandia Sheetrock Community	2.5 ha	0.5 %	--	--
Stipagrostis uniplumis - Eragrostis pallens Sandveld Variation	--	--	620.4 ha	84.6 %
Typha capensis Impoundment Variation	7.4 ha	1.5 %	--	--

Table 10: Comparative floristic sensitivities for each of the Alternative Sites		
Floristic Sensitivities	***Site Alternative 1***	***Site Alternative 2***
Hig Floristic Sensitivity	0.0 %	0.0 %
Medium-high Floristic Sensitivity	100.0 %	0.2 %
Medium Floristic Sensitivity	0.0 %	96.4 %
Medium-low Floristic Sensitivity	0.0 %	3.4 %
Low Floristic Sensitivity	**0.0 %**	**0.0 %**

Figure 9: Floristic Sensitivity of the site alternativess



7.8 DISCUSSION

The suitability of the respective sites for the proposed activity is strongly determined by the sensitivity and status of floristic habitat types that characterise these areas. Additional factors taken into consideration is the connectivity of the respective sites to adjacent and surrounding natural habitat as well as existing impacts within and adjacent to the sites, including required and existing transportation infrastructure.

Typically, natural vegetation of the respective sites, as well as the immediate surrounds, are strongly determined by the savanna character of the region. A dominant woody layer and a diverse herbaceous stratum are evident on both site alternatives. Protected trees were recorded throughout both site alternatives and this was therefore not used as a specific point of reference in terms of the suitability of either of the sites. However, visual observations indicate that the number of protected trees within Site Alternative 1 is higher than in Site Alternative 2.

Habitat diversity is an important attribute that affects the suitability of the sites. Site Alternative 2 was found to contain largely homogenous woodland vegetation, while Site Alternative 1 exhibits more localised variations in terms of biophysical habitat conditions as well as the associated floristic types. Similarly local degradation patterns resulting from utilisation influences the status of the vegetation significantly. Vegetation of Site Alternative 1 was found to be largely pristine; hence, a medium-high floristic sensitivity was attributed to all the variations and communities of this alternative. In contrast, high utilisation factors affected the status of vegetation of Site Alternative 2 adversely and the vegetation exhibit largely attributes of medium sensitivity.

7.8.1 Site Alternative 1

Floristic communities and variations of this area are pristine and representative of the regional vegetation type. Calculated diversity indices confirm this natural status. A high connectivity to adjacent pristine savanna habitat is noted to the south. Additionally, riparian woodlands located to the south of this alternative are regarded sensitive. It is possible, although unlikely, that these sensitive habitat types could be affected adversely by the extension of the existing ashing facility. The loss of natural (pristine) habitat from this site by the development of the ashing facility is regarded significant, more so than for Alternative 2. A medium-high floristic sensitivity is therefore, estimated for all natural vegetation of this site

7.8.2 Site Alternative 2

Habitat of this unit is regarded slightly degraded due to persistent high grazing. In particular, the herbaceous layer exhibits a species composition that includes dominant weeds and indicator species of poor habitat conditions. Habitat diversity within this area is also lower compared to Alternative 1 and the loss of habitat from this site is therefore not regarded as significant. Ecological connectivity of this site is good; being surrounded by natural woodland habitat. However, visual observations indicate that similar poor habitat conditions prevail in surrounding areas. Importantly though, no existing infrastructure is available for the transportation of ash to this area, implying that an additional conveyor section needs to be constructed. This will result in increased habitat fragmentation on a local scale. This factor was included in the preference ranking for the respective sites.

7.9 FLORISTIC PREFERENCE RANKING

In order to rank the site alternatives in terms of floristic sensitivity/ preference for the proposed project, a site preference rating system is applied, based on integrated results of the floristic assessments. The following protocol is applied:

1 = Not Suitable for development / No-Go (impact of very high significance - negative)
2 = Not Preferred (impact of high significance - negative)
3 = Acceptable (impact of moderate significance - negative)
4 = Preferred (impact of low or negligible significance - negative)

The following criteria are applied for the ranking protocol:

Table 11: Criteria for site preference ranking

Site preference Category	*Criteria*
Preferred site	• No natural habitat remaining; or • Highly fragmented habitat in-between degraded habitat; and • Low intrinsic biodiversity and conservation value; and • Plants and animal species of conservation importance unlikely to occur; and • No significant direct and indirect impacts identified
Acceptable (3)	• Natural habitat largely degraded & transformed; and • A measure of original biodiversity still present, albeit mostly secondary climax status; and • High utilisation factors; and • Low probability for plants species of conservation importance to occur; and • Impact significance of moderate significance, but could be mitigated successfully
Not Preferred (2)	• Habitat suitable for RD flora species; and • High/ moderate-high intrinsic biodiversity value; and • Moderate to low transformation & degradation levels; and • Impacts of high significance identified, moderate potential to successfully mitigate
No-Go (1)	• Presence of RD flora species; and • Protected habitat types; and • Intrinsic high biodiversity value; and • Low transformation & fragmentation levels; and • Pristine status and high ecological functionality; and • Highly significant impacts identified, impossible to mitigate against

- Consideration of the extent of pristine vs. degraded habitat indicate that Site Alternative 1 exhibits significant aspects of sensitivity, compared to degraded woodland habitat of Site Alternative 2;
- The conservation importance of the regional vegetation type (Limpopo Sweet Bushveld) has no particular influence on the preference of any of the sites, natural habitat will be lost irrespective of which alternative is selected. The extent of natural habitat being lost within each of the alternatives varies to some degree, but negligently;
- Conservation important plants occur on both site alternatives and throughout the region. All natural woodland habitat is regarded suitable for a number of conservation important taxa; none of the site could be excluded based on presence/ absence of conservation important plants. Although a higher number of protected trees are present within Alternative 1;
- Habitat diversity of Site Alternative 1 is higher compared to Alternative 2;
- Surrounding influences from existing developments affect Site Alternative 1 slightly more; particular mention is made of the existing ashing facility on Site Alternative 1. However on a local scale, the area is characterised by increased transformative activities and Site Alternative 2 is situated within proximity to both the Matimba Power Station as well as Grootegeluk Coal Mine;
- The conservation potential of Site Alternative 1 is regarded higher due to the presence of pristine habitat, compared to degraded habitat of Site Alternative 2; and

- Likely and potential impacts on surrounding natural habitat of both the sites are likely to be severe, albeit localised. This is evident from existing impacts on the natural environment of Site Alternative 1. The presence of sensitive habitat situated to the south of Site Alternative 1, is regarded a significant potential impact.

Ultimately, upon consideration of all factors, Site Alternative 2 is regarded more suitable compared to Site Alternative 1. This recommendation is based on variations in the sensitivity associated with the site as a whole. Preference ranking ascribed to the various sites are as follows:
Site Alternative 1 – **2 (Not preferred);** and
Site Alternative 2 – **3 (Acceptable).**

7.10 PROPOSED CONVEYOR LINE

Results of this botanical assessment indicated the preference of Site Alternative 2 as the preferred option for the proposed ashing facility. This will therefore require the construction and operation of a conveyor line between the ashing facility and Matimba Power Station. A technically feasibly conveyor line has been proposed (refer **Figure 10**) and is assessed in this section. The proposed line will comprise a length of approximately 9.75 km, situated on portions of the following farms:

- Appelvlakte 448;
- Grootestryd 465; and
- Nelsonskop 454.

7.10.1 Identified Macro Habitat Types

A basic field investigation revealed the presence of three distinct macro habitat types within the proposed conveyor line (refer **Figure 11**). The floristic sensitivity of the proposed line is illustrated in **Figure 12.**

- **Degraded Woodland** – This habitat types is associated with existing infrastructure where the original woodland has been affected for construction or operational purposes. The vegetatal cover and compositional aspects are characteristic of recent and historic disturbances that caused the removal of most of the original woodland vegetation, and subsequent development of a vegetatal cover of a secondary climax status. Proximity to transformed areas, frequently of an industrial or civil nature, results in alteration of the vegetatal composition and structure.
  Noteworthy species occurring in these areas frequently include the forbs *Vernonia* species, *Acrotome inflata, Sansevieria aethiopica, Gisekia africana* subsp. *africana, Melolobium candicans, Solanum panduriforme, Waltheria indica, Limeum fenestratum, Hibiscus micranthus* and *Sesamum triphyllum.* The woody species *Euclea undulata, Terminalia sericea, Grewia flava, Combretum apiculatum, Commiphora pyracanthoides, Grewia flavescens* and *Dichrostachys cinerea* indicates the degraded nature of this unit. Typically, the floristic composition of these areas changes over a period, depending on the severity of impact.
  A medium-low floristic sensitivity is ascribed to these parts, resulting from a sub-climax composition and the absence of plant taxa of conservation importance.

- **Natural Woodland** – This community is typical of the natural woodland variations recorded in the greater region, manifesting as a moderately dense woodland, as described in **Section 7.6.3**, particularly the *Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation identified within Site Alternative 2. Typical biophysical habitat attributes include yellow and/ red soils with clay content that vary between

sandy and loam. Slopes are generally even and the vegetation reflects these main biophysical attributes.

Prominent woody species include *Acacia burkei, A. erioloba, A. erubescens, A. nigrescens, Acacia nilotica, Combretum imberbe, Peltophorum africanum* as well as the tall shrubs *Acacia mellifera, Boscia foetida, Combretum hereroense, Commiphora pyracanthoides, Dichrostachys cinerea, Euclea undulata, Grewia flava, Ochna pulchra* and *Ziziphus mucronata.* Noteworthy herbaceous species such as *Aristida stipitata, Eragrostis pallens, Evolvulus alsinoides, Heliotropium ciliatum, Schmidtia pappophoroides, Aristida adscensionis, Digitaria eriantha, Eragrostis lehmanniana, Eragrostis rigidior, Melhania acuminata, Ammocharis coranica, Dicoma tomentosa, Indigofera* species*, Tylosema fassoglense, Vernonia sutherlandii* and *Panicum maximum* were recorded. Various protected trees are present within these areas, including *Combretum imberbe, Boscia albitrunca, Securidaca longipedunculata* var. *longepedunculata, Acacia erioloba* and *Sclerocarya birrea* subsp. *africana*.

The vegetation of this unit exhibits some indications of surrounding land transformation and degradation effects; a medium floristic status is therefore ascribed to this area. The presence of numerous protected species is however an aspect of importance, albeit typical of the natural woodlands of the region.

- ***Spirostachys africana* Woodland** – Biophysical and physiognomic characteristics, when observed from a larger scale) indicate a potentially ephemeral nature of the vegetation contained within these parts of the proposed lines. However, inundated periods are expected to be extremely infrequent and irregular and no floristic obligate characteristics was observed, other than the dominant presence of the tree *Spirostachys africana*, which is known to be strongly affiliated with drainage lines, which are extremely ill-defined. Most frequently, the floristic composition and local soil characteristics provide a more accurate indication of the presence of this habitat, rather than the physical characteristics such as a streambed or other typical drainage line characteristics. The local and regional formation of these ill-defined floodplains is assumed to have taken place over a long period, resulting from the deposition of sediment on a floodplain or bed, which ultimately becomes alluvial soil. Soils in this area are frequently dark with a clay content of the A- horizon only slightly higher than surrounding areas. The topography of this unit is flat, with slopes generally lower than 2 %.

  The vegetation of this unit is pristine, comprising of typical woodland species, but with a characteristic dominance of the tree *Spirostachys africana.* This unit is floristically similar to the *Acacia nigrescens – Melhania forbesii Woodland* Variation that was delineated on Site Alternative 1 (refer **Section 7.6.**2). Other prominent species that were recorded in this unit include the woody species *Combretum zeyheri, Peltophorum africanum, Combretum imberbe, Combretum hereroense, Euclea undulata* and *Sclerocarya birrea* subsp. *africana.* Grass and forb species typical of this habitat type include *Waltheria indica, Digitaria eriantha, Urochloa* species, *Lotononis* species, *Tricholaena monachne, Hibiscus* species, *Vernonia* species, *Heliotropium ciliatum, Commelina erecta, Abutilon* species and *Acroceras macrum.*

  The ecological contribution and importance of these variations in terms of local and regional habitat diversity and ecosystem services are important. Atypical habitat provides in the habitat requirements of numerous faunal taxa that are not available in the terrestrial woodland habitat types, rendering the faunal component of these areas relative unique on a local and regional scale. In addition, the particularly high occurrence of protected trees and the affiliation with a mesic environment renders the floristic sensitivity of this unit moderately high. A realignment of the proposed line is strongly recommended in order to avoid impacts on this woodland community.

Figure 10: Proposed ashing linear infrastructure route towards Site Alternative 2

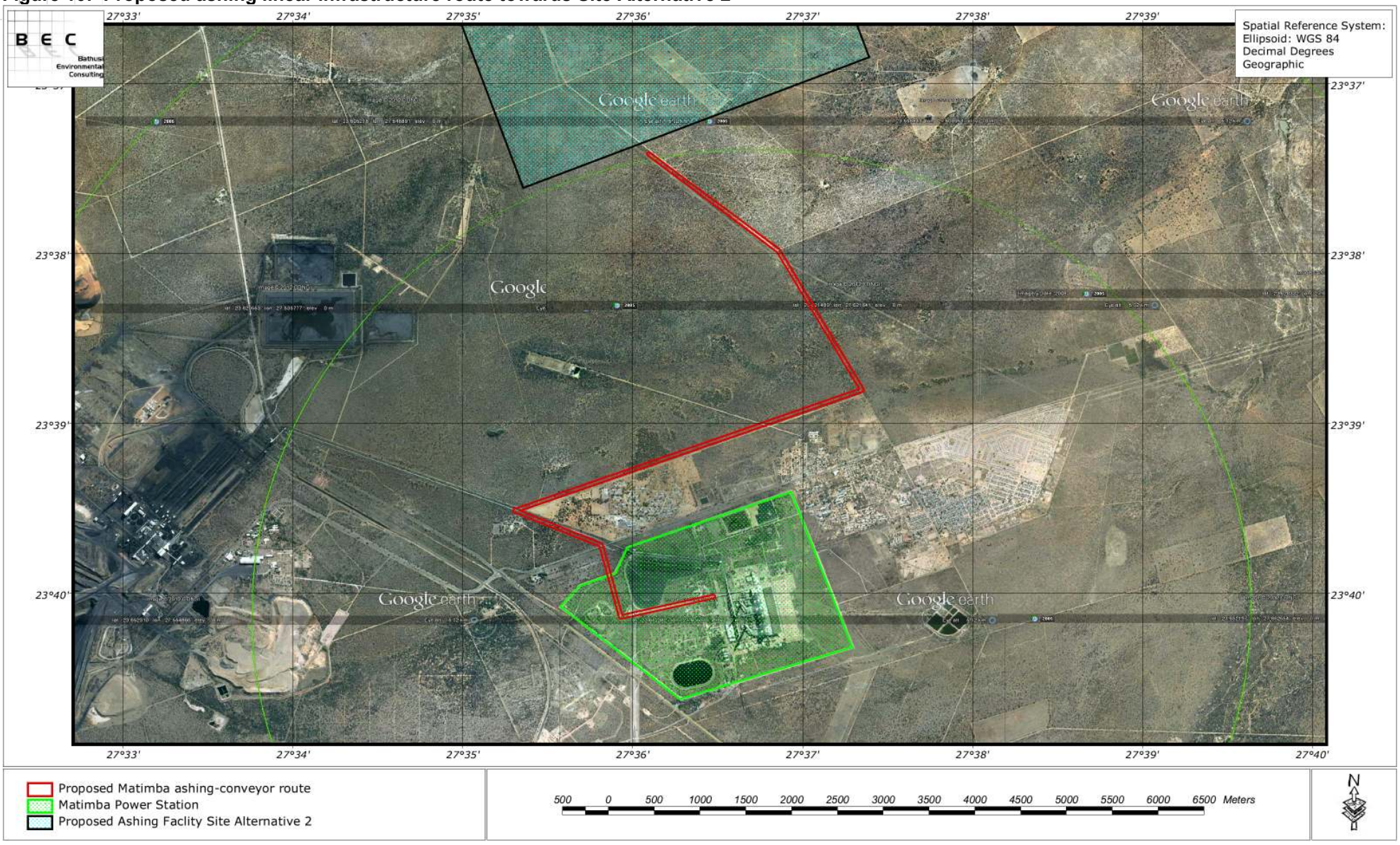


Figure 11: Floristic habitat types of the proposed conveyor line

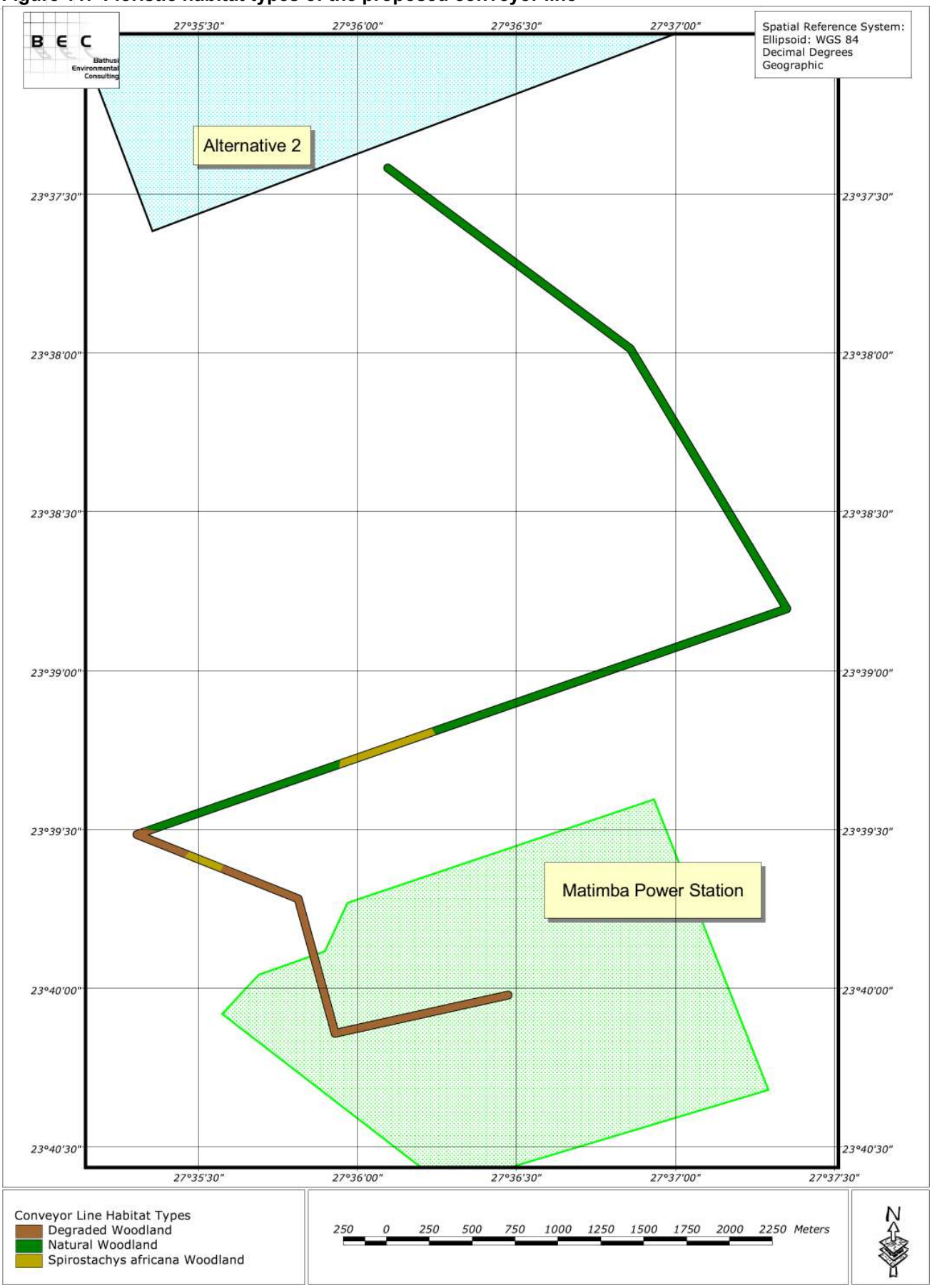
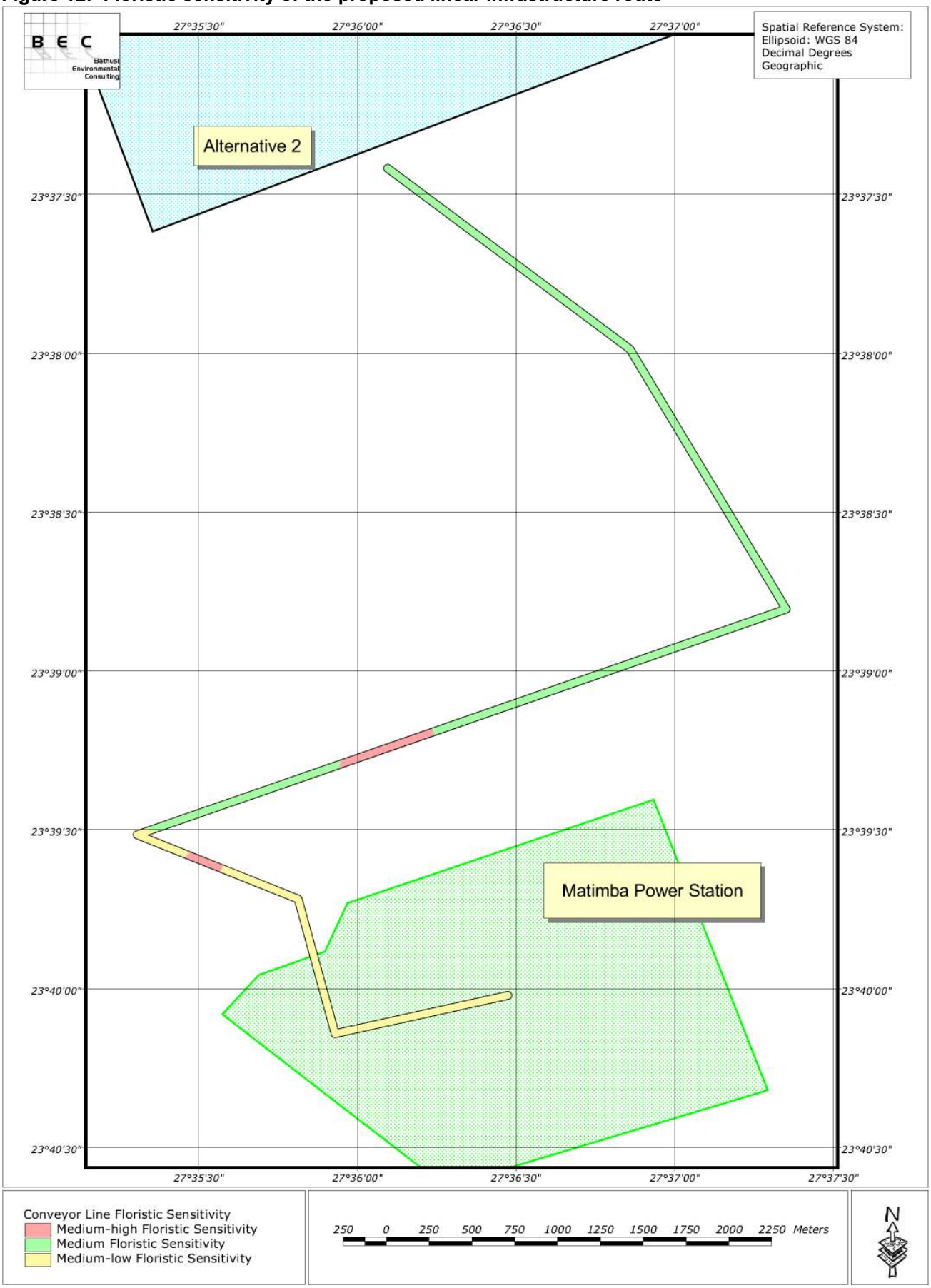


Figure 12: Floristic sensitivity of the proposed linear infrastructure route

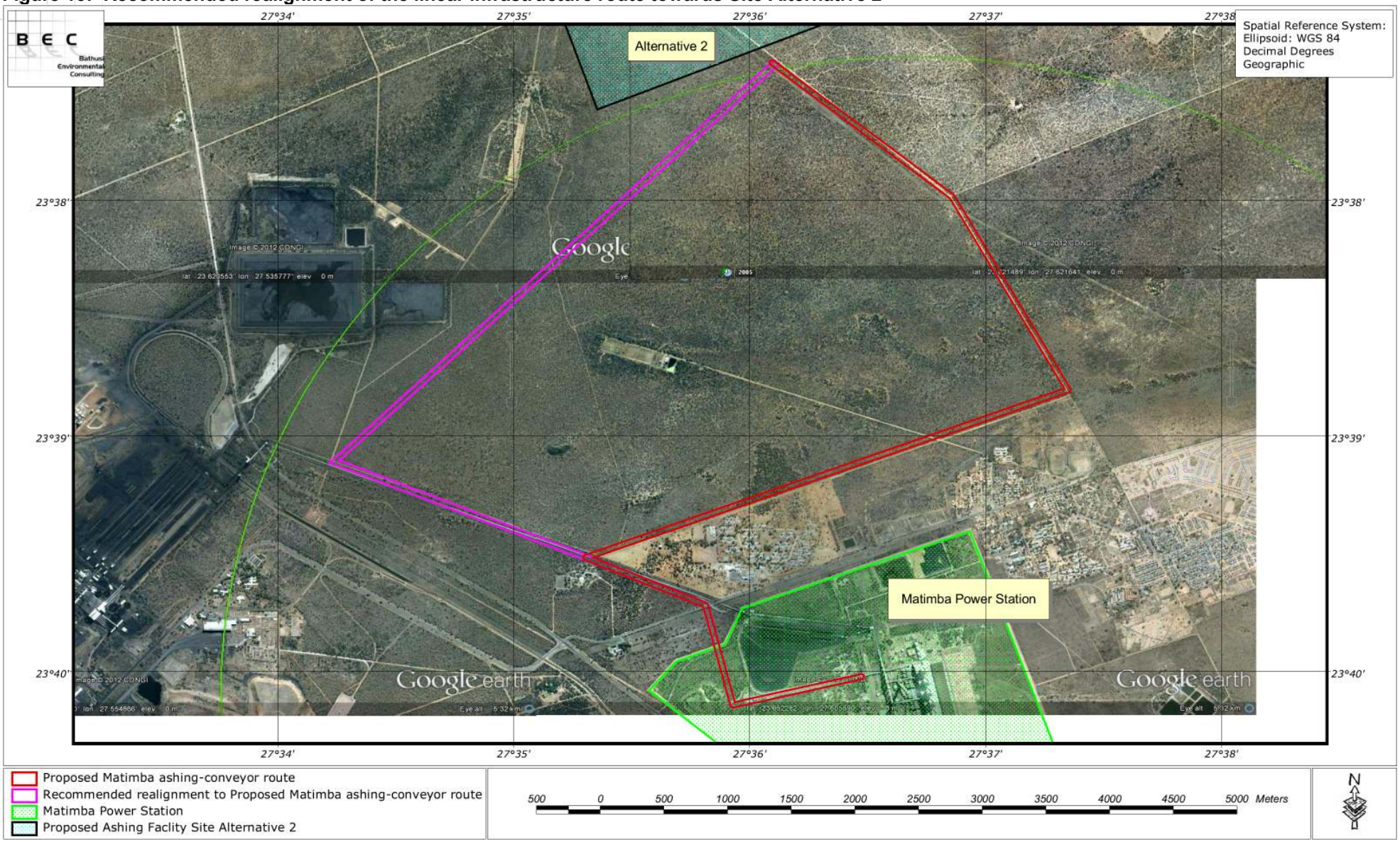


7.10.2 Discussion & Recommendations

Natural woodland communities and variations within the proposed linear infrstucture route between Matimba Power Station and the proposed Site Alternative 2 exhibit the typical floristic composition, physiognomy and inherent sensitivities encountered on a local and regional scale. Natural woodland varies considerably on a local and regional scale; this is mostly attributed to soil conditions and the prevalence of mesic environs as little topographical heterogeneity can be noted. Slight degradation resulted from surrounding land uses and developments as well as persistent high grazing. The largest extent of the proposed conveyor line exhibit floristic attributes of a moderate sensitivity, mostly attributed to the characteristic presence of protected trees. Potential and likely impacts of the construction and operation of the proposed conveyor lines are therefore likely to result in significant, but localised impacts on the floristic environment. The application of generic mitigation measures are expected to reduce the significance of impacts to an acceptable level.

While the presence of protected trees within natural woodland is a typical characteristic of the natural woodland on a regional scale, a particularly high density of *Spirostachys africana* within a portion of the proposed line was recognised; these areas are visually recognisable from aerial imagery. A medium-high floristic sensitivity was ascribed to these portions. Impacts within these areas are therefore considered significant because of the exceptional density of protected trees and realignment is strongly recommended in order to avoid these areas in their entirety. The proposed realignment should follow the existing Grootegeluk – Matimba conveyor line and divert eastwards towards Site Alternative 2 immediately south of Grootegeluk Mine. All woodland habitat types of medium-high floristic sensitivity will be avoided by this recommended alignment and potential and likely impacts are likely to by significantly lower. Deviation from the existing Grootegeluk – Matimba conveyor line must take place as far north as possible in order avoid the Nelsonskop topographical feature as this represents a particularly significant topographical and environmentally sensitive feature.

Figure 13: Recommended realignment of the linear infrastructure route towards Site Alternative 2



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 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. Remaining areas of natural habitat are frequently too small to support the biodiversity that previously occupied these areas, consequently the area and the region is constantly losing its ecological integrity and diversity (Kamffer 2004). Savannas of Limpopo are no exception and the presence of minerals such as coal has led to significant transformation, degradation and fragmentation of the region's savannas. Agriculture and pastoral activities have had a moderate impact on the biodiversity of the region, but farming is believed by some to be the most damaging sector of human activity affecting wild nature (Balmford *et al* 2012).

The area investigated is found in the Q-grid 2327DA at 900 mmasl (mean meters above sea level). The site alternatives are located between the Limpopo and Mokolo rivers, in the quaternary catchment A42J of the Limpopo River primary catchment area. The site alternatives are situated within the regional vegetation community of Limpopo Sweet Bushveld (Central Bushveld Bioregion: Savanna Biome – VegMap, 2006). This ecological type is listed as Least Threatened (94.9 % remains untransformed - 2006).

It is important to view the area on an ecologically relevant scale; consequently, all sensitive animal species (specific faunal groups) known from the Limpopo 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:

- Dragonflies and Damselflies (Invertebrata: Insecta: Odonata). References used include the IUCN Red List (2011) – http://www.iucnredlist.org and Field Guides to the Dragonflies and Damselflies of South Africa (Tarboton & Tarboton 2005).
- Butterflies (Invertebrata: Insecta: Lepidoptera – Nymphalidae, Lycaenidae, Hesperiidae, Pieridae and Papilionidae). References used include the IUCN Red List (2011) – http://www.iucnredlist.org, the South African Butterfly Conservation Assessment (SABCA, 2011) – http://sabca.adu.org.za and the Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas (Mecenero *et al* [eds.], 2013).
- 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: The Southern African Bird Atlas Project 2 – http://sabap2.adu.org.za.
- 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 recent inclusions. Animals known to be present in the ¼-degree grid 2327DA were therefore considered potential inhabitants of the site alternatives (all species known from the Limpopo Province were included in the assessment to limit the known effects of sampling bias).

8.2 FAUNAL DIVERSITY OF THE SITE

8.2.1 General Diversity

During previous and on-going studies in the immediate vicinity of the site alternatives during the past years, a total 332 animal species have been confirmed to occur in the site alternatives and immediate surrounds (approximately an area of 100 km²) of the site alternatives (refer **Appendix 2**). The following results were obtained:

- 53 invertebrate species;
- 9 frog species;
- 20 reptile species;
- 204 bird species; and
- 46 mammal species.

The diversity of animals recorded in the region included eighteen Red Data species, namely:

- Giant Bullfrog: *Pyxicephalus adspersus* Tschudi, 1838;
- Black Stork: *Ciconia nigra* (Linnaeus, 1758);
- Secretarybird: *Sagittarius serpentarius* (J.F. Miller, 1779);
- White-backed Vulture: *Gyps africanus* Salvadori, 1865;
- Tawny Eagle: *Aquila rapax* (Temminck, 1828);
- Martial Eagle: *Polemaetus bellicosus* (Daudin, 1800);
- Lesser Kestrel: *Falco naumanni* Fleischer, 1818;
- Kori Bustard: *Ardeotis kori* (Burchell, 1822);
- Red-billed Oxpecker: *Buphagus erythrorhynchus* (Stanley, 1814);
- Bushveld Elephant Shrew: *Elephantulus intufi* (A. Smith, 1836);
- Ground Pangolin: *Manis temminckii* Smuts, 1832;
- Bushveld Gerbil: *Tatera leucogaster* (Peters, 1852);
- Cheetah: *Acinonyx jubatus* (Schreber, 1775);
- Brown Hyaena: *Parahyaena brunnea* (Thunberg, 1820);
- Honey Badger: *Mellivora capensis* (Schreber, 1776);
- Southern Sable Antelope: *Hippotragus niger* (Harris, 1838); and
- Western Tsessebe: *Damaliscus lunatus* (Burchell, 1823).

The diversity of animals recorded in the site alternatives included two Alien and Invasive species, namely:

- *Acridotheres tristis* (Common Myna); and
- *Equus asinus* (Donkey).

The presence of 98 animal species was confirmed during the April 2013 investigation (refer **Table 12**) 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:

- 22 invertebrate species;
- 1 frog species;
- 3 reptile species;
- 53 bird species; and
- 19 mammal species.

The diversity of animals recorded in the site alternatives included three Red Data species, namely:

- Tawny Eagle (*Aquila rapax* (Temminck, 1828));
- Leopard (*Panthera pardus* (Linnaeus, 1758)); and
- Brown Hyaena (*Parahyaena brunnea* (Thunberg, 1820)).

8.3 RED DATA FAUNA ASSESSMENT

A total of 164 Red Data animals are known to occur in the Limpopo Province (dragonflies, damselflies, butterflies, frogs, reptiles, birds and mammals), indicated in **Table 13**.

The following conservation categories area included:

- 28 species are listed as Data Deficient (DD);
- 68 species are listed as Near Threatened (NT);
- 50 species are listed as Vulnerable (VU);
- 13 species are listed as Endangered (EN);
- 4 species are listed as Critically Endangered (CR);and
- 1 species is listed as Extinct (EX).

Estimated Probability of Occurrence (PoC) of the Red Data fauna assessment is based on:

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

An assessment of the PoC for these animals yielded the following probabilities (refer **Table 13**):

- 119 species have a low PoC;
- 16 species have a moderate-low PoC;
- 9 species have a moderate PoC;
- 2 species have a moderate-high PoC; and
- 15 species have a high PoC.

Three conservation important species were recorded in the site alternatives during the survey period (refer **Table 13**, indicated in **red**).

Table 12: Animal species confirmed for the site alternatives

Class	Order	Family	Binomial Name	Colloquial Name	Alt 1	Alt 2
Insecta	Odonata	Aeshnidae	*Anax imperator* Leach, 1815	Blue Emperor	X	X
		Libellulidae	*Brachythemis leucosticta* Burmeister, 1839	Banded Groundling	X	
			Orthetrum trinacria Selys, 1841	Long Skimmer	X	
	Isoptera	Termitidae	*Macrotermes natalensis* (Haviland, 1898)	Large Fungus-growing Termite		X
	Coleoptera	Buprestidae	*Sternocera orissa* Buquet, 1837	Giant Jewel Beetle	X	X
	Lepidoptera	Hesperiidae	*Spialia spio* (Linnaeus, 1764)	Mountain Sandman		X
		Pieridae	*Belenois aurota* (Fabricius, 1793)	Brown-veined White		X
			Catopsilla florella (Fabricius, 1775)	African Migrant	X	X
			Colotis annae annae (Wallengren, 1857)	Scarlet Tip		X
			Colotis evagore antigone (Boisduval, 1836)	Small Orange Tip	X	X
			Colotis evenina evenina (Wallengren, 1857)	Orange Tip		X
			Eurema brigitta brigitta (Stoll, [1780])	Broad-bordered Grass Yellow	X	X
			Pinacopteryx eriphia eriphia (Godart, [1819])	Zebra White	X	X
			Teracolus agoye agoye (Wallengren, 1857)	Speckled Sulphur Tip	X	X
		Nymphalidae	*Byblia anvatara acheloia* (Wallengren, 1857)	Joker	X	X
			Charaxes phaeus Hewitson, 1877d	Demon Charaxes	X	
			Danaus chryssipus orientis (Aurivillius, 1909)	African Monarch	X	X
			Hamanumida daedalus (Fabricius, 1775)	Guineafowl Butterfly		X
			Junonia hierta cebrene Trimen, 1870	Yellow Pansy	X	X
			Junonia oenone oenone (Linnaeus, 1758)	Blue Pansy		X
		Lycaenidae	*Azanus ubaldus* (Stoll, [1782])	Velvet-spotted Babul Blue	X	X
	Hymenoptera	Apidae	*Apis mellifera* Linnaeus, 1758	Honey Bee		X
Amphibia	Anura	Pyxicephalidae	*Amietia angolensis* (Bocage, 1866)	Common River Frog	X	
Reptilia	Squamata	Scincidae	*Trachylepis varia* (Peters, 1867)	Variable Skink	X	
		Lacertidae	*Heliobolus lugubris* Smith, 1838	Bushveld Lizard		X
		Agamidae	*Acanthocercus atricollis* Smith, 1849	Southern Tree Agama	X	
Aves	Galliformes	Numididae	*Numida meleagris* (Linnaeus, 1758)	Helmeted Guineafowl	X	X
		Phasianidae	*Dendroperdix sephaena* (A. Smith, 1836)	Crested Francolin	X	X
			Pternistis swainsonii (A.Smith, 1836)	Swainson's Spurfowl		X
	Falconiformes	Accipitridae	*Melierax gabar* (Daudin, 1800)	Gabar Goshawk		X
			Aquila rapax (Temminck, 1828)	Tawny Eagle	X	
	Gruiformes	Otididae	*Lophotis ruficrista* (A. Smith, 1836)	Red-crested Korhaan		X
	Charadriiformes	Recurvirostridae	*Himantopus himantopus* (Linnaeus, 1758)	Black-winged Stilt	X	

Table 12: Animal species confirmed for the site alternatives

Class	Order	Family	Binomial Name	Colloquial Name	Alt 1	Alt 2
		Charadriidae	*Vanellus armatus* (Burchell, 1822)	Blacksmith Lapwing	X	
			Vanellus coronatus (Boddaert, 1783)	Crowned Lapwing	X	
	Columbiformes	Columbidae	*Streptopelia capicola* (Sundevall, 1857)	Ring-necked Dove	X	X
			Turtur chalcospilos (Wagler, 1827)	Emerald-spotted Wood Dove		X
			Oena capensis (Linnaeus, 1766)	Namaqua Dove	X	X
	Musophagiformes	Musophagidae	*Corythaixoides concolor* (A. Smith, 1833)	Grey Go-away-bird	X	X
	Apodiformes	Apodidae	*Tachymarptis melba* (Linnaeus, 1758)	Alpine Swift		X
	Coliiformes	Coliidae	*Urocolius indicus* (Latham, 1790)	Red-faced Mousebird		X
	Coraciiformes	Coraciidae	*Coracias caudatus* Linnaeus, 1766	Lilac-breasted Roller	X	
		Dacelonidae	*Halcyon albiventris* (Scopoli, 1786)	Brown-hooded Kingfisher	X	
		Meropidae	*Merops bullockoides* A. Smith, 1834	White-fronted Bee-eater	X	
	Upupiformes	Upupidae	*Upupa africana* Bechstein, 1811	African Hoopoe		X
		Rhinopomastidae	*Rhinopomastus cyanomelas* (Vieillot, 1819)	Common Scimitarbill		X
	Bucerotiformes	Bucerotidae	*Tockus nasutus* (Linnaeus, 1766)	African Grey Hornbill	X	
			Tockus rufirostris (Sundevall, 1850)	Southern Red-billed Hornbill	X	
			Tockus leucomelas (Lichtenstein, 1842)	Southern Yellow-billed Hornbill	X	X
	Piciformes	Indicatoridae	*Indicator indicator* (Sparrman, 1777)	Greater Honeyguide	X	
		Picidae	*Dendropicos namaquus* (A.A.H. Lichtenstein, 1793)	Bearded Woodpecker	X	
	Passeriformes	Malaconotidae	*Batis molitor* (Kuster, 1836)	Chinspot Batis	X	X
			Prionops plumatus (Shaw, 1809)	White-crested Helmet-Shrike	X	
			Malaconotus blanchoti Stephens, 1826	Grey-headed Bushshrike	X	
			Tchagra senegala (Linnaeus, 1766)	Black-crowned Tchagra	X	X
		Laniidae	*Laniarius atrococcineus* (Burchell, 1822)	Crimson-breasted Shrike		X
			Nilaus afer (Latham, 1802)	Brubru	X	
			Urolestes melanoleucus (Jardine, 1831)	Magpie Shrike	X	
			Eurocephalus anguitimens Smith, 1836	Southern White-crowned Shrike		
		Dicruridae	*Dicrurus adsimilis* (Bechstein, 1794)	Fork-tailed Drongo	X	X
		Paridae	*Parus cinerascens* Vieillot, 1818	Ashy Tit		X
		Pycnonotidae	*Pycnonotus nigricans* (Vieillot, 1818)	African Red-eyed Bulbul		X
		Hirundinidae	*Riparia paludicola* (Vieillot, 1817)	Brown-throated Martin	X	
		Cisticolidae	*Prinia flavicans* (Vieillot, 1820)	Black-chested Prinia		X
		Sylviidae	*Sylvietta rufescens* (Vieillot, 1817)	Long-billed Crombec	X	
			Turdoides bicolor (Jardine, 1831)	Southern Pied Babbler		X
			Sylvia subcaerulea Vieillot, 1817	Chestnut-vented Tit-Babbler	X	X

Table 12: Animal species confirmed for the site alternatives

Class	Order	Family	Binomial Name	Colloquial Name	Alt 1	Alt 2
		Sturnidae	*Lamprotornis nitens* (Linnaeus, 1766)	Cape Starling		X
		Muscicapidae	*Erythropygia leucophrys* (Vieillot, 1817)	White-browed Scrub Robin	X	X
			Erythropygia paena Smith, 1836	Kalahari Scrub Robin	X	X
			Bradornis mariquensis Smith, 1847	Marico Flycatcher		X
		Nectariniidae	*Cinnyris talatala* A. Smith, 1836	White-bellied Sunbird	X	
		Ploceidae	*Plocepasser mahali* Smith, 1836	White-browed Sparrow-Weaver	X	X
			Sporopipes squamifrons(Smith, 1836)	Scaly-feathered Weaver		X
			Quelea quelea (Linnaeus, 1758)	Red-billed Quelea		X
		Estrildidae	*Pytilia melba* (Linnaeus, 1758)	Green-winged Pytilia		X
			Lagonosticta rhodopareia (Heuglin, 1868)	Jameson's Firefinch	X	
			Uraeginthus angolensis (Linnaeus, 1758)	Blue Waxbill	X	X
		Viduidae	*Vidua regia* (Linnaeus, 1766)	Shaft-tailed Whydah		X
Mammalia	Primates	Cercopithecidae	*Papio ursinus* (Kerr, 1792)	Chacma Baboon	X	X
			Cercopithecus aethiops (Linnaeus, 1758)	Vervet Monkey	X	
	Rodentia	Sciuridae	*Paraxerus cepapi* (A. Smith, 1836)	Tree Squirrel	X	
		Bathyergidae	*Cryptomys damarensis* (Ogilby, 1838)	Damaraland Mole-rat	X	X
		Hystricidae	*Hystrix africaeaustralis* Peters, 1852	Porcupine		X
	Carnivora	Felidae	*Panthera pardus* (Linnaeus, 1758)	Leopard		X
			Caracal caracal (Schreber, 1776)	Caracal	X	X
		Hyaenidae	*Parahyaena brunnea* (Thunberg, 1820)	Brown Hyaena	X	X
		Herpestidae	*Mungos mungo* (Gmelin, 1788)	Banded Mongoose	X	
		Canidae	*Canis mesomelas* Schreber, 1775	Black-backed Jackal	X	X
	Tubulidentata	Orycteropodidae	*Orycteropus afer* (Pallas, 1766)	Aardvark	X	X
	Perissodactyla	Equidae	*Equus quagga* Boddaert, 1758	Plains Sebra	X	X
	Artiodactyla	Suidae	*Phacochoerus africanus* (Gmelin, 1788)	Common Warthog	X	X
		Bovidae	*Strepsiceros zambesiensis*	Zambezi Kudu	X	X
			Aepyceros melampus (Lichtenstein, 1812)	Common Impala	X	X
			Raphicerus campestris (Thunberg, 1811)	Steenbok	X	X
			Kobus ellipsiprymnus (Ogilby, 1833)	Ellipsen Waterbuck		X
			Connachaetes taurinus (Burchell, 1823)	Blue Wildebeest	X	
		Giraffidae	*Giraffa camelXpardalis* (Linnaeus, 1758)	Giraffe	X	

Table 13: Red Data assessment for the site alternatives			
Binomial Name	***Colloquial Name***	***Red Data Status***	***Probability Assessment***
Dragonflies & Damselflies			
Chlorolestes elegans Pinhey, 1950	Elegant Malachite	Vulnerable	low
Pseudagrion newtoni Pinhey, 1962	Newton's Sprite	Vulnerable	low
Butterflies			
Alaena margaritacea Eltringham, 1929	Wolkberg Zulu	Critically Endangered	low
Aloeides stevensoni Tite & Dickson, 1973	Stevenson's Copper	Endangered	low
Anthene crawshayi juanitae Henning, G.A. & Henning, S.F., 1993	Juanita's Hairtail	Critically Endangered	low
Dingana clara (van Son, 1940)	Wolkberg Widow	Endangered	low
Erikssonia edgei Gardiner & Terblanche, 2010b	Waterberg Copper	Critically Endangered	moderate-low
Lepidochrysops lotana Swanepoel, 1962	Lotana Blue	Endangered	low
Orachrysops violescens Henning G.A. & Henning S.F., 1994i	Violescent Blue	Vulnerable	low
Pseudonympha swanepoeli van Son, 1955	Swanepoel's Brown	Data Deficient	low
Telchinia induna salmontana (Henning G.A. & Henning S.F., 1996c)	Soutpansberg Acraea	Endangered	low
Frogs			
Breviceps sylvestris FitzSimons, 1930	Northern Forest Rain Frog	Vulnerable	low
Pyxicephalus adspersus Tschudi, 1838	Giant Bullfrog	Near Threatened	high
Reptiles			
Acontias kgalagadi subtaeniatus (Broadley, 1968)	Stripe-bellied Blind Legless Skink	Data Deficient	low
Acontias richardi (Jacobsen, 1987)	Richard's Blind Legless Skink	Near Threatened	low
Acontias rieppeli Lamb, Biswas & Bauer, 2010	Woodbush Legless Skink	Endangered	low
Afroedura pondolia multiporis (Hewitt, 1925)	Woodbush Flat Gecko	Vulnerable	low
Australolacerta rupicola FitzSimons, 1933	Soutpansberg Rock Lizard	Near Threatened	low
Chamaesaura aenea Fitzinger, 1843	Coppery Grass Lizard	Near Threatened	low
Chamaesaura macrolepis Cope, 1862	Large-scaled Grass Lizard	Near Threatened	low
Chirindia langi occidentalis Jacobsen, 1984	Soutpansberg Worm Lizard	Vulnerable	low
Crocodylus niloticus Laurenti, 1768	Nile Crocodile	Vulnerable	low
Homopholis mulleri Visser, 1987	Muller's Velvet Gecko	Vulnerable	low
Homoroselaps dorsalis Smith, 1849	Striped Harlequin Snake	Near Threatened	low
Kininyx natalensis	Natal Hinged Tortoise	Near Threatened	low
Lamprophis fuscus Boulenger, 1839	Yellow-bellied House Snake	Near Threatened	low
Lygodactylus graniticolus Jacobsen, 1992	Granite Dwarf Gecko	Near Threatened	low
Lygodactylus methueni FitzSimons, 1937	Methuen's Dwarf Gecko	Vulnerable	low
Lygodactylus nigropunctatus incognitus Jacobsen, 1992	Cryptic Dwarf Gecko	Data Deficient	low
Lygodactylus nigropunctatus montiscaeruli Jacobsen, 1992	Makgabeng Dwarf Gecko	Data Deficient	low

Table 13: Red Data assessment for the site alternatives			
Binomial Name	***Colloquial Name***	***Red Data Status***	***Probability Assessment***
Lygodactylus ocellatus soutpansbergensis Jacobsen, 1994	Soutpansberg Dwarf Gecko	Near Threatened	low
Platysaurus monotropis Jacobsen, 1994	Orange-throated Flat Lizard	Endangered	low
Platysaurus relictus Broadley, 1976	Soutpansberg Flat Lizard	Near Threatened	low
Pseudocordylus transvaalensis Branch, 1998	Northern Crag Lizard	Near Threatened	low
Scelotes limpopoensis albiventris Jacobsen, 1987	White-bellied Dwarf Burrowing Skink	Near Threatened	low
Tetradactylus breyeri Roux, 1907	Breyer's Long-tailed Seps	Vulnerable	low
Tetradactylus eastwoodae Hewitt & Methuen, 1913	Eastwood's Long-tailed Seps	Extinct	low
Xenocalamus transvaalensis Methuen, 1919	Speckled Quill-snouted Snake	Data Deficient	low
Birds			
Alcedo semitorquata Swainson, 1823	Half-collared Kingfisher	Near Threatened	low
Anastomus lamelligerus Temminck, 1823	African Openbill	Near Threatened	low
Anthropoides paradiseus (A.A.H. Lichtenstein, 1793)	Blue Crane	Vulnerable	moderate-low
Apalis ruddi Grant, 1908	Rudd's Apalis	Near Threatened	low
Aquila ayresii (Gurney, 1862)	Ayres's Hawk-Eagle	Near Threatened	moderate-low
Aquila rapax (Temminck, 1828)	Tawny Eagle	Vulnerable	confirmed
Ardeotis kori (Burchell, 1822)	Kori Bustard	Vulnerable	high
Balearica regulorum (E.T. Bennett, 1834)	Grey Crowned Crane	Vulnerable	low
Botaurus stellaris (Linnaeus, 1758)	Eurasian Bittern	Critically Endangered	low
Bucorvus leadbeateri (Vigors, 1825)	Southern Ground-Hornbill	Vulnerable	moderate-low
Buphagus africanus Linnaeus, 1766	Yellow-billed Oxpecker	Vulnerable	low
Buphagus erythrorhynchus (Stanley, 1814)	Red-billed Oxpecker	Near Threatened	high
Centropus grillii Hartlaub, 1861	Black Coucal	Near Threatened	low
Certhilauda chuana (Smith, 1836)	Short-clawed Lark	Near Threatened	moderate-low
Charadrius pallidus Strickland, 1853	Chestnut-banded Plover	Near Threatened	low
Ciconia episcopus (Boddaert, 1783)	Woolly-necked Stork	Near Threatened	low
Ciconia nigra (Linnaeus, 1758)	Black Stork	Near Threatened	high
Circus macrourus (S.G. Gmelin, 1770)	Pallid Harrier	Near Threatened	moderate
Circus ranivorus (Daudin, 1800)	African Marsh-Harrier	Vulnerable	low
Crex crex (Linnaeus, 1758)	Corn Crake	Vulnerable	low
Crithagra citrinipectus (Clancey & Lawson, 1960)	Lemon-breasted Canary	Near Threatened	low
Ephippiorhynchus senegalensis (Shaw, 1800)	Saddle-billed Stork	Endangered	low
Eupodotis senegalensis (Vieillot, 1820)	White-bellied Korhaan	Vulnerable	low
Falco biarmicus Temminck, 1825	Lanner Falcon	Near Threatened	high
Falco naumanni Fleischer, 1818	Lesser Kestrel	Vulnerable	high

Table 13: Red Data assessment for the site alternatives

Binomial Name	*Colloquial Name*	*Red Data Status*	*Probability Assessment*
Falco peregrinus Tunstall, 1771	Peregrine Falcon	Near Threatened	moderate-low
Geronticus calvus (Boddaert, 1783)	Southern Bald Ibis	Vulnerable	low
Glareola nordmanni Fischer von Waldheim, 1842	Black-winged Pratincole	Near Threatened	moderate-low
Glareola pratincola (Linnaeus, 1766)	Collared Pratincole	Near Threatened	low
Gorsachius leuconotus (Wagler, 1827)	White-backed Night-Heron	Vulnerable	low
Gyps africanus Salvadori, 1865	White-backed Vulture	Vulnerable	high
Gyps coprotheres (J.R. Forster, 1798)	Cape Vulture	Vulnerable	moderate
Hypargos margaritatus (Strickland, 1844)	Pink-throated Twinspot	Near Threatened	low
Leptoptilos crumeniferus (Lesson, 1831)	Marabou Stork	Near Threatened	moderate-low
Lioptilus nigricapillus (Vieillot, 1818)	Bush Blackcap	Near Threatened	low
Lissotis melanogaster (Rüppel, 1835)	Black-bellied Bustard	Near Threatened	low
Macheiramphus alcinus Bonaparte, 1850	Bat Hawk	Near Threatened	low
Microparra capensis (A. Smith, 1839)	Lesser Jacana	Near Threatened	low
Mirafra cheniana Smith, 1843	Melodious Lark	Near Threatened	low
Mycteria ibis (Linnaeus, 1766)	Yellow-billed Stork	Near Threatened	moderate-low
Necrosyrtes monachus (Temminck, 1823)	Hooded Vulture	Vulnerable	low
Neotis denhami (Children & Vigors, 1826)	Denham's Bustard	Vulnerable	low
Nettapus auritus (Boddaert, 1783)	African Pygmy-Goose	Near Threatened	low
Pelecanus onocrotalus Linnaeus, 1758	Great White Pelican	Near Threatened	low
Pelecanus rufescens Gmelin, 1789	Pink-backed Pelican	Vulnerable	low
Phoenicopterus minor E. Geoffroy Saint-Hilare, 1789	Lesser Flamingo	Near Threatened	low
Phoenicopterus ruber Linnaeus, 1758	Greater Flamingo	Near Threatened	low
Platysteira peltata Sundevall, 1850	Black-throated Wattle-eye	Near Threatened	low
Podica senegalensis (Vieillot, 1817)	African Finfoot	Vulnerable	low
Poicephalus robustus (Gmelin, 1788)	Cape Parrot	Endangered	low
Polemaetus bellicosus (Daudin, 1800)	Martial Eagle	Vulnerable	high
Pterocles gutturalis A. Smith, 1836	Yellow-throated Sandgrouse	Near Threatened	moderate
Rostratula benghalensis (Linnaeus, 1758)	Greater Painted-snipe	Near Threatened	low
Sagittarius serpentarius (J.F. Miller, 1779)	Secretarybird	Near Threatened	high
Schoenicola brevirostris (Sundevall, 1850)	Broad-tailed Warbler	Near Threatened	low
Scotopelia peli (Bonaparte, 1850)	Pel's Fishing-Owl	Vulnerable	low
Smithornis capensis (A. Smith, 1839)	African Broadbill	Near Threatened	low
Spermestes fringilloides (Lafresnaye, 1835)	Magpie Mannikin	Near Threatened	low
Stephanoaetus coronatus (Linnaeus, 1766)	African Crowned Eagle	Near Thratened	low

Table 13: Red Data assessment for the site alternatives			
Binomial Name	***Colloquial Name***	***Red Data Status***	***Probability Assessment***
Terathopius ecaudatus (Daudin, 1800)	Bateleur	Vulnerable	high
Torgos tracheliotus (J.R. Forster, 1796)	Lappet-faced Vulture	Vulnerable	moderate-high
Trigonoceps occipitalis (Burchell, 1824)	White-headed Vulture	Vulnerable	moderate-low
Tyto capensis (A. Smith, 1834)	African Grass-Owl	Vulnerable	low
Vanellus albiceps Gould, 1834	White-crowned Lapwing	Near Threatened	low
Vanellus melanopterus (Cretzschmar, 1829)	Black-winged Lapwing	Near Threatened	low
Zoothera gurneyi (Hartlaub, 1864)	Orange Ground-Thrush	Near Threatened	low
Mammals			
Acinonyx jubatus (Schreber, 1775)	Cheetah	Vulnerable	high
Amblysomus hottentotus (A. Smith, 1829)	Hottentot's Golden Mole	Data Deficient	low
Atelerix frontalis (A. Smith, 1831)	South African Hedgehog	Near Threatened	moderate
Calcochloris obtusirostris (Peters, 1851)	Yellow Golden Mole	Vulnerable	low
Canis adustus Sundevall, 1847	Side-striped Jackal	Near Threatened	low
Cercopithecus mitis erythrarchus Peters, 1852	Samango Monkey	Vulnerable	low
Cercopithecus mitis labiatus I. Geoffroy, 1842	Samango Monkey	Endangered	low
Cercopithecus mitis Wolf, 1822	Samango Monkey	Vulnerable	low
Cloeotis percivali Thomas, 1901	Percival's Short-eared Trident Bat	Vulnerable	low
Cricetomys gambianus Waterhouse, 1840	Giant Rat	Vulnerable	low
Crocidura cyanea(Duvernoy, 1838)	Reddish-grey Musk Shrew	Data Deficient	moderate-high
Crocidura fuscomurina (Heuglin, 1865)	Tiny Musk Shrew	Data Deficient	moderate-low
Crocidura hirta Peters, 1852	Lesser Red Musk Shrew	Data Deficient	moderate
Crocidura maquassiensis Roberts, 1946	Maquassie Musk Shrew	Vulnerable	low
Crocidura mariquensis (A. Smith, 1844)	Swamp Musk Shrew	Data Deficient	moderate-low
Crocidura silacea Thomas, 1895	Lesser Grey-brown Musk Shrew	Data Deficient	low
Crocuta crocuta (Erxleben, 1777)	Spotted Hyaena	Near Threatened	low
Damaliscus lunatus (Burchell, 1823)	Western Tsessebe	Endangered	low
Dasymys incomtus (Sundevall, 1847)	Water Rat	Near Threatened	low
Dendromus nyikae Wroughton, 1909	Nyika Climbing Mouse	Near Threatened	low
Elephantulus brachyrhynchus (A. Smith, 1836)	Short-snouted Elephant-shrew	Data Deficient	moderate
Elephantulus intufi (A. Smith, 1836)	Bushveld Elephant-shrew	Data Deficient	high
Felis nigripes Burchell, 1824	Black-footed Cat	Vulnerable	moderate-low
Grammomys cometes (Thomas & Wroughton, 1908)	Mozambique Woodland Mouse	Data Deficient	low
Grammomys dolichurus (Smuts, 1832)	Woodland Mouse	Data Deficient	low
Graphiurus platyops Thomas, 1897	Rock Dormouse	Data Deficient	low

Table 13: Red Data assessment for the site alternatives

Binomial Name	*Colloquial Name*	*Red Data Status*	*Probability Assessment*
Hippopotamus amphibius Linnaeus, 1758	Common Hippopotamus	Vulnerable	low
Hipposideros gigas Wagner, 1845	Giant Leaf-nosed Bat	Near Threatened	moderate-low
Hippotragus equinus (Desmarest, 1804)	Roan Antelope	Vulnerable	low
Hippotragus niger (Harris, 1838)	Southern Sable Antelope	Vulnerable	low
Hydrictis maculicollis (Lichtenstein, 1835)	Spotted-necked Otter	Near Threatened	low
Lemniscomys rosalia (Thomas, 1904)	Single-striped Mouse	Data Deficient	moderate-low
Leptailurus serval (Schreber, 1776)	Serval	Near Threatened	moderate
Loxodonta africana (Blumenbach, 1797)	African Savanna Elephant	Vulnerable	low
Lycaon pictus (Temminck, 1820)	African Wild Dog	Endangered	low
Manis temminckii Smuts, 1832	Pangolin	Vulnerable	high
Mellivora capensis (Schreber, 1776)	Honey Badger	Near Threatened	high
Miniopterus natalensis (A. Smith, 1834)	Natal Long-fingered Bat	Near Threatened	moderate-low
Mus neavei (Thomas, 1910)	Thomas' Pygmy Mouse	Data Deficient	low
Myosorex cafer (Sundevall, 1846)	Dark-footed Forest Shrew	Data Deficient	low
Myosorex varius(Smuts, 1832)	Forest Shrew	Data Deficient	low
Neamblysomus gunningi (Broom, 1908)	Gunning's Golden Mole	Endangered	low
Neamblysomus juliane (Meester, 1972)	Juliana's Golden Mole	Vulnerable	low
Neoromicia melckorum (Roberts, 1919)	Kruger Serotine	Data Deficient	low
Neotragus livingstonianus	Livingstone's Suni	Vulnerable	low
Nycteris woodi K. Andersen, 1914	Wood's Slit-faced Bat	Near Threatened	low
Panthera leo (Linnaeus, 1758)	Lion	Vulnerable	low
Panthera pardus (Linnaeus, 1758)	Leopard	Near Threatened	confirmed
Paracynictis selousi (de Winton, 1896)	Selous' Mongoose	Data Deficient	low
Parahyaena brunnea (Thunberg, 1820)	Brown Hyaena	Near Threatened	confirmed
Petrodromus tetradactylus Peters, 1846	Four-toed Elephant-shrew	Endangered	low
Poecilogale albinuc ha (Gray, 1864)	African Striped Weasel	Data Deficient	moderate
Raphicerus sharpei Thomas, 1897	Sharp's Grysbok	Near Threatened	low
Rhinolophus blasii Peters, 1866	Blasius's Horseshoe Bat	Near Threatened	moderate
Rhinolophus swinnyi Gough, 1908	Swinny's Horseshoe Bat	Near Threatened	low
Rhynchogale melleri (Gray, 1865)	Meller's Mongoose	Data Deficient	low
Suncus infinitesimus (Heller, 1912)	Least Dwarf Shrew	Data Deficient	low
Suncus lixus (Thomas, 1898)	Greater Dwarf Shrew	Data Deficient	low
Suncus varilla (Thomas, 1895)	Lesser Dwarf Shrew	Data Deficient	low
Tatera leucogaster (Peters, 1852)	Bushveld Gerbil	Data Deficient	high

8.4 PROVINCIALLY PROTECTED TAXA

In addition to the above-mentioned Red Data species of Limpopo, five animal taxa (some overlap does occur) have protected status (NEMBA) within Limpopo (www.speciesstatus.sanbi.org). PoC for these species was estimated as follows (refer **Table 15**):

- 3 species have a low PoC;
- 1 species has a moderate PoC; and
- 1 species has a moderate-high PoC.

Table 14: Protected fauna species of Mpumalanga

Binomial Name	*Colloquial Name*	*NEMBA status*	*Probability Assessment*
Aonyx capensis (Schinz, 1821)	African Clawless Otter	Protected	low
Atelerix frontalis (A. Smith, 1831)	South African Hedgehog	Protected	moderate
Bucorvus leadbeateri (Vigors, 1825)	Southern Ground-Hornbill	Protected	moderate-high
Circus ranivorus (Daudin, 1800)	African Marsh Harrier	Protected	low
Connachaetes gnou (Zimmermann, 1777)	Black Wildebeest	Protected	low

8.5 ANNOTATIONS ON CONFIRMED RED DATA ANIMALS OF THE SITE ALTERNATIVES

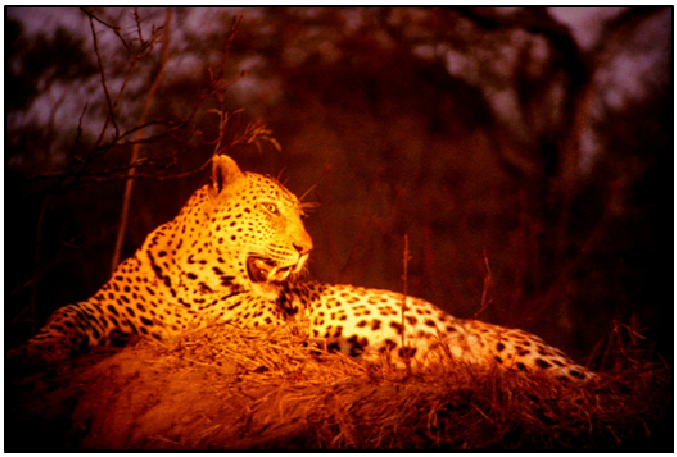
8.5.1 Tawny Eagle (Aquila rapax, Temminck, 1828)

The Tawny Eagle, *Aquila rapax* (Temminck, 1828), is widespread in sub-Saharan Africa, with isolated populations in North Africa and India. The species is found throughout southern Africa, but is absent from most of the coastal strip, highveld grassland and western Namibia. The Tawny Eagle is resident in southern Africa with local movements probably driven by concentrations of food (such as Red-billed Quelea colonies).

It is found in lightly wooded savanna and is absent from dense forests and highlands. The species is usually found singly or in pairs and is territorial year-round. The Tawny Eagle is a predator, pirate and scavenger; it hunts from a perch or in flight. Live prey items include mammals, birds, reptiles, amphibians, fish and insects (grasshoppers and termites). The species competes with vultures and Marabou Storks at carcasses and regularly scavenges at road kills.

The Tawny Eagle is listed as Least Concern globally (http://www.iucnredlist.org/details/106003532/0) but is listed as Vulnerable in South Africa – the species is known to have decreased in range and numbers in the Transvaal. It suffers from both inadvertent and deliberate poisoning as well as from shooting. Scavenging habits of the Tawny Eagle make it a non-target victim of farmers who indiscriminately place poisoned baits for small livestock predators (http://sabap2.adu.org.za/spp_summary.php?Spp=134&section=5).

8.5.2 Leopard (Panthera pardus, Linnaeus, 1758)



Originally described as *Felis pardus* Linnaeus, 1758, The Leopard is found in Africa south of the Sahara and Asia. Currently, the subspecies in South Africa is recognized as *Panthera pardus melanotica* Günther, 1775. As is evident from the distribution of the species, Leopards are able to live in almost every type of habitat, including true desert. They are adaptable generalists, able to survive on an extraordinary variety of large or small prey.

The cat truly has a catholic diet, known to take at least 92 prey species in sub-Saharan Africa. Leopards can survive on extremely small prey, an ability that allows them to live in areas from which larger prey has long since been extirpated. In most areas where Leopards have been studied, the cats are largely nocturnal. Mating associations are brief, lasting only one or two days. Most litters consist of two young and females use caves, rocky outcrops, abandoned burrows or dense thickets for birth dens. By the time Leopards are 12-18 months of age, the young are usually independent of their mother; sexual maturity is attained by two to three years of age. The Leopard is listed in CITES Appendix I and is classified as Near Threatened on The IUCN Red List. The Leopard is in the odd position of being endangered in some parts of its range and a pest in others.

Leopards clearly have the ability to survive near humans. They can feed on any type of prey and do not have highly specific habitat requirements. However, they are vulnerable to persecution. The greatest threat to the leopard's continued survival is the loss of habitat and wild prey as livestock activities expand (Wilson & Mittermeier [eds.], 2009).

8.5.3 Brown Hyaena (*Parahyaena brunnea,* Thunberg, 1820)

Originally described as *Hyaena brunnea* Thunberg, 1820, the Brown Hyena is found in Namibia, Botswana, Zimbabwe, Mozambique, Swaziland, Lesotho and South Africa. Brown Hyenas are found in a variety of relatively arid habitats from open desert or semi-desert in the Namib and Kalahari, to dry open scrub and woodland savannah, Mopani scrub, and tree savannah, as well as the Bushveld of the northern Transvaal.

They do not need drinking water and inhabit areas where annual rainfall may be even lower than 100 mm, up to about 650 mm. These Hyenas forage alone at night and do not cooperate in hunting or feeding, although group members tolerate each other at large food items. Although not competent hunters, Brown Hyenas are extremely efficient scavengers with an omnivorous diet. They are opportunistic feeders on a range of vertebrates, primarily mammals, the vast majority of which is scavenged, often from the kills of other carnivores. The Brown Hyena is primarily a nocturnal mammal,

although activity is occasionally observed during the day, particularly on cool, cloudy days during the rainy season. Brown Hyenas typically rest during the day in a hole, or under a large tree or bush. Approximately 65 % of Brown Hyenas in a population are members of small social groups called clans, with the remaining individuals living as nomads. Clan sizes ranges from 4-14 individuals, including cubs, and clans defend large, stable territories. Brown Hyenas are polyestrous, non-seasonal breeders. Litters range from 1-4 cubs with a modal litter size of three. Cubs are fully grown at 30 months and the earliest breeding in the wild is at 35 months.

The Brown Hyena is listed as Near Threatened in the IUCN Red List. It is generally considered widespread yet rare. It is estimated that areas in excess of 1,000 km² are required to maintain a viable population of this animal. Much of the habitat where Brown Hyenas occur outside protected areas is used for livestock ranching, and the hyenas are heavily persecuted (shot, poisoned, trapped and hunted with dogs) in these areas because they are assumed to be livestock predators. This persecution, and habitat loss and fragmentation, are the primary threats to persistence of Brown Hyena (Wilson & Mittermeier [eds.], 2009).

8.6 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. 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 the vegetal formations 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 in isolation without considering vegetation habitat diversity; therefore, the plant communities or macro habitat types described in this document (refer **Section 7.6**) are considered the main faunal habitats within the site alternatives for the purposes of this EIA assessment. The reader is referred to **Figure 8** for an illustration of the vegetal communities of the respective study sites.

8.6.1 Transformed Habitats

Transformed habitats represent areas of an atypical nature - areas where the 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. The Artificial Woodland Habitat is included in this category.

Artificial Woodland Habitat have lost the ability to function ecologically and bear no biological resemblance to the original faunal habitat associated with the Central Bushveld Bioregion's (Mucina & Rutherford, 2004) woodlands 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 passing through). Further transformation and degradation of the transformed faunal habitats is unlikely to lead to an accelerated loss of

biodiversity or a significant negative impact on the faunal assemblages currently persisting in these areas. A low faunal sensitivity is therefore ascribed to the Artificial Woodland Habitat areas.

8.6.2 Wetland Faunal Habitats

Wetland habitats encountered within the proposed site alternatives are characterised by areas of permanent or temporary surface water and vegetation associated with such areas. These wetland habitats include the *Nymphaea – Schoenoplectus* Impoundments Community. Within the larger landscape, wetland habitat is fairly unique and uncommon (compared to terrestrial woodland). Because of the unique and scarce nature of wetland habitat, these areas of temporary and permanent surface water are at risk when changes in land use are considered. Wetlands often host a variety of sensitive and threatened faunal taxa; faunal wetland species are often particularly sensitive because of the pressures on the freshwater ecological systems of South Africa. Sensitive faunal wetland species considered likely to persist in the site alternatives include:

- *Ciconia nigra* (Black Stork, Linnaeus, 1758); and
- *Pyxicephalus adspersus* (Giant Bullfrog, Tschudi, 1838).

The wetlands encountered within the site alternativs therefore exhibit high conservation characteristics; the ecological functionality and biodiversity value of these wetlands are high, despite its artificial nature. Wetland habitats of the site alternatives therefore exhibit medium-high faunal sensitivity.

8.6.3 Natural Faunal Woodland Habitats

The natural woodland habitats of the site alternatives comprises those parts that still exhibit (to varying degrees) a significant proportion of the functional ecological characteristics of the original Limpopo Sweet Bushveld (Mucina and Rutherford 2004). In other words, these areas currently constitute untransformed, functioning faunal woodland habitat characteristic of the Central Bushveld Bioregion of South Africa. The natural (terrestrial) faunal woodland habitats of the site alternatives include:

- *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland Community;
- *Portulaca – Oldenlandia* Sheetrock Community; and
- *Vernonia – Panicum maximum* Degraded Woodland Community.

Ecological interaction of natural terrestrial woodland habitats is often very complex. Potentially, some woodland specialist species might be excluded from degraded woodlands and will only be limited to natural woodlands (depending on the level of degradation), while others might be unaffected by woodland habitat degradation (up to certain point). The level of habitat degradation that might be tolerated by woodland fauna species is different for each species; species loss rates compared to habitat degradation rates is also likely to differ between woodland habitat types. In a landscape matrix including fragments of natural, degraded and transformed terrestrial faunal habitats, it is often difficult to predict the faunal assemblages likely to persist in each fragment. Some fragments of a degraded (or even transformed) nature might (when considered in isolation) be of a poor ecological status or low biodiversity value, but when considered within the landscape matrix in relevance to other, natural habitat fragments, might be of considerable conservation value as a movement corridor or sink population source.

Sensitive terrestrial faunal species that are regarded likely to persist in the natural woodland of the site alternatives (not necessarily recorded during the field investigation) include:

- *Panthera pardus* (Linnaeus, 1758) – Leopard;
- *Aquila rapax* (Temminck, 1828) – Tawny Eagle;

- *Elephantulus intufi* (A. Smith, 1836) – Bushveld Elephant Shrew;
- *Tatera leucogaster* (Peters, 1852) – Bushveld Gerbil;
- *Buphagus erythrorhynchus* (Stanley, 1814) – Red-billed Oxpecker;
- *Falco biarmicus* Temminck, 1825 – Lanner Falcon;
- *Mellivora capensis* (Schreber, 1776) – Honey Badger;
- *Parahyaena brunnea* (Thunberg, 1820) – Brown Hyaena;
- *Sagittarius serpentarius* (J.F. Miller, 1779) – Secretarybird;
- *Acinonyx jubatus* (Schreber, 1775) – Cheetah;
- *Ardeotis kori* (Burchell, 1822) – Kori Bustard;
- *Falco naumanni* Fleischer, 1818 – Lesser Kestrel;
- *Gyps africanus* Salvadori, 1865 – White-backed Vulture;
- *Manis temminckii* Smuts, 1832 – Ground Pangolin;
- *Polemaetus bellicosus* (Daudin, 1800) – Martial Eagle; and
- *Terathopius ecaudatus* (Daudin, 1800) – Bateleur.

The natural terrestrial woodland communities of the site alternatives therefore exhibit moderately high conservation characteristics; ecological functionality and biodiversity value of these woodlands are high and changes in the land use are likely to influence a significant number of sensitive and threatened faunal taxa. Based on the level of degradation, the woodland communities exhibit varying faunal sensitivities:

- *Kyphocarpa – Eragrostis* Woodland Community: medium-high faunal sensitivity;
- *Portulaca – Oldenlandia* Sheetrock Community: high faunal sensitivity; and
- *Vernonia – Panicum* Degraded Woodland Community: medium faunal sensitivity.

8.7 FAUNAL HABITAT SENSITIVITY ASSESSMENT

The site alternatives were investigated and the faunal sensitivity of respective habitat types assessed in terms of the following biodiversity attributes (refer **Table 15**):

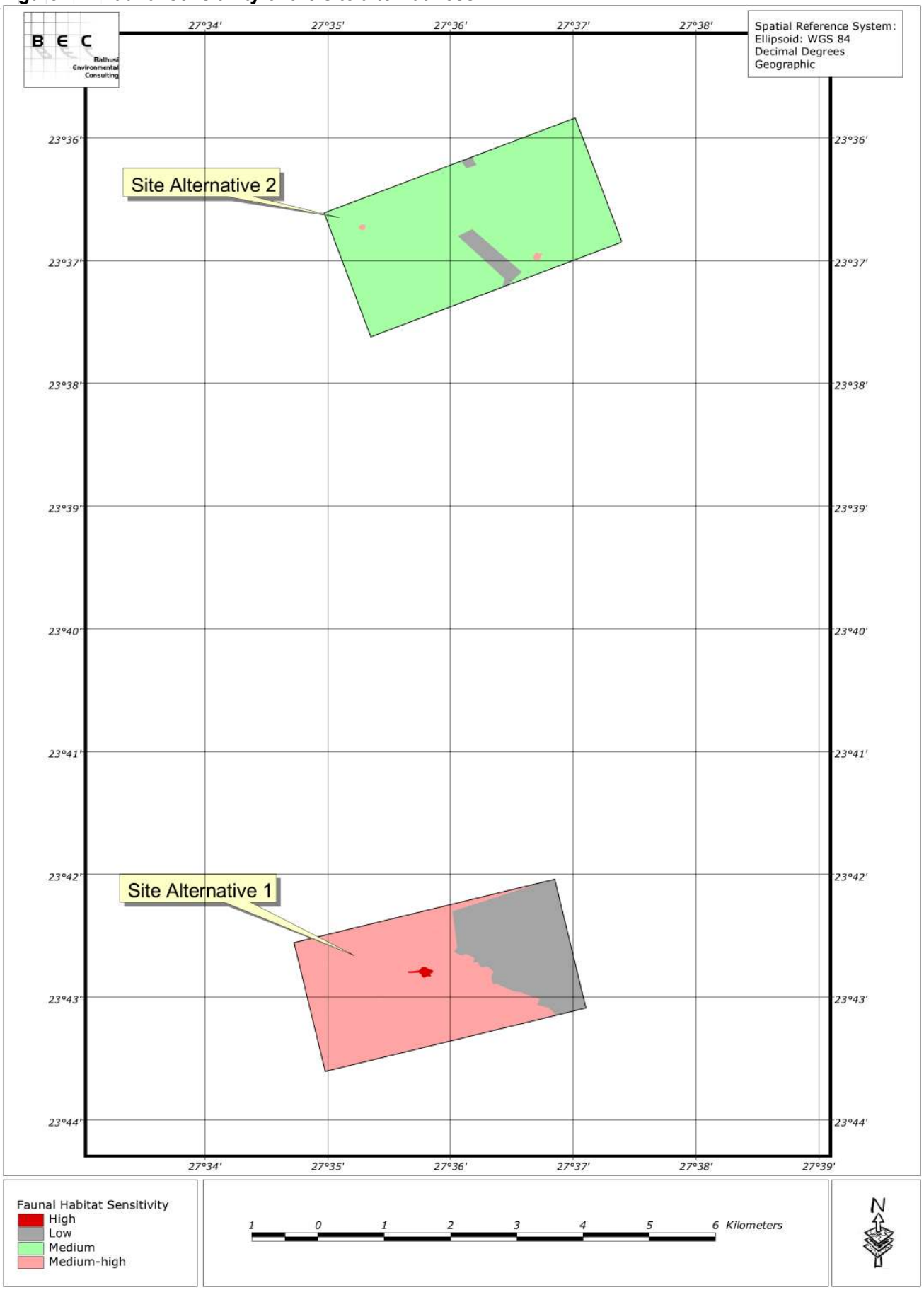
- Habitat status (ST): level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity (DV): the number of different faunal habitat types (both on micro- and macro-scale) found within the proposed site and bordering areas;
- Habitat linkage (LN): the degree to which the 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 area (larger study area) 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 15: Faunal Sensitivities for the respective habitat types

Unit	*Habitat Type*	*ST*	*DV*	*LN*	*RD*	*SE*	*Average*	*Category*
Transformed	Artificial woodland	2	2	3	1	1	18 %	**low**
Wetland	*Nymphaea - Schoenoplectus* impoundments	5	7	7	6	6	62 %	**medium-high**
Woodland	*Kyphocarpa - Eragrostis* woodland	8	8	7	7	7	74 %	**medium-high**
	Portulaca - Oldenlandia sheetrock community	9	7	8	7	9	80 %	**high**
	Vernonia - Panicum degraded woodland	6	5	7	5	5	56 %	**medium**

Faunal habitat sensitivities of the habitat types are illustrated in **Figure 14**.

Figure 14: Faunal sensitivity of the site alternativess



8.8 DISCUSSION

The site alternatives are characterised by (largely) untransformed Sweet Limpopo Bushveld faunal habitat. Although some transformation is evident on the two sites investigated as well as (extensively) in the region, most of the original faunal habitat of the site alternatives is still ecologically intact. The presence of 98 animal species in the study area (confirmed during the April 2013 field investigation) attests to the untransformed nature of the faunal habitats. The ecological functionality, integrity, faunal biodiversity and general sensitivity of the site alternatives is underlined by the confirmed presence of three Red Data species in the site alternatives as well as the confirmed presence of eighteen Red Data species in the immediate vicinity.

The region in which the site alternatives is located has been significantly altered (the presence of Grootegeluk opencast coalmine, Matimba and Medupi (under construction) power stations and associated infrastructure) and continues to experience very high land use change pressures. Consequently, the general sensitivities of faunal habitats and faunal communities of the region in which the site alternatives is located, increases almost on a daily basis.

Within the scope of a single EIA related biodiversity assessment, cumulative impacts for a specific region are very difficult to identify, quantify and assess. These difficulties are especially relevant to the region of the relevant to the continuous ashing project proposed for the Matimba Power Station because of the extensive faunal habitat loss and fragmentation in the immediate vicinity of the site alternatives. Additionally, the habitat loss (and fragmentation) thresholds of the sensitive faunal inhabitants of the region (eighteen Red Data species confirmed) are mostly unknown and warrant caution.

8.8.1 Site Alternative 1

Site Alternative 1 is located next to the existing ashing facility. The eastern third of the site alternative is characterised by artificial faunal woodland habitat (low faunal sensitivity). The remaining (approximately) two thirds of Site Alternative 1 include *Kyphocarpa angustifolia – Eragrostis rigidior* Woodland (medium-high faunal sensitivity), *Nymphaea – Schoenoplectus* impoundments (medium-high faunal sensitivity) and *Portulaca – Oldenlandia* sheetrock faunal habitat (high faunal sensitivity). A higher habitat diversity is associated with this site alternative; while the status of the habitat is also in a better condition.

Sixty-four animal species were recorded in Site Alternative 1, including the Red Data species *Aquila rapax* (Temminck, 1828) and *Parahyaena brunnea* (Thunberg, 1820).

Therefore, based on these considered factors, Site Alternative 1 is considered the least preferred Alternative (most sensitive).

8.8.2 Site Alternative 2

Site Alternative 2 is situated northeast of the Grootegeluk opencast coalmine. Most of this site alternative is characterised by *Vernonia – Panicum maximum* degraded woodland faunal habitat (medium faunal sensitivity). Some areas of artificial woodland habitat (low faunal sensitivity) is evident, also two small *Nymphaea – Schoenoplectus* impoundments (medium-high faunal sensitivity). Site Alternative 2 does not include any faunal habitat fragments of high faunal sensitivity. Low habitat diversity and variability is associated with Site Alternative 2, hence a moderate faunal sensitivity is ascribed to this option.

Sixty-five animal species were confirmed to be present in Site Alternative 2, including the Red Data species *Panthera pardus* (Linnaeus, 1758) and *Parahyaena brunnea* (Thunberg, 1820).

Based on these considered factors, Alternative 2 is considered the most preferred Alternative (least sensitive).

8.9 FAUNAL PREFERENCE RANKING

In order to rank the site alternatives in terms of faunal sensitivity/ preference for the proposed project, a site preference rating system is applied, based on integrated results of the faunal assessments. The following protocol is applied:

1 = Not Suitable for development / No-Go (impact of very high significance - negative)
2 = Not Preferred (impact of high significance - negative)
3 = Acceptable (impact of moderate significance - negative)
4 = Preferred (impact of low or negligible significance - negative)

Criteria applied for the ranking protocol is detailed in **Section 8.7**.

Impacts on faunal attributes of any of the alternatives are of such a nature that severe and significant impacts on the faunal environment are reasonably expected. The nature of the development implies that significant habitat will be lost, resulting in significant direct and indirect impacts on faunal attributes of the area. Site Alternative 2 is regarded slightly more suitable for the proposed development because of a combination of sensitivity criteria. The following aspects ultimately render Site Alternative 1 less suitable for the proposed project:

- Pristine terrestrial woodland habitat types that are regarded suitable for a selection of conservation important fauna species;
- High connectivity to surrounding natural/ pristine habitat; and
- Nearby sensitive habitat that will be affected adversely.

Preference ranking ascribed to the various sites are as follows:
Site Alternative 1 – **2 (Not preferred); and**
Site Alternative 2 – **3 (Acceptable).**

8.10 PROPOSED LINEAR INFRASTUCTURES ROUTE

As discussed above, results of the faunal assessment indicated the preference of Site Alternatives for the proposed ashing facility for Matimba Power Station. Should Site Alternative 2 be authorized for the proposed Continuous Ash Disposal Programme, the construction and operation of a conveyor line and access road between Matimba Power Station and Site Alternative 2 will be required. A technically feasible linear infrastructures route has been proposed (refer **Figure 10**) and is assessed in terms of faunal habitat and animal communities likely to be influenced during the construction and operation of the proposed conveyor line.

8.10.1 Faunal Habitat Types

When discerning faunal habitat types for the proposed linear infrastructures route, the same principles apply as was applied in **Section 8.6**. Faunal habitats are based on the floristic Macro Habitat Types, using an

ecologically holistic approach and considering the important interaction between animals and their biotic and abiotic environment. Three faunal habitats have been identified for the area proposed for the conveyor line:

- Degraded Woodland;
- Natural Woodland; and
- *Spirostachys africana* Woodland.

Degraded woodland is found wherever the natural woodland of the site alternatives has been degraded because of the presence of existing infrastructure (overhead power lines and roads). This habitat type includes typical areas that have been affected by both long term and recent (or short term) anthropogenic activities. The degraded woodland faunal habitat is not of a pristine nature and therefore the sensitivity of this area has been reduced; a medium-low faunal sensitivity is estimated for this faunal habitat type.

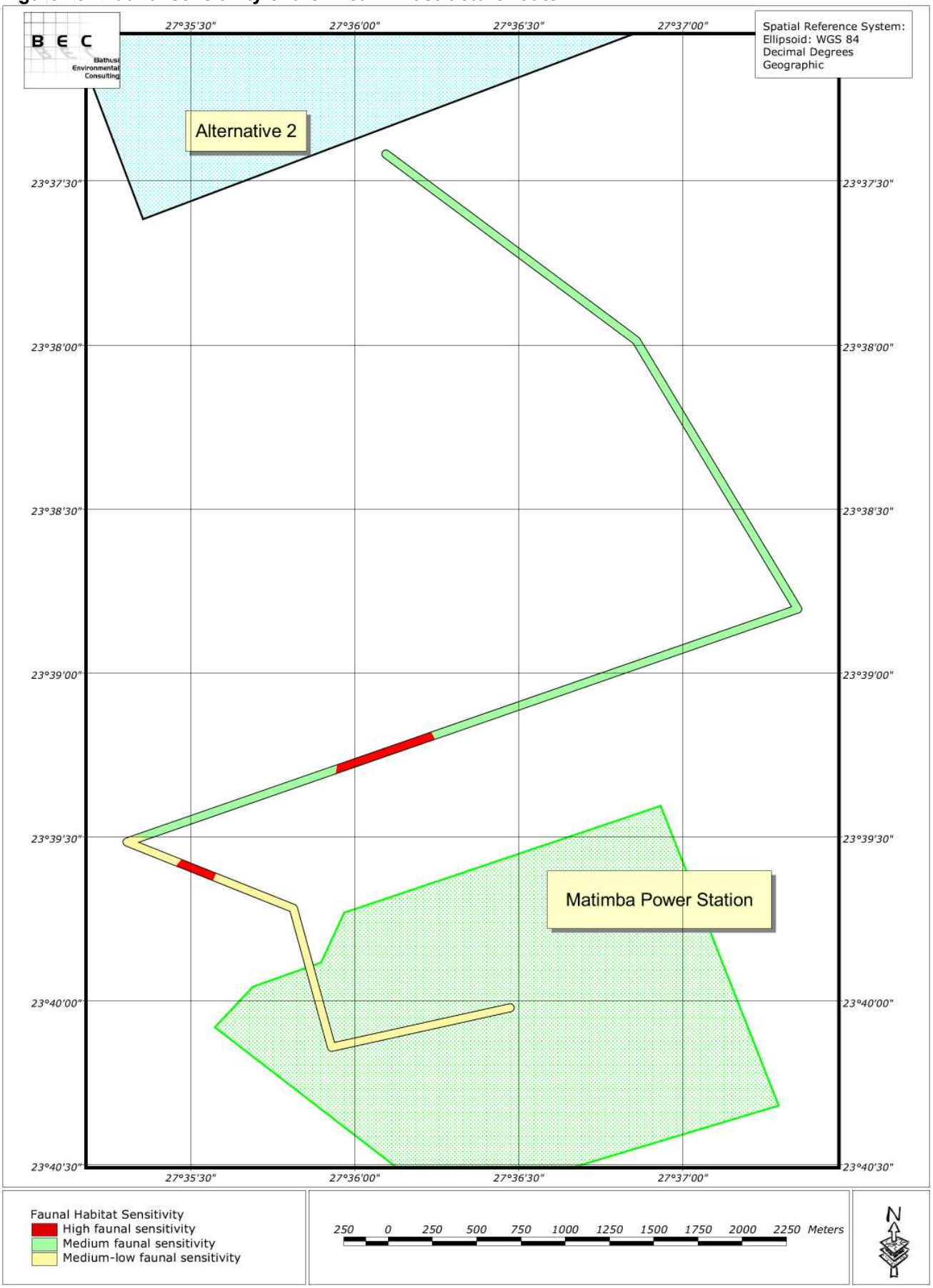
Natural woodland faunal habitat type represents natural Limpopo Sweet Bushveld of the Central Bushveld Bioregion (Mucina & Rutherford 2006). The Limpopo Sweet Bushveld regional vegetation community remains mostly untransformed; more than 94% of this community was still considered untransformed by 2006. It is listed as Least Threatened, even though it is hardly protected (0.6%). It is therefore reasonable to assume that the natural woodland faunal habitat type of the site alternatives is representative of typical faunal habitat of the Central Bushveld Bioregion that is not currently under threat. Furthermore, this habitat type does not include any unique habitat characteristics (such as those found on outcrops or in and near wetlands). It is therefore considered unlikely that any sensitive or threatened faunal species, assemblage or community will adversely (significantly) affected by the proposed conveyor line. Consequently, the natural woodland faunal habitat type is considered to exhibit a medium faunal sensitivity.

The *Spirostachys africana* woodland exhibits habitat characteristics that suggest infrequent and irregular inundation, such as the domination of Tamboti (*Spirostachys africana*), which is usually found in areas of clayey soils within a sand-dominated landscape such as the immediate region. These unique abiotic habitat features results in the presence of unique faunal communities, assemblages and species, especially during the end of the wet season when surface water is present on occasion. Species such as Giant Bullfrog, *Pyxicephalus adspersus* Tschudi, 1838, Bubbling Kassina, *Kassina senegalensis* Duméril and Bibron, 1841, Common Platanna, *Xenopus laevis* Daudin, 1802 and Southern Foam Nest Frog, *Chiromantis xerampelina* Peters, 1854, is likely to utilise inundated conditions within the *Spirostachys africana* woodland faunal community for breeding purposes. Fragments of suitable amphibian breeding habitat within the region's arid landscape are usually small and isolated; these scarce 'breeding oases' are in need of conservation and should be considered sensitive. Consequently, the *Spirostachys africana* woodland faunal community is assigned a high faunal sensitivity.

8.10.2 Discussion & Recommendations

Based on the faunal habitat status, diversity, ecological connectivity, Red Data hosting ability and inherent sensitivity, different faunal sensitivities are assigned to the three macro habitat types of the proposed conveyor line (refer **Figure 15**). Degraded and Natural Woodland habitats are not deemed particularly sensitive and it is regarded unlikely that any animal species, assemblage or community of conservation importance will be adversely affected by the construction and operation of the proposed conveyor line. However, the *Spirostachys africana* Woodland faunal habitat type exhibit unique and sensitive faunal habitat within the general arid landscape of the region. This faunal habitat is therefore deemed sensitive and not suitable for the construction and operation of a conveyor line. It is strongly recommended that it is excluded by means of a realignment of the proposed line towards the north (refer **Figure 13**).

Figure 15: Faunal sensitivity of the linear infrastructure route



9 ECOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED ASHING FACILITY

The impact assessment is aimed at presenting a description of the nature, extent and significance 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 and potential impacts within the development area.

Direct or primary impacts from these types of development can result from any activity that involves land clearance (such as access road construction, topsoil stripping or tailings impoundment construction) or direct discharges to water bodies (riverine tailings disposal, for instance, or tailings impoundment releases) or the air (such as dusts or smelter emissions). Direct impacts are usually readily identifiable, while indirect or secondary impacts can result from social or environmental changes induced by industrial operations and are often harder to identify and assess. Cumulative impacts occur when existing impacts from anthropogenic activities are exacerbated by 'new' or additional developments, industrial and non- industrial or when the footprint or severity of existing impacts are increased.

9.1 IDENTIFICATION OF IMPACTS

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

Impacts resulting from the proposed ashing activity on floristic and faunal attributes of the site alternatives are largely restricted to the physical effects of habitat clearance and the establishment of artificial habitat. Direct impacts include any effect on the natural environment where species (populations, individuals or overall species richness) are affected; recovery is usually not possible. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of special concern. Impacts on sensitive or protected habitat are also 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 consequently cannot be measured at a specific moment in time. The extent of these impacts 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 project into a regional and national context, particularly in view of similar or resultant developments and activities.

The following impacts were identified as relevant to this proposed 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 sensitive or protected habitat types (including loss and degradation);
- 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 briefly described below. This list was compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of this type of development on the floristic environment.

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

Development activities frequently result in the destruction of:

- Individual conservation important species;
- Communities of conservation important species;
- Areas where conservation important species are known to occur (historically recorded); or
- Areas that are considered particularly suitable for these species (potentially present, but not previously recorded due to poor floristic sampling records).

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 they generally occur in low numbers. However, since they usually provide an indication of the ecological integrity of an ecosystem, a high ecological value and importance is placed on their presence. Conversely, the presence of pristine habitat conditions is usually perceived as an indication of the potential presence of species of conservation importance. Moist habitat conditions and areas of high spatial heterogeneity are known for a high incidence of conservation important plants.

Red Data species are particularly sensitive to changes in their environment, being adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human-related activities is one of the greatest reasons for these species being in danger of extinction. 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 an 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 abundant plants of conservation importance, particularly protected trees, was established during the brief survey period. Habitat throughout both site alternatives is furthermore suitable for a number of other taxa that were not recorded during the survey. This impact will therefore likely be severe. Exclusion of habitat suitable for the potential presence of conservation important plants is the only sensible manner in which this impact can be mitigated. Due to the widespread occurrence of conservation important plants across both site alternatives, it is strongly recommended that the alternative with the lowest abundance be selected.

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

Similarly, 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 and integrity of a region as their presence usually provides an indication of a relatively pristine environment. Because animals are mostly mobile and are 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. Additional aspects that will be affected include migration patterns and suitable habitat for breeding and foraging purposes. Habitat requirements and preferences of conservation important species are much stricter than for common or generalist species and a higher conservation obligation is placed on these areas. Even slight changes to habitat in which these species persist are therefore likely to have significant effects on the presence and status of these taxa within the immediate region.

The presence of conservation important fauna species within as well as near to the proposed development areas 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 immediate region is regarded high. Exclusion of Red Data habitat is the only sensible manner in which this impact can be mitigated to some extent.

9.2.3 Impacts on sensitive or protected habitat types (including loss and degradation)

The loss or degradation of natural vegetation or habitat that is regarded sensitive because of restricted presence in the larger region represents a potential loss of habitat diversity on a local and regional scale. Sensitive habitat types 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. A high conservation value is generally ascribed to floristic communities that occupy these areas as they contribute significantly to the biodiversity of a region.

Extensive areas of natural habitat will be affected adversely by direct impacts resulting from construction and operational phases of the ashing activity. Particular reference is made to the loss of habitat resulting from surface clearing activities, the construction of infrastructure and contamination of natural habitat through the leaching of chemicals into the groundwater and surface water and generation of huge amounts of dust and spillages. Also of importance is the loss of habitat that is not necessarily considered suitable for Red Data species, but where high endemic species richness is likely to be recorded. Natural woodland habitat that is in an optimal condition is regarded sensitive, particularly in view of the presence of several conservation important plant and animal taxa that were recorded within these areas during the survey period.

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. An aspect that is of concern is the presence of vehicles on access roads, leading to accidental death of animals, particularly concerning nocturnal animals.

The presence of personnel within the development area during construction and operational phases will inevitably result in contact with animals. Evidence from nearby developments indicates that numerous encounters with dangerous animals (such as snakes, scorpions and spiders) can reasonably be expected. Encounters with dangerous mammals are less likely, but still possible. 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 frequently results in the unnecessary killing of these animals.

9.2.5 Impacts on ecological connectivity & ecosystem functioning

The larger region is characterised by moderate to low transformation levels. This is reflected in the site alternatives and immediate surrounds. 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. It is therefore reasonable to assume that the animals that utilise 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 persistence 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.

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. utilise all available natural habitat as either corridors, ‘stepping stones’ or habitat. Loss of current migration routes or connectivity areas (‘stepping stones’) within the site alternatives 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/ communities present in the direct vicinity of the site alternatives will likely be affected adversely by indirect impacts resulting from construction and operational activities. These indirect impacts also include adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;

- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

These impacts lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases, these effects are not bound and are dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. The nature of the operation is such that pollution and degradation of the surrounding areas could reasonably be expected. These effects are evident from existing activities in the immediate surrounds.

These impacts lead to a reduction in the resilience of peripheral ecological communities and ecosystems or loss or changes in ecosystem function.

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

Adverse impacts on the conservation status of regional ecological types on a local and national level are regarded a cumulative impact since it incorporates impacts from the development under consideration in conjunction with other types of local and regional impacts. The conservation 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 are regarded significant. The current conservation status is based on regional information relating to the status and availability of remaining natural habitat. The vegetation of the region (Limpopo Sweet Bushveld) is included in the 'Least Threatened' category.

However, recent developments that have taken place subsequent to the compilation of the VEGMAP database have resulted in further decimation of natural woodland in the region, contributing to a 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.

9.2.8 Cumulative increase in local and 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 fragments, implies that endemic biodiversity have permanently lost that opportunity to occupy 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 are 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 moderate to low levels of transformation and habitat fragmentation.

9.3 ECOLOGICAL IMPACT RATING TABLES FOR THE PROPOSED ASHING FACILITY

9.3.1 Construction Phase

Table 16: Impact evaluation for the Construction Phase

Ash Disposal Facility – Site Alternative 1

Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	4	4	3	4	15	**Very High**
	with	4	4	3	4	15	**Very High**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	4	4	3	4	15	**Very High**
	with	3	4	2	3	12	**High**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	3	4	4	3	14	**Very High**
	with	3	4	4	3	14	**Very High**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	2	4	3	3	12	**High**
	with	2	4	3	3	12	**High**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	3	4	3	4	14	**Very High**
	with	3	3	3	3	12	**High**
Impacts on ecological connectivity and ecosystem functioning;	**without**	3	4	3	4	14	**Very High**
	with	2	3	2	2	9	**Medium**
Indirect impacts on surrounding habitat	**without**	2	3	3	4	12	**High**
	with	2	3	2	2	9	**Medium**

Ash Disposal Facility – Site Alternative 2

Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	4	4	2	4	14	**Very High**
	with	4	4	2	4	14	**Very High**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	4	4	2	3	13	**Very High**
	with	3	3	2	3	11	**High**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	4	3	3	12	**High**
	with	2	4	3	3	12	**High**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	2	4	2	3	11	**High**
	with	2	4	2	2	10	**High**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	4	3	3	12	**High**
	with	2	3	3	3	11	**High**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	4	2	3	11	**High**
	with	2	3	2	2	9	**Medium**
Indirect impacts on surrounding habitat	**without**	2	3	2	4	11	**High**
	with	2	3	2	2	9	**Medium**

9.3.2 Operational Phase

Table 17: Impact evaluation for the Operational Phase

Ash Disposal Facility – Site Alternative 1

Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	4	4	3	2	13	**Very High**
	with	1	2	2	1	6	**Low**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	4	4	3	2	13	**Very High**
	with	1	2	2	1	6	**Low**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	4	3	2	11	**High**
	with	1	2	2	1	6	**Low**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	3	2	2	8	**Medium**
	with	1	3	2	1	7	**Medium**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	4	2	3	11	**High**
	with	2	3	2	2	9	**Medium**
Impacts on ecological connectivity and ecosystem functioning;	**without**	3	4	2	4	13	**Very High**
	with	3	3	2	3	11	**High**
Indirect impacts on surrounding habitat	**without**	2	3	2	4	11	**High**
	with	2	3	2	3	10	**High**

Ash Disposal Facility – Site Alternative 2

Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	3	4	3	2	12	**High**
	with	1	2	2	1	6	**Low**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	2	3	2	2	9	**Medium**
	with	1	2	2	1	6	**Low**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	3	2	2	9	**Medium**
	with	1	2	2	1	6	**Low**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	2	2	1	6	**Low**
	with	1	2	1	1	5	**Low**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	3	2	3	10	**High**
	with	2	2	1	2	7	**Medium**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	3	2	2	9	**Medium**
	with	2	2	2	2	8	**Medium**
Indirect impacts on surrounding habitat	**without**	2	2	2	2	8	**Medium**
	with	2	2	2	2	8	**Medium**

9.3.3 Decommissioning Phase

Table 18: Impact evaluation for the Decommissioning Phase

Ash Disposal Facility – Site Alternative 1

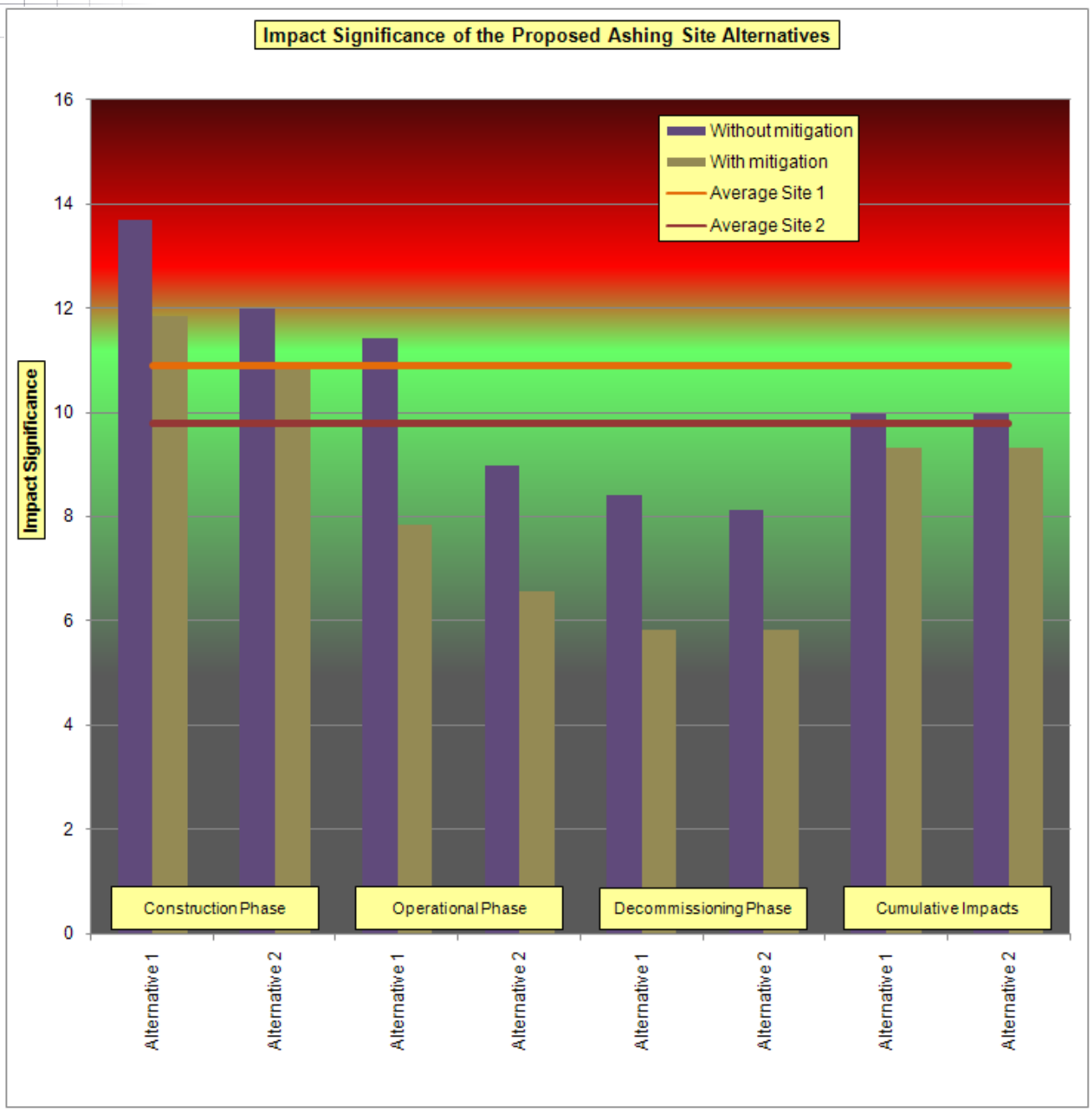
Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	2	3	2	2	9	**Medium**
	with	2	2	2	1	7	**Medium**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	2	3	2	2	9	**Medium**
	with	2	2	1	1	6	**Low**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	2	2	2	8	**Medium**
	with	2	2	1	1	6	**Low**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	2	2	2	7	**Medium**
	with	1	2	1	1	5	**Low**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	1	3	2	2	8	**Medium**
	with	1	2	1	1	5	**Low**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	3	2	2	9	**Medium**
	with	2	2	1	1	6	**Low**
Indirect impacts on surrounding habitat	**without**	2	3	2	2	9	**Medium**
	with	2	2	1	1	6	**Low**

Ash Disposal Facility – Site Alternative 2

Potential Impact	*Mitigation*	*Extent* (E)	*Duration* (D)	*Magnitude* (M)	*Probability* (P)	*Significance* (S=(E+D+M)*P)	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	2	2	2	2	8	**Medium**
	with	2	2	2	1	7	**Medium**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	2	2	2	2	8	**Medium**
	with	2	2	1	1	6	**Low**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	1	2	2	2	7	**Medium**
	with	1	2	1	1	5	**Low**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	2	2	2	7	**Medium**
	with	1	2	1	1	5	**Low**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	3	2	2	9	**Medium**
	with	1	2	1	2	6	**Low**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	3	2	2	9	**Medium**
	with	2	2	1	1	6	**Low**
Indirect impacts on surrounding habitat	**without**	2	3	2	2	9	**Medium**
	with	2	2	1	1	6	**Low**

9.3.4 Cumulative Impacts

Table 19: Cumulative Impact evaluation for the Development							
Ash Disposal Facility – Site Alternative 1							
Potential Impact	**Mitigation**	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**	
		(E)	**(D)**	**(M)**	**(P)**	**(S=(E+D+M)*P)**	
Cumulative impacts on conservation obligations & targets (including national and regional)	**without**	3	5	8	5	**48**	**Medium**
	with	3	5	8	5	**48**	**Medium**
Cumulative increase in local and regional fragmentation/ isolation of habitat	**without**	3	5	6	5	**60**	**Medium**
	with	3	5	6	4	**48**	**Medium**
Cumulative increase in environmental degradation, pollution	**without**	3	4	8	5	**65**	**High**
	with	3	4	6	4	**44**	**Medium**
Ash Disposal Facility -Site Alternative 2							
Potential Impact	**Mitigation**	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**	
		(E)	**(D)**	**(M)**	**(P)**	**(S=(E+D+M)*P)**	
Cumulative impacts on conservation obligations & targets (including national and regional)	**without**	3	5	8	5	**42**	**Medium**
	with	3	5	8	5	**42**	**Medium**
Cumulative increase in local and regional fragmentation/ isolation of habitat	**without**	3	5	6	5	**60**	**Medium**
	with	3	5	6	4	**48**	**Medium**
Cumulative increase in environmental degradation, pollution	**without**	3	4	8	5	**65**	**High**
	with	3	4	6	4	**44**	**Medium**



Graph 11: Impact significance within Ashing Site Alternatives during development phases

9.4 DISCUSSION

Impacts associated with the proposed development clearly falls within three categories, namely:

- Direct, immediate and highly significant impacts, also of a permanent nature;
- Indirect, referred and moderate significant impacts; and
- Cumulative, permanent and highly significant impacts.

Destruction of habitat as well as the accompanying loss of common and, more importantly, conservation important species, will lead to site-specific and local (5-10km) effects on biodiversity. Activities that cause these impacts are most significant during the site preparation and construction phases when vegetation is removed, soils stripped and the site prepared for the operational phase. The loss of species and habitat during this phase of the project is significant and impossible to mitigate against. It is important to understand that effects of these initial activities on the natural environment are irreversible.

Subsequent to the site preparation phase, actual construction and operational activities are expected to result in indirect and referred impacts on the surrounding biological and ecological environment. Significance of these impacts is mostly of a moderate significance and is generally effectively ameliorated by means of the implementation of generic and some site-specific mitigation measures, although rarely achieved successfully. Containment of impacts to the construction / operational site and preventing the spread thereof into adjacent natural habitat should be the major objective of the EMP during this stage of the project.
Lastly, cumulative impacts of the project and impacts on the ecological and biological environment during and subsequent to decommissioning of the project will result in significant and lasting impacts on the ecological environment. The immediate area as well as the larger region is characterised by moderate levels of habitat loss and fragmentation. Cumulative impacts of habitat destruction and the associated loss of species are regarded severe on a local and regional scale. Ample evidence of anthropogenic encroachment is present in the immediate surrounds and is causing widespread, uncontrolled and irreversible impacts on the natural savannas of this region.

The known and potential presence of conservation important plant and animal taxa in a specific area normally dictates the suitability of a site for a development. In this particular case, conservation important taxa are known to persist, or are highly likely to persist, on both site alternatives. The importance of this aspect was definitely not discarded and the recommendation of site Alternative 2 as the (slightly) preferred option is partly based on the lowest potential for conservation important taxa to persist within this area. The suitability of site Alternative 2 is slightly challenged by the need for a conveyor connection to the source of the ash. Such a linear infrastructure will undoubtedly increase local and regional habitat fragmentation levels, impact adversely on movement and migration corridors as well as crossing and effects on sensitive species and habitat types. Additionally, conservation important taxa are known to occur throughout the region.

Results of the impacts assessment clearly indicate that expected and likely impacts within both of the proposed site alternatives are regarded severe, particularly direct impacts associated with the construction phase. Site Alternative 1 constantly exhibits a higher sensitivity towards the proposed development.

Ultimately, both site alternatives exhibit aspects of biodiversity importance, but expected and likely impacts associated with the development and operation on Site Alternative 1 is regarded more significant than for Site Alternative 2.

10 ECOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED LINEAR INFRASTUCTURE ROUTE

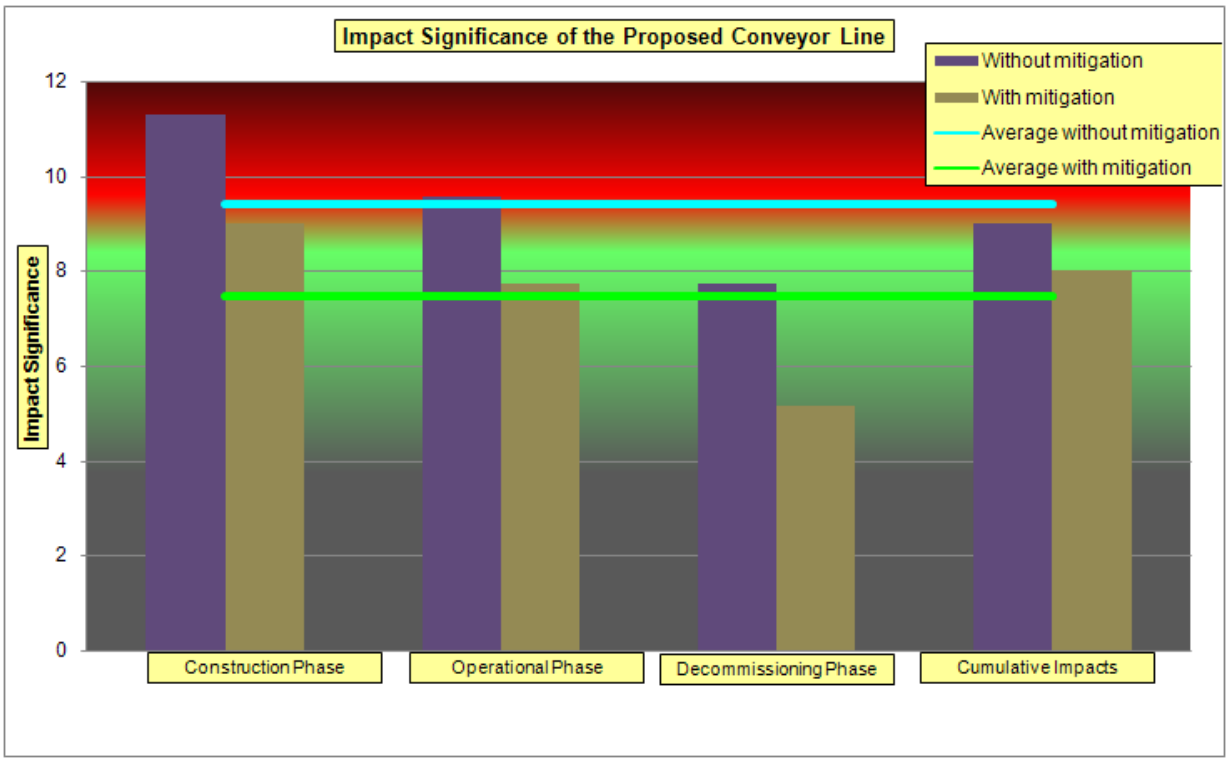
The impact assessment is aimed at presenting a description of the nature, extent and significance of identified impacts on the ecological environment that will result from the construction and operation of the proposed conveyor line and access roads between Matimba Power Station and the Proposed Alternative 2. Likely and potential impacts are similar to those identified for the Proposed Ashing Facility (refer **Section11.1 – 11.2**). Tabular assessments are presented in **Section 10.2** in the form of an Impact Rating Matrix for expected and potential impacts within the development area.

10.1 DISCUSSION

Impacts associated with the proposed development clearly falls within three categories, namely:

- Direct, immediate and highly significant impacts, also of a permanent nature;
- Indirect, referred and moderate significant impacts; and
- Cumulative, permanent and highly significant impacts.

Destruction of habitat as well as the accompanying loss of common and, more importantly, conservation important species, will lead to site-specific and local (5-10 km) effects on biodiversity. Activities that cause these impacts are most significant during the site preparation and construction phases when vegetation is removed, soils stripped and the site prepared for the operational phase. Loss of species and habitat during the construction phase of the project is unavoidable. The implementation of generic mitigation measures are expected to ameliorate impacts to an acceptable significance. While numerous protected trees occur throughout the greater region, parts of the proposed conveyer line are characterised by an exceptional density of the Protected Trees *Spirostachys africana* and significant impacts on this species are expected. This impact can only be ameliorated with a recommended realignment of the proposed conveyor route. This realignment of the proposed conveyor route therefore represents the most significant mitigation measures for this aspect of the proposed development.



Graph 12: Impact significance within the Linear Infrastructure Line during development phases

10.2 ECOLOGICAL IMPACT RATING TABLES FOR THE PROPOSED LINEAR INFRASTUCTURE ROUTE

10.2.1 Construction Phase

Table 20: Impact evaluation for the Construction Phase							
Ash Disposal Facility – Linear infrastructures route							
Potential Impact	***Mitigation***	***Extent***	***Duration***	***Intensity***	***Probability***	***Significance***	
		(E)	**(D)**	**(I)**	**(P)**	**(S=(E+D+M+P)**	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	3	3	3	4	**13**	**Very High**
	with	1	3	3	3	**10**	**High**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	3	3	3	4	**13**	**Very High**
	with	2	3	2	3	**10**	**High**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	3	3	4	**12**	**High**
	with	2	3	2	2	**9**	**Medium**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	2	3	2	4	**11**	**High**
	with	1	3	2	3	**9**	**Medium**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	3	2	3	**10**	**High**
	with	2	3	2	2	**9**	**Medium**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	3	3	3	**11**	**High**
	with	2	3	2	2	**9**	**Medium**
Indirect impacts on surrounding habitat	**without**	2	3	2	2	**9**	**Medium**
	with	2	2	2	1	**7**	**Medium**

10.2.2 Operational Phase

Table 21: Impact evaluation for the Operational Phase							
Ash Disposal Facility – Linear infrastructures route							
Potential Impact	***Mitigation***	***Extent***	***Duration***	***Intensity***	***Probability***	***Significance***	
		(E)	**(D)**	**(I)**	**(P)**	**(S=(E+D+M)*P)**	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	2	3	2	3	10	**High**
	with	2	3	2	2	9	**Medium**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	2	3	3	3	11	**High**
	with	2	3	2	2	9	**Medium**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	2	3	2	2	9	**Medium**
	with	2	2	2	1	7	**Medium**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	3	2	2	8	**Medium**
	with	1	2	2	1	6	**Low**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	3	3	3	11	**High**
	with	2	3	2	2	9	**Medium**
Impacts on ecological connectivity and ecosystem functioning;	**without**	2	3	2	2	9	**Medium**
	with	2	2	2	1	7	**Medium**
Indirect impacts on surrounding habitat	**without**	2	3	2	2	9	**Medium**
	with	2	2	2	1	7	**Medium**

10.2.3 Decommissioning Phase

Table 22: Impact evaluation for the Decommissioning Phase							
Ash Disposal Facility – Linear infrastructures route							
Potential Impact	***Mitigation***	***Extent***	***Duration***	***Intensity***	***Probability***	***Significance***	
		(E)	**(D)**	**(I)**	**(P)**	**(S=(E+D+M)*P)**	
Impacts on flora species of conservation importance (including habitat suitable for these species	**without**	1	3	2	2	8	**Medium**
	with	1	2	2	1	6	**Low**
Impacts on fauna species of conservation importance (including habitat suitable for these species)	**without**	2	3	2	2	9	**Medium**
	with	1	2	1	2	6	**Low**
Impacts on unique or protected habitat types (including loss and degradation)	**without**	1	2	2	2	7	**Medium**
	with	1	1	2	1	5	**Low**
Loss of sensitive/ natural habitat types (including plant diversity & abundance)	**without**	1	2	2	2	7	**Medium**
	with	1	1	2	1	5	**Low**
Displacement of fauna species, human-animal conflicts & interactions (including diversity & abundance)	**without**	2	3	2	2	9	**Medium**
	with	1	2	1	1	5	**Low**
Impacts on ecological connectivity and ecosystem functioning;	**without**	1	2	2	2	7	**Medium**
	with	1	1	2	1	5	**Low**
Indirect impacts on surrounding habitat	**without**	1	2	2	2	7	**Medium**
	with	1	1	1	1	4	**Low**
	with	1	3	2	2	8	**Medium**

10.2.4 Cumulative Impacts

Table 23: Cumulative Impact evaluation for the Development Ash Disposal Facility – Linear infrastructure routes							
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Intensity (I)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**	
Cumulative impacts on conservation obligations & targets (including national and regional)	**without**	2	3	1	3	**9**	**Medium**
	with	2	3	1	2	**8**	**Medium**
Cumulative increase in local and regional fragmentation/ isolation of habitat	**without**	2	3	1	3	**9**	**Medium**
	with	2	3	1	2	**8**	**Medium**
Cumulative increase in environmental degradation, pollution	**without**	2	3	1	3	**9**	**Medium**
	with	2	3	1	2	**8**	**Medium**

11 RECOMMENDED MITIGATION MEASURES

11.1.1 Site Specific Mitigation Measures

Mitigation Measure 1 - Realign the proposed conveyor route towards the north in order to avoid significant impacts on habitat types of moderate high sensitivity;

Mitigation Measure 2 - Exclude all areas of high ecological sensitivity from the proposed development. Preference for Alternative 2 is indicated;

Mitigation Measure 3 - Prevent all and any effluent from the ashing facility into wetland habitat;

Mitigation Measure 4 - Prevent contamination of natural habitat and nearby wetlands from any source of pollution; and

Mitigation Measure 5 - Provide an adequate buffer between areas of development and surrounding natural habitat.

11.1.2 General Aspects

Mitigation Measure 6 - Compile and implement biodiversity 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;

11.1.3 Fences & Demarcation

Mitigation Measure 7 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel, vehicles, providing boundaries for construction and operational sites;

Mitigation Measure 8 - 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;

11.1.4 Fire

Mitigation Measure 9 - 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 10 - Prevent all open fires;

Mitigation Measure 11 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

Mitigation Measure 12 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

11.1.5 Roads & Access

Mitigation Measure 13 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 14 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 15 - Dust control on all roads should be prioritised;

Mitigation Measure 16 - No roads should be allowed within ecologically sensitive areas.

11.1.6 Vegetation Clearance & Operations

Mitigation Measure 17 - Conduct a protected species survey. Results of this survey will guide permitting requirements for the removal of protected trees from the selected property;

Mitigation Measure 18 - The landowner must immediately take steps to remove alien vegetation as per Conservation of Agricultural Resource Act (No. 43 of 1983). 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 19 - The size of areas subjected to land clearance will be kept to a minimum;

Mitigation Measure 20 - Only areas as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 21 - Cleared vegetation and debris that has not been utilised will be collected and disposed of to a suitable waste disposal site. It will not be burned on site;

Mitigation Measure 22 - All vegetation not required to be removed will be protected against damage;

Mitigation Measure 23 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 24 - 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 25 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area. Removal of topsoil should be done to a depth of at least 1m;

Mitigation Measure 26 - Stored topsoil will be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds, which would adversely affect its suitability for planting;

Mitigation Measure 27 - No spoil material will be dumped outside the defined site;

Mitigation Measure 28 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 29 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 30 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 31 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 32 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 33 - Revegetated areas should be fenced to prevent damage by grazing animals;

Mitigation Measure 34 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 35 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 36 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

11.1.7 Animals

Mitigation Measure 37 - 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 38 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 39 - Speed of vehicles should be limited to allow for sufficient safety margins;

Mitigation Measure 40 - Dangerous animals should be handled by a competent person;

Mitigation Measure 41 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction;

Mitigation Measure 42 - Sensitize all personnel to the presence, characteristics and behaviour of animals on the site;

Mitigation Measure 43 - Include suitable procedures in the event of encountering potentially dangerous animals on the site;

Mitigation Measure 44 - 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 45 - No domestic pets should be allowed on the site.

12 PHOTOGRAPHIC RECORDS

Photo 1: Example of Leopard tracks

Photo 2: Example of an artificial impoundment (*Typha capensis* Variation, Site Alternative 1)

Photo 3: Example of natural woodland, Site Alternative 1 (*Acacia nigrescens – Melhania forbesii Woodland Variation)*

Photo 4: Example of sheetrock outcrops, Site Alternative 1 (*Portulaca – Oldenlandia* Sheetrock Community)

Photo 5: Example of artificial impoundment, Site Alternative 2 (*Brachiaria nigropedata* Variation

Photo 6: Example of artificial habitat, Site Alternative 2

Photo 7: Example of woodland habitat of Site Alternative 2 (*Stipagrostis uniplumis – Eragrostis pallens* Sandveld Variation

Photo 8: Example of *Acacia mellifera – Acacia tortilis* Alluvial Plains Variation (Site Alternative 2)

Photo 9: Example of *Spirostachys africana* Woodland (Proposed Conveyor Line)

13 APPENDIX 1: FLORISTIC DIVERSITY OF THE SITE

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

Binomial Name	Family	Growth Form	Status/ Uses	Colloquial Name
Abutilon species	Malvaceae	Forb	None	--
Acacia burkei	Fabaceae	Tree	Medicinal uses	Black monkey thorn (e), Swartapiesdoring (a)
Acacia erioloba	**Fabaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood. Declining Status**	**Camel Thorn (e), Kameeldoring (a)**
Acacia erubescens	Fabaceae	Tree	Edible parts (gum)	Blue thorn (e), Blouhaak (a)
Acacia luederitzii	Fabaceae	Small tree	None	False umbrella thorn (e), Basterhaak-en-steek (a)
Acacia mellifera **	Fabaceae	Shrub	Declared indicator of encroachment, medicinal uses, poison source	Black Thorn (e), Swarthaak (a)
Acacia nigrescens	Fabaceae	Tree	Tannin rich bark	Knob thorn (e), Knoppiesdoring (a)
Acacia nilotica	Fabaceae	Tree	Dyes and tans	Scented thorn (e), Lekkerruikpeul (a)
Acacia robusta	Fabaceae	Tree	None	--
Acacia species	Fabaceae	Tree	None	Acacia (e), Acacia (a)
Acacia tortilis	Fabaceae	Tree	Medicinal uses (bark)	Umbrella thorn (e), Hak-en-steek (a)
Acanthosicyos naudinianus	Cucurbitaceae	Prostrate herb	Edible parts	Gemsbok cucumber (e), Gemsbok komkommer (a)
Acroceras macrum	Poaceae	Grass	None	--
Acrotome inflata	Lamiaceae	Forb	None	Tumble weed (e), Tolbossie (a)
Aloe species	Asphodelaceae	Succulent	None	Aloe (e), Aalwyn (a)
Alternanthera pungens **	Amaranthaceae	Prostrate herb	Weed, pioneer species	Khaki Weed (e), Dubbeltjie (a)
Aristida bipartita	Poaceae	Grass	Unpalatable, indicator of degraded veld, Increaser IIc	Rolling grass (e), Grootrolgras (a)
Aristida congesta subsp. *barbicollis*	Poaceae	Grass	Poor grazing potential, Increaser IIc	Spreading Three-awn (e), Lossteekgras (a)
Aristida congesta subsp. *congesta*	Poaceae	Grass	Poor grazing potential, indicator of poor habitat, Increaser IIC	Tassel Three-awn (e), Katstertsteekgras (a)
Aristida species	Poaceae	Grass	None	--
Aristida stipitata	Poaceae	Grass	Poor grazing potential, indicator of poor habitat, Increaser IIC	Long-awned Three-awn (e), Langnaaldsteekgras (a)
Asparagus species	Liliaceae	Shrub	None	Wild Asparagus (e), Katbos (a)
Asparagus species 1	Liliaceae	Shrub	None	Asparagus (e), Katbos (a)
Asparagus species 2	Liliaceae	Shrub	None	Asparagus (e), Katbos (a)
Asparagus species 3	Liliaceae	Shrub	None	Asparagus (e), Katbos (a)

Barleria species	Acanthaceae	Dwarf shrub	None	--
Bauhinia petersiana	Fabaceae	Shrub	Medicinal uses, edible parts, substitute for coffee	Coffee neat's foot (e), Koffiebeesklou (a)
Bidens pilosa	Asteraceae	Forb	Naturalised exotic, edible parts	Black-jack (e), Knapsekêrel (a)
Boscia albitrunca	**Capparaceae**	**Tree**	**Protected Tree (National Forest Act, 1998)**	**Sheperd's Tree (e), Witgat (a)**
Boscia foetida	Capparaceae	Shrub	Medicinal uses, browsing value	Stink Bush (e), Stinkwitgat (a)
Brachiaria nigropedata	Poaceae	Grass	None	--
Bulbostylis hispidula	Cyperaceae	Sedge	None	--
Burkea africana	Caesalpiniaceae	Tree	Medicinal properties, edible worms feeding on the bark	Wild seringa (e), Wildesering (a)
Carissa bispinosa	Apocynaceae	Shrub	Edible parts, medicinal uses	Forest num-num (e), Bosnoemnoem (a)
Chamaecrista species	Caesalpiniaceae	Forb	None	--
Chloris virgata	Poaceae	Grass	None	Feather-top Chloris (e), Witpluim-chloris (a)
Chlorophytum species	Liliaceae	Geophyte	None	--
Cleome rubella	Capparaceae	Forb	None	--
Cleome species	Capparaceae	Forb	None	--
Combretum apiculatum	Combretaceae	Tree	Edible parts, firewood	Red bushwillow (e), Rooibos (a)
Combretum hereroense	Combretaceae	Small tree	Firewood	Russet bushwillow (e), Kierieklapper (a)
Combretum imberbe	**Combretaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), firewood, medicinal uses**	**Leadwood (e), Hardekool (a)**
Combretum zeyheri	Combretaceae	Tree	Edible parts, timber, weaving, medicinal uses	Large-fruited bushwillow (e), Raasblaar (a)
Commelina africana	Commelinaceae	Forb	Medicinal properties	Yellow Wandering Jew (e), Geeleendagsblom (a)
Commelina erecta	Commelinaceae	Forb	None	--
Commiphora africana	Burseraceae	Shrub	Water source, medicinal uses	Hairy corkwood (e), Harige kanniedood (a)
Commiphora pyracanthoides	Burseraceae	Small tree	Edible parts, traditional uses	Common corkwood (e), Gewone kanniedood (a)
Crinum species	Amaryllidaceae	Geophyte	None	--
Crotalaria species	Fabaceae	Dwarf shrub	None	--
Croton gratissimus	Euphorbiaceae	Tree	Medicinal uses, larval food for *Charaxes candiope candiope*	Lavender fever-berry (e), Laventelkoorsbessie (a)
Cyperus species	Cyperaceae	Sedge	None	--
Dactyloctenium aegyptium	Poaceae	Grass	None	--
Dactyloctenium giganteum	Poaceae	Grass	Palatable grazing	Giant Crowfoot (e), Reuse Hoenderspoor (a)
Datura stramonium **	Solanaceae	Forb	Declared Invader - Category 1B, weed	Common thorn apple (e)
Dichrostachys cinerea **	Fabaceae	Small tree	Invader, medicinal properties, traditional uses, firewood, weaving	Sicklebush (e), Sekelbos (a)

Digitaria eriantha	Poaceae	Grass	Weaving, palatable grazing grass, Decreaser	Finger grass (e), Finger gras (a)
Digitaria species	Poaceae	Grass	None	--
Dipcadi species	Liliaceae	Geophyte	None	--
Ehretia rigida	Ehretiaceae	Small tree	None	Puzzle Bush (e), Deurmekaarbos (a)
Elephantorrhiza elephantina	Fabaceae	Dwarf shrub	Medicinal uses, poisonous parts, dyes & tanning	Eland's Bean (e), Elandsboontjie (a)
Enteropogon macrostachyus	Poaceae	Grass	None	--
Eragrostis gummiflua	Poaceae	Grass	Unpalatable, low grazing potential, Increaser IIc	Gum grass (e), Gomgras (a)
Eragrostis lehmanniana	Poaceae	Grass	Weaving	Lehmanns' Love Grass (e), Knietjiesgras (a)
Eragrostis nindensis	Poaceae	Grass	Increaser IIc	Wether Love Grass (e), Hamelgras (a)
Eragrostis pallens	Poaceae	Grass	Thatching & weaving	Broom Love Grass (e), Besemgras (a)
Eragrostis porosa	Poaceae	Grass	None	--
Eragrostis rigidior	Poaceae	Grass	None	Broad curly leaf (e), Breë Krulblaar (a)
Eragrostis species	Poaceae	Grass	None	--
Euclea undulata	Ebenaceae	Small tree	Firewood	Common Guarri (e), Gewone ghwarrie (a)
Evolvulus alsinoides	Convolvulaceae	Forb	None	Blue Haze (e)
Flaveria bidentis **	Asteraceae	Forb	Declared Invader - Category 1B	Smelter's bush, Smelterbossie (a)
Gardenia volkensii	Rubiaceae	Tree	Medicinal uses, carving, traditional uses	Savanna gardenia (e), Bosveldkatjiepiering (a)
Geigeria burkei	Asteraceae	Dwarf shrub	None	Vermeerbos (a)
Gisekia africana var. *africana*	Gisekiaceae	Prostrate herb	None	Rooi-rankopslag (a), Volstruisdruiwe (a)
Gomphocarpus fruticosus	Apocynaceae	Shrub	Medicinal uses	Milkweed (e), Melkbos (a)
Gomphrena celosioides **	Amaranthaceae	Prostrate herb	Weed, South America	Bachelor's button (e), Mierbossie (a)
Grewia flava **	Tiliaceae	Shrub	Edible parts, weaving, traditional uses, declared indicator of encroachment	Velvet Raisin (e), Fluweelrosyntjiebos (a)
Grewia flavescens	Tiliaceae	Shrub	Edible parts, beer brewing	Bushman Raisin (e), Kruisbessie (a)
Grewia monticola	Tiliaceae	Shrub	Edible parts, traditional uses, important browsing	Silver raisin (e), Vaal rosyntjiebos (a)
Gymnosporia buxifolia	Celastraceae	Small tree	Traditional uses	Common spike-thorn (e), Gewone pendoring (a)
Heliotropium ciliatum	Boraginaceae	Forb	None	Vergeet-my-nietjie (a)
Hermannia tomentosa	Malvaceae	Dwarf shrub	None	Lusernbos (a)
Hibiscus micranthus	Malvaceae		None	--
Hibiscus species	Malvaceae	Forb	None	--
Hibiscus trionum	Malvaceae	Forb	None	Bladderweed (e), Terblansbossie (a)
Hirpicium bechuanense	Asteraceae	Forb	Potentially poisonous	Botswana Marygold (e), Botswana-gousblom (a)
Indigofera filipes	Fabaceae	Forb	None	--

Indigofera species	Fabaceae	Forb	None	--
Ipomoea magnusiana	Convolvulaceae	Prostrate herb	None	Small Pink Ipomoea (e)
Jatropha species	Euphorbiaceae	Forb	None	--
Justicia flava	Acanthaceae	Forb	None	--
Kalanchoe rotundifolia	Crassulaceae	Succulent	Medicinal uses, potentially poisonous	Nentakalanchoe (e), Nentabos (a)
Kalanchoe thyrsiflora	Crassulaceae	Succulent	None	--
Kiggelaria africana	Flacourtiaceae	Shrub	Traditional uses, larval host for *Acrea horta & Hynmothoe alcimeda*	Wild Peach (e), Wildeperske (a)
Kyphocarpa angustifolia	Amaranthaceae	Forb	None	Silky Burweed (e)
Laggera decurrens	Asteraceae	Forb	None	--
Ledebouria species	Liliaceae	Geophyte	None	--
Limeum fenestratum	Aizoaceae	Forb	None	Lintblommetjie (a)
Litogyne gariepina	Asteraceae	Forb	Traditional uses	Dwarf Sage (e), Blougifbossie (a)
Lotononis species	Fabaceae	Forb	None	--
Lycium cinereum	Solanaceae	Shrub	Traditional uses	Kriedoring (a), Slangbessie (a)
Malva species	Malvaceae	Dwarf shrub	None	--
Melhania forbesii	Malvaceae	Forb	None	--
Melhania species	Malvaceae	Forb	None	--
Melinis nerviglumis	Poaceae	Grass	Increaser I	Bristle-leaved red top (e)
Melolobium candicans	Fabaceae	Dwarf shrub	None	--
Miscanthus junceus	Poaceae	Grass	None	--
Momordica balsamina	Cucurbitaceae	Climber	Edible parts, medicinal uses	Balsam Pear (e), Laloentjie (a), Balsam Peer (a)
Monsonia angustifolia	Geraniaceae	Forb	None	Crane's Bill (e), Angelbossie (a)
Nymphaea species	Nymphaeaceae	Hydrophilic	None	--
Ochna pulchra	Ochnaceae	Tree	Traditional uses	Peeling plane (e), Lekkerbreek (a)
Oldenlandia herbacea	Rubiaceae	Forb	None	False Spurry (e)
Ozoroa paniculosa	Anacardiaceae	Low tree	None	Bushveld Resin-tree (e), Bosveldharpuisboom (a)
Panicum maximum	Poaceae	Grass	None	Buffalo Grass (e), Gewone Buffelsgras (a)
Pappea capensis	Sapindaceae	Tree	Edible parts	Jacket-plum (e), Doppruim (a)
Pellaea calomelanos	Adianthaceae	Fern	Medicinal properties	Hard Fern (e), Hardevaring (a)
Peltophorum africanum	Caesalpiniaceae	Tree	Medicinal properties	Weeping wattle (e), Huilboom (a)
Pergularia daemia	Apocynaceae	Climber	Medicinal uses	Bobbejaankambro (a), Kgaba
Perotis patens	Poaceae	Grass	Indicator of poor management, Decreaser IIc	Cat's Tail (e), Katstertgras (a)

Phyllanthus species	Euphorbiaceae	Forb	None	--
Pogonarthria squarrosa	Poaceae	Grass	Unpalatable, indicator of poor habitat conditions	Herringbone Grass (e), Sekelgras (a)
Pollichia campestris	Illebracaceae	Dwarf shrub	Edible parts	Waxberry (e), Teesuiker (a)
Polygala uncinata	Polygalaceae	Forb	None	--
Portulaca kermesina	Portulacaceae	Succulent	None	--
Ptycholobium biflorum	Fabaceae	Forb	None	--
Raphionacme species	Periplocaceae	Succulent	None	--
Rhigozum brevispinosum	Bignoniaceae	Shrub	None	Short-thorn pomegranate (e), Kortdoringgranaat (a)
Sansevieria aethiopica	Liliaceae	Geophyte	Medicinal properties, weaving, garden plants	Bowstring hemp (e), Skoonma-se-tong (a)
Sarcostemma viminale	Apocynaceae	Climber	Medicinal uses	--
Schkuhria pinnata	Asteraceae	Forb	Medicinal uses, weed (S. America)	Dwarf Marigold (e), Bitterbossie (a)
Schmidtia pappophoroides	Poaceae	Grass	Palatable grazing grass, Increaser	Sand Quick (e), Sandkweek (a)
Schoenoplectus corymbosus	Cyperaceae	Hydrophilic	None	--
Scirpus species	Cyperaceae	Sedge	None	--
Sclerocarya birrea	**Anacardiaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), edible parts, traditional uses**	**Marula (e), Maroela (a)**
Searsia species	Anacardiaceae	Shrub	None	--
Searsia tenuinervis	Anacardiaceae	Shrub	Dyes & tanning	Kalahari Currant (e), Kalahari-taaibos (a)
Securidaca longepedunculata* var. *longepedunculata	**Polygalaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), Medicinal uses, poisonous parts**	**Violet tree (e), Krinkhout (a)**
Sesamum triphyllum	Pedaliaceae	Forb	Edible parts, essential oils	Wild sesame (e), Brandboontjie (a)
Setaria species	Poaceae	Grass	None	Bristle grass (e), Mannagras (a)
Setaria sphacelata	Poaceae	Grass	Edible parts, palatable, Decreaser	Common bristle grass (e), Gewone Mannagras (a)
Sida species	Malvaceae	Forb	None	--
Solanum lichtensteinii	Solanaceae	Dwarf shrub	None	Bitter apple (e), Bitter appel (a)
Solanum panduriforme	Solanaceae	Forb	Weed, traditional medicine, poisonous	Poison Apple (e), Gifappel (a)
Solanum species **	Solanaceae	Dwarf shrub	Declared Invader - Category 1	--
Sphenostylis species	Fabaceae	Forb	None	--
Spirostachys africana	**Euphorbiaceae**	**Tree**	**Timber, traditional uses, potentially poisonous Provincially Protected Tree**	**Tamboti (e), Tambotie (a)**
Sporobolus nitens	Poaceae	Grass	None	--
Stipagrostis uniplumis	Poaceae	Grass	Edible parts, thatching, weaving	Silky Bushman Grass (e)
Strychnos pungens	Loganiaceae	Low tree	Edible parts, medicinal uses	Spine-leaved monkey orange (e), Stekelblaarklapper (a)

Talinum crispalatum	Portulacaceae	Succulent	None	--
Tapiphyllum parvifolium	Rubiaceae	Small tree	Edible fruit	Wild medlar (e), Mispel (a)
Tarchonanthus camphoratus	Asteraceae	Shrub	Medicinal uses	Wild Camphor Bush (e), Vaalbos (a)
Tephrosia species	Fabaceae	Forb	None	--
Terminalia sericea	Combretaceae	Tree	Medicinal properties, timber	Silver cluster-leaf (e), Vaalboom (a)
Tricholaena monachne	Poaceae	Grass	Moderate grazing potential, Increaser IIc	Blue-seed grass (e), Blousaadgras
Typha capensis	Typhaceae	Hydrophilic	Cosmopolitan weed, edible parts, medicinal uses	Bulrush (e), Papkuil (a)
Urochloa mosambicensis	Poaceae	Grass	Edible parts, palatable grazing grass	Bushveld signal grass (e), Bosveldbeesgras (a)
Urochloa panicoides	Poaceae	Grass	None	Garden Urochloa (e), Tuinbeesgras (a)
Vernonia species	Asteraceae	Forb	None	--
Vigna species	Fabaceae	Climber	None	--
Waltheria indica	Sterculiaceae	Forb	None	Meidebossie (a)
Xenostegia tridentata	Convolvulaceae	Prostrate herb	Medicinal uses	Miniature Morning Glory (e), Frankhout (a)
Ziziphus mucronata	Rhamnaceae	Tree	Edible parts, medicinal uses	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)
Zornia linearis	Fabaceae	Prostrate herb	None	Narrow-leaved Catterpillar Bean (e)

14 APPENDIX 2: FAUNAL DIVERSITY OF THE IMMEDIATE REGION

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

Animal species confirmed for the region of the site alternatives				
Class	***Order***	***Family***	***Binomial Name***	***Colloquial Name***
Insecta	Isoptera	Hodotermitidae	*Hodotermes mossambicus*	Northern Harvester Termites
		Termitidae	*Macrotermes natalensis*	Large Fungus-growing Termites
			Odontotermes badius	Common Fungus-growing Termites
	Orthoptera	Gryllidae	*Gryllus bimaculatus*	Common Garden Cricket
		Pyrgomorphidae	*Zonocerus elegans*	Elegant Grasshopper
	Coleoptera	Carabidae	*Graphipterus limbatus*	Velvet Ground Beetle
		Scarabaeidae	*Dischista cincta*	Common Savanna Fruit Chafer
			Mausoleopis amabilis	White-spotted Fruit Chafer
			Leucocelis vitticollis	Fruit Chafer
			Leucocelis amethystina	Amethyst Fruit Chafer
			Pedinorrhina plana	Yellow-belted Fruit Chafer
			Plaesiorrhinella trivittata	Fruit Chafer
			Phoxomeloides laticincta	Fruit Chafer
			Polystalactica furfurosa	Fruit Chafer
			Rhabdotis albinigra	Scarce Limpopo Fruit Chafer
		Buprestidae	*Agelia peteli*	Meloid-mimicking Jewel Beetle
			Sternocera orissa	Giant Jewel Beetle
		Meloidae	*Mylabris oculata*	CMR Beetle
			Decapotoma transvaalica	Transvaal Blister Beetle
		Curculionidae	*Polyclaeis equestris*	Pink-banded Weevil
	Lepidoptera	Nymphalidae	*Acraea neobule neobule*	Wandering Donkey Acraea
			Byblia ilithyia	Spotted Joker
			Charaxes jasius saturnus	Foxy Charaxes
			Danaus chryssipus orientis	African Monarch
			Hamanumida daedalus	Guinea-fowl Butterfly
			Hypolimnas missipus	Common Diadem
			Junonia hierta cebrene	Yellow Pansy
			Junonia oenone oenone	Blue Pansy
			Phalanta phalant ha aethiopica	African Leopard

			Precis archesia archesia	Garden Commodore
			Telchinia serena	Dancing Acraea
			Vanessa cardui	Painted Lady
		Lycaenidae	*Aloeides aranda*	Aranda Copper
			Axiocerses amanga amanga	Bush Scarlet
			Azanus moriqua	Black-bordered Babul Blue
			Chilades trochylus	Grass Jewel Blue
		Pieridae	*Belenois aurota*	Brown-veined White
			Belenois creona severina	African Common White
			Belenois gidica abyssinica	African Veined White
			Catopsilla florella	African Migrant
			Colotis evenina evenina	Orange Tip
			Colotis ione	Bushveld Purple Tip
			Colotis regina	Queen Purple Tip
			Eurema brigitta brigitta	Broad-bordered Grass Yellow
			Nepheronia buquetii buquetii	Buquet's Vagrant
			Pinacopteryx eriphia eriphia	Zebra White
		Papilionidae	*Papilio demodocus demodocus*	Citrus Swallowtail
			Papilio nireus lyaeus	Green-banded Swallowtail
		Hesperiidae	*Abantis tettensis*	Spotted Velvet Skipper
			Gegenes pumilio gambica	Dark Hottentot Skipper
	Diptera	Muscidae	*Musca domestica*	House Fly
	Hymenoptera	Formicidae	*Megaponera foetens*	Matabele Ant
		Formicidae	*Dorylus helvolus*	Red Driver Ant
Amphibia	Anura	Bufonidae	*Amietophrynus rangeri*	Raucous Toad
		Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina
		Microhylidae	*Phrynomantis bifasciatus*	Banded Rubber Frog
		Ptychadenidae	*Ptychadena mossambica*	Broad-banded Grass Frog
		Pipidae	*Xenopus laevis*	Common Platanna
		Pyxicephalidae	*Cacosternum boettgeri*	Boettger's Caco
			Pyxicephalus adspersus	**Giant Bullfrog**
			Tomopterna krugerensis	Knocking Sand Frog
		Rhacophoridae	*Chiromantis xerampelina*	Southern Foam Nest Frog
Reptilia	Testudines	Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise
		Pelomedusidae	*Pelomedusa subrufa*	Marsh Terrapin
	Squamata	Boidae	*Python natalensis*	Southern African Python

		Atractaspididae	*Aparallactus capensis*	Cape Centipede Eater
		Colubridae	*Lamprophis capensis*	Brown House Snake
			Psammophis subtaeniatus	Stripe-bellied Sand Snake
			Philothamnus semivariegatus	Spotted Bush Snake
			Thelotornis capensis	Twig Snake
		Elapidae	*Aspidelaps scutatus*	Shield-nose Snake
			Naja annulifera	Snouted Cobra
			Naja mossambica	M'fezi
			Dendroaspis polylepis	Black Mamba
		Viperidae	*Bitis arietans*	Puff Adder
		Scincidae	*Trachylepis striata*	Striped Skink
			Trachylepis varia	Variable Skink
		Lacertidae	*Heliobolus lugubris*	Bushveld Lizard
			Nucras intertexta	Spotted Sandveld Lizard
		Varanidae	*Varanus albigularis*	Rock Monitor
		Agamidae	*Acanthocercus atricollis*	Southern Tree Agama
		Chamaeleonidae	*Chamaeleo dilepis*	Flap-neck Chameleon
Aves	Struthioniformes	Struthionidae	*Struthio camelus*	Common Ostrich
	Galliformes	Numididae	*Numida meleagris*	Helmeted Guineafowl
		Phasianidae	*Peliperdix coqui*	Coqui Francolin
			Dendroperdix sephaena	Crested Francolin
			Pternistis natalensis	Natal Spurfowl
			Pternistis swainsonii	Swainson's Spurfowl
	Anseriformes	Dendrocygnidae	*Dendrocygna viduata*	White-faced Whistling Duck
		Anatidae	*Alopochen aegyptiaca*	Egyptian Goose
			Anas erythrorhyncha	Red-billed Teal
			Anas hottentota	Hottentot Teal
	Ciconiiformes	Podicipedidae	*Tachybaptus ruficollis*	Little Grebe
		Ciconiidae	***Ciconia nigra***	**Black Stork**
		Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis
			Platalea alba	African Spoonbill
		Ardeidae	*Ixobrychus sturmii*	Dwarf Bittern
			Nycticorax nycticorax	Black-crowned Night Heron
			Bubulcus ibis	Western Cattle Egret
			Ardea cinerea	Grey Heron
		Phalacrocoracidae	*Microcarbo africanus*	Reed Cormorant

	Falconiforme	Sagittariidae	***Sagittarius serpentarius***	**Secretarybird**
		Accipitridae	*Elanus caeruleus*	Black-winged Kite
			Milvus parasitus	Yellow-billed Kite
			Haliaeetus vocifer	African Fish Eagle
			Gyps africanus	**White-backed Vulture**
			Circaetus pectoralis	Black-chested Snake-Eagle
			Circaetus cinereus	Brown Snake Eagle
			Polyboroides typus	African Harrier-Hawk
			Melierax metabates	Dark Chanting Goshawk
			Melierax canorus	Pale Chanting Goshawk
			Micronisus gabar	Gabar Goshawk
			Accipiter badius	Shikra
			Accipiter minullus	Little Sparrowhawk
			Kaupifalco monogrammicus	Lizard Buzzard
			Buteo buteo	Common Buzzard
			Aquila rapax	**Tawny Eagle**
			Hieraaetus wahlbergi	Wahlberg's Eagle
			Polemaetus bellicosus	**Martial Eagle**
		Falconidae	***Falco naumanni***	**Lesser Kestrel**
			Falco rupicolus	Rock Kestrel
			Falco biarmicus	**Lanner Falcon**
	Gruiformes	Otididae	***Ardeotis kori***	**Kori Bustard**
			Lophotis ruficrista	Red-crested Korhaan
			Afrotis afraoides	Northern Black Korhaan
	Turniciformes	Turnicidae	*Turnix sylvaticus*	Kurrichane Buttonquail
	Charadriiformes	Burhinidae	*Burhinus capensis*	Spotted Thick-knee
		Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
		Charadriidae	*Vanellus armatus*	Blacksmith Lapwing
			Vanellus coronatus	Crowned Lapwing
			Charadrius tricollaris	Three-banded Plover
		Jacanidae	*Actophilornis africanus*	African Jacana
		Scolopacidae	*Tringa nebularia*	Common Greenshank
			Tringa glareola	Wood Sandpiper
			Actitis hypoleucos	Common Sandpiper
		Glareolidae	*Cursorius temminckii*	Temminck's Courser
			Rhinoptilus chalcopterus	Bronze-winged Courser

		Pteroclidae	*Pterocles bicinctus*	Double-banded Sandgrouse
			Pterocles burchelli	Burchell's Sandgrouse
	Columbiformes	Columbidae	*Columba guinea*	Speckled Pigeon
			Streptopelia semitorquata	Red-eyed Dove
			Streptopelia capicola	Ring-necked Dove
			Spilopelia senegalensis	Laughing Dove
			Turtur chalcospilos	Emerald-spotted Wood Dove
			Oena capensis	Namaqua Dove
	Psittaciformes	Psittacidae	*Poicephalus meyeri*	Meyer's Parrot
	Musophagiformes	Musophagidae	*Corythaixoides concolor*	Grey Go-away-bird
	Cuculiformes	Centropodidae	*Centropus burchellii*	Burchell's Coucal
		Cuculidae	*Clamator levaillantii*	Levaillant's Cuckoo
			Clamator jacobinus	Jacobin Cuckoo
			Chrysococcyx caprius	Diderick Cuckoo
			Chrysococcyx klaas	Klaas's Cuckoo
			Cuculus clamosus	Black Cuckoo
			Cuculus gularis	African Cuckoo
	Strigiformes	Tytonidae	*Tyto alba*	Western Barn Owl
		Strigidae	*Otus senegalensis*	African Scops Owl
			Bubo africanus	Spotted Eagle-Owl
			Glaucidium perlatum	Pearl-spotted Owlet
		Caprimulgidae	*Caprimulgus europaeus*	European Nightjar
			Caprimulgus rufigena	Rufous-cheeked Nightjar
			Caprimulgus pectoralis	Fiery-necked Nightjar
	Apodiformes	Apodidae	*Apus apus*	Common Swift
			Cypsiurus parvules	African Palm-Swift
			Apus affinis	Little Swift
			Apus caffer	White-rumped Swift
	Coliiformes	Coliidae	*Colius colius*	White-backed Mousebird
			Urocolius indicus	Red-faced Mousebird
	Coraciiformes	Coraciidae	*Coracias naevius*	Purple Roller
			Coracias caudatus	Lilac-breasted Roller
			Coracias garrulus	European Roller
		Dacelonidae	*Halcyon albiventris*	Brown-hooded Kingfisher
		Meropidae	*Merops hirundineus*	Swallow-tailed Bee-eater
			Merops pusillus	Little Bee-eater

			Merops bullockoides	White-fronted Bee-eater
			Merops persicus	Blue-cheeked Bee-eater
			Merops apiaster	European Bee-eater
	Upupiformes	Upupidae	*Upupa africana*	African Hoopoe
		Phoeniculdae	*Phoeniculus purpureus*	Green Wood-Hoopoe
		Rhinopomastidae	*Rhinopomastus cyanomelas*	Common Scimitarbill
	Bucerotiformes	Bucerotidae	*Tockus nasutus*	African Grey Hornbill
			Tockus rufirostris	Southern Red-billed Hornbill
			Tockus leucomelas	Southern Yellow-billed Hornbill
	Piciformes	Lybiidae	*Tricholaema leucomelas*	Acacia Pied Barbet
			Lybius torquatus	Black-collared Barbet
			Trachyphonus vaillantii	Crested Barbet
		Indicatoridae	*Indicator minor*	Lesser Honeyguide
			Indicator indicator	Greater Honeyguide
		Picidae	*Campethera bennettii*	Bennett's Woodpecker
			Campethera abingoni	Golden-tailed Woodpecker
			Dendropicos fuscescens	Cardinal Woodpecker
			Dendropicos namaquus	Bearded Woodpecker
	Passeriformes	Malaconotidae	*Batis molitor*	Chinspot Batis
			Prionops plumatus	White-crested Helmet-Shrike
			Malaconotus blanchoti	Grey-headed Bushshrike
			Chlorophoneus sulfureopectus	Orange-breasted Bushshrike
			Tchagra australis	Brown-crowned Tchagra
			Tchagra senegalus	Black-crowned Tchagra
			Dryoscopus cubla	Black-backed Puffback
		Laniidae	*Laniarius atrococcineus*	Crimson-breasted Shrike
			Nilaus afer	Brubru
			Urolestes melanoleucus	Magpie Shrike
			Eurocephalus anguitimens	Southern White-crowned Shrike
			Lanius collurio	Red-backed Shrike
			Lanius minor	Lesser Grey Shrike
			Lanius collaris	Common Fiscal
		Campephagidae	*Campephaga flava*	Black Cuckooshrike
		Oriolidae	*Oriolus larvatus*	Black-headed Oriole
		Dicruridae	*Dicrurus adsimilis*	Fork-tailed Drongo
		Monarchidae	*Terpsiphone viridis*	African Paradise Flycatcher

		Corvidae	*Corvus capensis*	Cape Crow
			Corvus albus	Pied Crow
		Paridae	*Parus niger*	Southern Black Tit
			Parus cinerascens	Ashy Tit
		Alaudidae	*Mirafra africana*	Rufous-naped Lark
			Calendulauda africanoides	Fawn-coloured Lark
			Calendulauda sabota	Sabota Lark
		Pycnonotida	*Pycnonotus nigricans*	African Red-eyed Bulbul
			Pycnonotus tricolor	Dark-capped Bulbul
		Hirundinidae	*Riparia paludicola*	Brown-throated Martin
			Hirundo rustica	Barn Swallow
			Cecropis cucullata	Greater Striped Swallow
			Hirundo abyssinica	Lesser Striped Swallow
			Cecropis semirufa	Red-breasted Swallow
		Cisticolidae	*Cisticola chiniana*	Rattling Cisticola
			Cisticola rufilatus	Tinkling Cisticola
			Cisticola fulvicapilla	Neddicky
			Prinia subflava	Tawny-flanked Prinia
			Prinia flavicans	Black-chested Prinia
			Camaroptera brevicaudata	Grey-backed Camaroptera
			Calamonastes fasciolatus	Barred Wren-Warbler
		Sylviidae	*Phylloscopus trochilus*	Willow Warbler
			Eremomela usticollis	Burnt-necked Eremomela
			Sylvietta rufescens	Long-billed Crombec
			Turdoides jardineii	Arrow-marked Babbler
			Turdoides bicolor	Southern Pied Babbler
			Sylvia subcaerulea	Chestnut-vented Tit-Babbler
		Zosteropidae	*Zosterops capensis*	Cape White-eye
		Sturnidae	***Acridotheres tristis***	**Common Myna**
			Creatophora cinerea	Wattled Starling
			Lamprotornis nitens	Cape Starling
			Lamprotornis australis	Burchell's Starling
			Cinnyricinclus leucogaster	Violet-backed Starling
			Onychognathus morio	Red-winged Starling
			Buphagus erythrorhynchus	**Red-billed Oxpecker**
		Muscicapidae	*Psophocichla litsipsirupa*	Groundscraper Thrush

			Turdus libonyanus	Kurrichane Thrush
			Erythropygia leucophrys	White-browed Scrub Robin
			Erythropygia paena	Kalahari Scrub Robin
			Cercomela familiaris	Familiar Chat
			Myrmecocichla formicivora	Ant-eating Chat
			Bradornis mariquensis	Marico Flycatcher
			Muscicapa striata	Spotted Flycatcher
		Nectariniidae	*Cinnyris mariquensis*	Marico Sunbird
			Cinnyris talatala	White-bellied Sunbird
		Passeridae	*Passer motitensis*	Great Sparrow
			Passer melanurus	Cape Sparrow
			Passer diffusus	Southern Grey-headed Sparrow
			Gymnoris supercilliaris	Yellow-throated Petronia
		Ploceidae	*Plocepasser mahali*	White-browed Sparrow-Weaver
			Bubalornis niger	Red-billed Buffalo-Weaver
			Sporopipes squamifrons	Scaly-feathered Weaver
			Ploceus velatus	Southern Masked Weaver
			Ploceus cucullatus	Village Weaver
			Anaplectes melanotis	Red-headed Weaver
			Quelea quelea	Red-billed Quelea
			Euplectes orix	Southern Red Bishop
		Estrildidae	*Pytilia melba*	Green-winged Pytilia
			Amadina erythrocephala	Red-headed Finch
			Amadina fasciata	Cut-throat Finch
			Lagonosticta senegala	Red-billed Firefinch
			Lagonosticta rhodopareia	Jameson's Firefinch
			Uraginthus granatinus	Violet-eared Waxbill
			Estrilda astrild	Common Waxbill
			Estrilda erythronotos	Black-faced Waxbill
		Viduidae	*Vidua chalybeata*	Village Indigobird
			Vidua macroura	Pin-tailed Whydah
			Vidua regia	Shaft-tailed Whydah
			Vidua paradisaea	Long-tailed Paradise Whydah
		Motacillidae	*Motacilla aguimp*	African Pied Wagtail
			Anthus cinnamomeus	African Pipit
		Fringillidae	*Crithagra atrogularis*	Black-throated Canary

			Crithagra mozambica	Yellow-fronted Canary
			Crithagra flaviventris	Yellow Canary
			Crithagra gularis	Streaky-headed Seedeater
			Emberiza tahapisi	Cinnamon-breasted Bunting
			Emberiza flaviventris	Golden-breasted Bunting
Mammalia	Insectivora	Macroscelididae	***Elephantulus intufi***	**Bushveld Elephant Shrew**
	Primates	Cercopithecidae	*Papio ursinus*	Chacma Baboon
			Cercopithecus aethiops	Vervet Monkey
	Pholidota	Manidae	***Manis temminckii***	**Ground Pangolin**
	Lagomorpha	Leporidae	*Lepus saxatilis*	Scrub Hare
	Rodentia	Sciuridae	*Paraxerus cepapi*	Tree Squirrel
		Bathyergidae	*Cryptomys hottentotus*	Common Mole-rat
		Pedetidae	*Pedetes capensis*	Springhare
		Hystricidae	*Hystrix africaeaustralis*	Porcupine
		Muridae	*Saccostomys campestris*	Pouched Mouse
			Tatera leucogaster	**Bushveld Gerbil**
			Aethomys chrysophilus	Red Veld Rat
			Mus minutoides	Pygmy Mouse
			Mastomys coucha	Multimammate Mouse
	Carnivora	Felidae	*Caracal caracal*	Caracal
			Acinonyx jubatus	**Cheetah**
			Felis silvestris	Wildcat
		Viverridae	*Civettictis civetta*	African Civet
			Genetta genetta	Common Genet
		Hyaenidae	*Proteles cristata*	Aardwolf
			Parahyaena brunnea	**Brown Hyaena**
		Herpestidae	*Galerella sanguinea*	Common Slender Mongoose
			Mungos mungo	Banded Mongoose
		Canidae	*Canis mesomelas*	Black-backed Jackal
			Otocyon megalotis	Bat-eared Fox
		Mustelidae	***Mellivora capensis***	**Honey Badger**
	Perissodactyla	Equidae	***Equus asinus***	**Donkey**
			Equus quagga	Plains Sebra
	Artiodactyla	Suidae	*Phacochoerus africanus*	Common Warthog
			Potamochoerus larvatus	Bushpig
		Bovidae	*Syncerus caffer*	Cape Buffalo

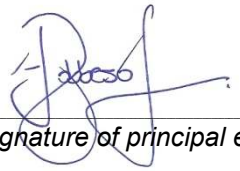
			Nyala angasii	Nyala
			Tragelaphus sylvaticus	Cape Bushbuck
			Strepsiceros zambesiensis	Zambezi Kudu
			Taurotragus oryx	Common Eland
			Aepyceros melampus	Common Impala
			Raphicerus campestris	Steenbok
			Kobus ellipsiprymnus	Ellipsen Waterbuck
			Hippotragus niger	**Southern Sable Antelope**
			Oryx gazella	Gemsbok
			Alcelaphus caama	Red Hartebeest
			Damaliscus phillipsi	Blesbok
			Damaliscus lunatus	**Western Tsessebe**
			Connachaetus taurinus	Blue Wildebeest
			Sylvicapra grimmia	Bush Duiker
		Giraffidae	*Giraffa camelopardalis*	Giraffe

15 APPENDIX 3: 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; and
- 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:

9th August 2013

Date:

16 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 24: Legislative guidance for this project

National Environmental Management: Biodiversity Act (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.
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.

Table 24: Legislative guidance for this project	
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 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"

17 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 site alternatives. 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 site alternatives was conducted between the 5th and 9th November 2012.

17.1 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 site alternatives and how this relates to the suitability/ unsuitability of the respective site alternatives 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 immediate region;
- Highlight flora and fauna species of conservation importance that are likely to occur within the immediate region;
- Estimate the level of potential impacts of the construction, operation and decommissioning of the proposed development on the biological resources of the immediate region; and
- Apply the Precautionary Principal throughout the assessment[6].

17.2 FLORISTIC ASSESSMENT

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

17.2.1 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.

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

17.2.2 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 site alternatives. 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 **(NO)**;
  - centres of endemism **(NO)**;
- Important Ecological Processes, including:
  - Corridors **(YES)**;
  - Mega-conservancy networks (**NO)**;
  - Rivers and wetlands **(YES)**; and
  - Important topographical features **(NO)**.

17.3 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 larger region. 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 site alternatives as well as the biodiversity contribution of the respective site alternatives within a larger topographical context.

17.3.1 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 were twofold, including:

- Firstly, sweepnet sampling bouts of invertebrates were used to compare sample plots in terms of species richness (number of species) and species diversity (relative abundances between species groups). Species found in these samples were also included in the species inventory; and
- Secondly, a species inventory of the site alternatives was compiled using above-mentioned methods as well as active searches for scorpions (under rocks and using UV-lights), for butterflies (using a hand-held net) and beetles (under rocks, bark, hand-netting, etc.).

17.3.2 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.)

17.3.3 Birds

Recording the avifaunal diversity of the site alternatives 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 habitat 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 areas.

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 areas (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 area in assessing the impacts of the proposed project on the avifaunal component of the site alternatives.

17.3.4 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 site alternatives.

17.3.5 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 site alternative/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 site alternatives and the potential impacts of the study area/s.

17.3.6 Faunal Sensitivity

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

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

17.4 IMPACT EVALUATION

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

Occurrence:

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

Severity:

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

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

Table 25: EIA Ratings used in this assessment

Extent	Duration	Intensity	Probability
4 - National	4 - Permanent	4 - Very High	4 - Definite
3 - Regional	3 - Long term (operational)	3 - High	3 - Highly Probable
2 - Local	2 - Medium term (5-15 years)	2 - Moderate	2 - Possible
1 - Site only	1 - Short Term (0-5 years)	1 - Low	1 - Improbable

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 + probability

The maximum value is 16 significance points (SP). Environmental effects were rated as either of high, moderate or low significance on the following basis:

- More than 13 SP indicate Very High (H) environmental significance.
- Between 10 and 12 SP indicate High (H) environmental significance.
- Between 7 and 9 SP indicate Moderate (M) environmental significance.
- Between 4 and 6 SP indicate Low (L) environmental significance.
- Less than 4 SP indicate Very Low (L) environmental significance.

18 APPENDIX 6: 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 site alternatives 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 site alternatives.
- 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.

19 APPENDIX 7: PERMIT APPLICATIONS

Protected Trees

Permit applications for the removal / relocation of protected trees in terms of NFA must be directed to the Department of Agriculture Forestry and Fisheries Affairs and Forestry (DAFF):

DWAF website: http://www.dwaf.gov.za/Forestry/PTlicence.asp

Protected Plants

The removal or relocation of protected plants in terms of LEMA is subjected to authorisation (permits) from the Limpopo Department of Economic Development, Environment and Tourism:

CITES and Permit Management
Department of Economic Development, Environment and Tourism
Limpopo
P.O.Box 55464
POLOKWANE
0700

Tel: 015 290 7000
Fax: (015) 295-5018

E-mail: Permits@Ledet.gov.za or
Rosa Moloto: MolotoMR@Ledet.gov.za

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BIODIVERSITY: RECOMMENDATION FOR OFFSITE MITIGATION STRATEGY

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To Whom It May Concern:

Brief comments pertaining to Biodiversity Offsite Mitigation Strategy for the proposed Matimba Ash Project, Lephalale

Results of the principal biodiversity assessment[1] indicated the sensitivity of parts of the proposed site in terms of local biodiversity attributes. Two major impacts were identified as crucial for the project, namely the loss of sensitive habitat types and the loss of a significant number of protected tree species.

The principal ecological report concluded that habitat types spatially situated within the proposed site (Alternative 1) exhibit botanical and faunal attributes of medium-high sensitivity, particularly some of the woodland communities. The inherent sensitivity of these woodland communities is a direct result of limited local and regional distribution patterns. Based on these outcomes, Site Alternative 2 was recommended as the preferred site for development purposes since:

1. No sensitive habitat was recorded within Site Alternative 2; and
2. The number of protected tree species was significantly lower, compared to Site Alternative 1.

The use of Site Alternative 2 would therefore effectively have prevented significant impacts on sensitive habitat types. However, technical constraints of Site Alternative 2 did not render this option feasible and Alternative 1 was subsequently put forward as the preferred site for the project. Based on this, recommended mitigation measures included the exclusion of sensitive habitat types. However, air space requirements and technical requirements for the project precluded the implementation of these mitigation measures and the (irreversible) loss of these sensitive habitat types is therefore implied.

It was also concluded that a significant number of protected trees will be adversely affected (removed) for the purpose of constructing and operation of the ash facility. Six protected species were recorded on the site, of which *Spirostachys africana* (Tamboti) occurs in significant numbers on the site. The need to conduct a detailed assessment to determine the numbers of trees that will be affected during land clearance operations were highlighted. Permits for the removal of protected trees need to be directed to the Department of Agriculture Forestry and Fisheries Affairs and Forestry (DAFF). The removal or relocation of protected plants in terms of LEMA is also subjected to authorisation (permits) from the Limpopo Department of Economic Development, Environment and Tourism (LEDET).

[1] Biodiversity Impact Assessment of the Proposed Continuous Ash Disposal Facility & Linear Infrastructure Route for Matimba Power Station, Limpopo Province, Reference RHD-MCA-20147/08 (Version 2014.07.18.5)

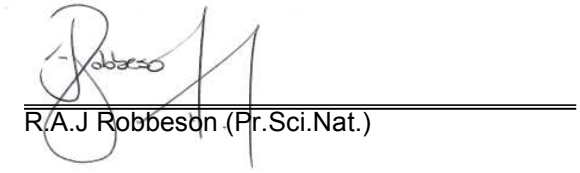
It is the conclusion of assessments that the loss of sensitive habitat within the proposed site is therefore unavoidable and impossible to mitigate against. Spatial and temporal impacts will therefore be unavoidable, permanent and irreversible.

It was ultimately recommended to implement an offsite mitigation intervention strategy, of which the major objective would be to improve biodiversity conservation and management on a local and regional scale. Various brief and informal discussions surrounding this were held and a number of potentially viable options were identified during high level discussions. It was, however, decided that details of such a plan should form part of a subsequent phase, subjected to the approval by authorities, *i.e.* a post authorisation requirement.

Ideally, the implementation of the offsite mitigation strategy should be executed prior to the commencement of the construction phase of the project.

We trust that these comments will clarify some of the issues surrounding the identification, assessment and implementation of an offsite biodiversity strategy for the proposed Matimba Ash Project. Should you have any further comments or queries regarding this, feel free to contact our offices immediately

Thank you kindly,



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