THE PROPOSED MEDUPI LANDFILL SITE

TERRESTRIAL ECOLOGICAL SITE SELECTION AND SCOPING PROCESS

Prepared for:

Envirolution Consulting

Unit 25 Sunninghill Office Park
4 Peltier Road
Sunninghill
2157

Tel: (011) 844 4999
Fax: (011) 234 0007

Compiled by:

Lukas Niemand Pr.Sci.Nat.
Pachnoda Consulting cc

88 Rubida Street
Murrayfield X1
Pretoria

Tel: (012) 365 2546
Fax: (012) 365 3217

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1. INTRODUCTION

The increase in human demand for space and life-supporting resources resulted in a rapid loss of natural open space in South Africa. When natural 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). Additionally, development rarely focussed on decisive planning to conserve natural environments, while little thought was given to the consequences on the ecological processes of development in highly sensitive areas.

Transformation and fragmentation are not the only results of unplanned and intended developments, the loss of ecosystem functioning and ultimately the local extinction of species can also result. Therefore, careful planning will not only preserve rare and endemic fauna and flora, but also the ecological integrity of ecosystems of the landscape level which is imperative for the continuation of natural resources, such as fossil fuels, water and soils with agricultural potential.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. The enactment of the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

1.1 Background

Pachnoda Consulting cc was appointed by Envirolution Consulting (Pty) Ltd as an independent ecological specialist to evaluate the ecological importance and function on four (4) selected sections of the Farm Grootvallei 515 LQ and a site located within the limits of the Matimba power station (on the Farm Grootestryd 465 LQ) for the proposed Medupi Landfill EIA located near Lephalale, Limpopo Province (Figure 1).

This document follows on results obtained during a three day site visit (17-18 November 2008 and 16 January 2008) with the main objective to provide a series of site selection criteria and to undertake a scoping level study on areas of potential developmental suitability from a terrestrial ecological perspective.

1.2 Terms of Reference

The main aim of this document is to investigate the ecological attributes of 5 study sites by means of a desktop analysis of GIS based information.

The terms of reference for this assessment are to:

- conduct an assessment of available information pertinent to floristic and biophysical attributes of the proposed sites;
- conduct an assessment of all information on a scoping level in order to present the following results:
    - typify the regional vegetation that will be affected by the proposed development;
    - highlight areas of sensitivity;
    - highlight gaps of information in terms of the ecological environment;
    - recommend further studies to be conducted as part of the Environmental Impact Assessment (EIA) phase.

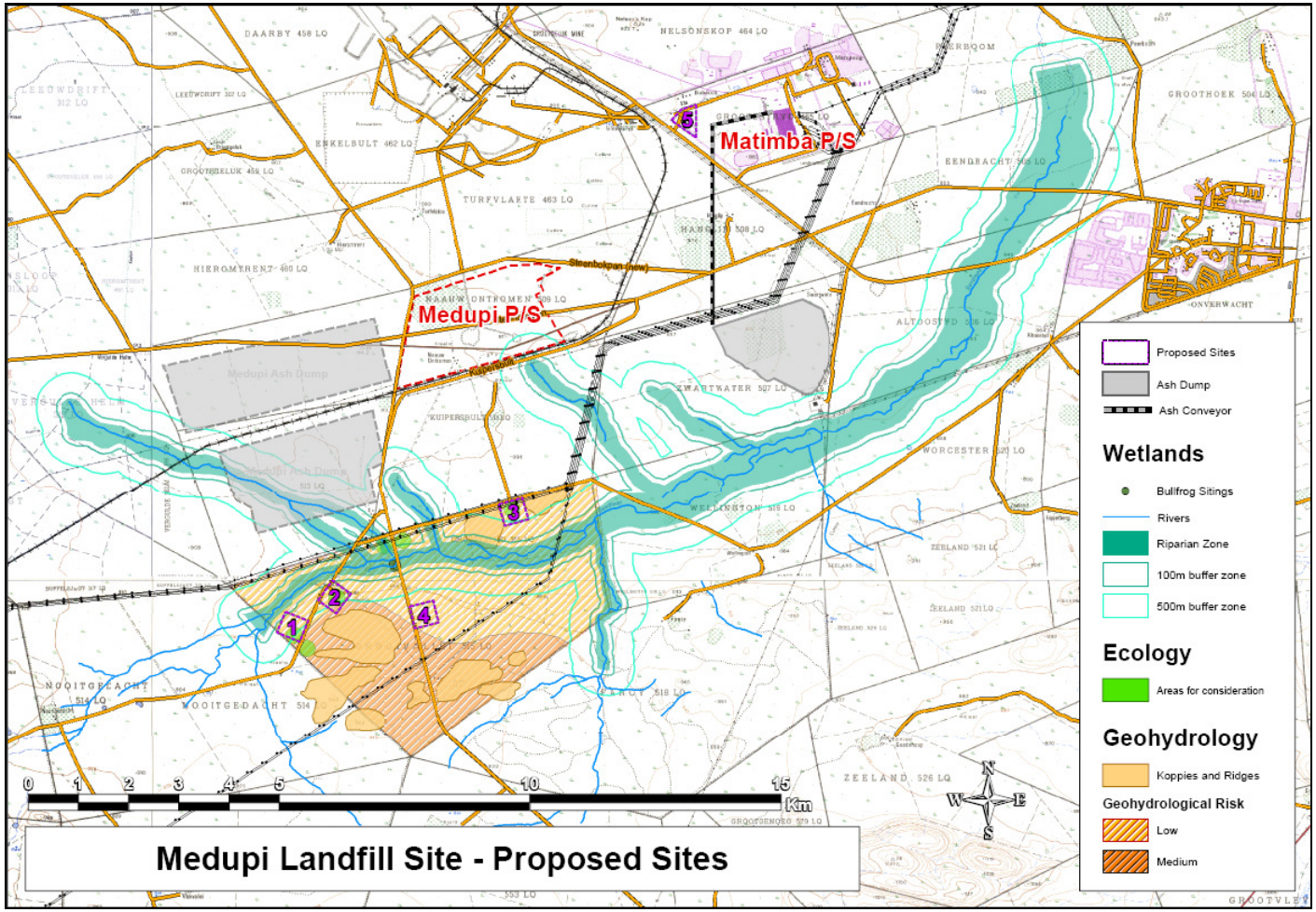

Figure 1: A locality map illustrating the geographic position of the proposed sites selected for the Medupi Landfill (Map obtained from Envirolution Consulting).

2. METHODOLOGY

The site selection assessment was a combined desktop and field survey approach. The desktop assessment was based on aerial photographs, topographical map interpretations and a number of GIS-based databases, while a short field survey was restricted to selected areas identified by the client.

The GIS-based databases of available biotic and biophysical attributes were as follows:

- Regional vegetation (Mucina and Rutherford, 2006);
- Land cover classes;
- Relief (20 m contour interval);
- Wetlands, rivers, drainage lines and other impoundments;
- Protected and conservation areas;
- Settlement and transformed areas.

These databases were also utilised to identify areas that constitute:

- natural vegetation;
- areas of environmental sensitivity (e.g. outcrops and wetland systems);
- areas likely to sustain high numbers of threatened, “near-threatened” and endemic taxa; and
- protected areas.

The likely occurrence of threatened, “near-threatened” and conservation important faunal and floral taxa were included based on the presence of suitable habitat and through various field guides and atlases. In addition, historical distribution records (when available) were also consulted.

Therefore, the probability of occurrence of conservation important taxa (both flora and fauna) was based on their respective geographical area of occupancy (rather than the extent of occupancy) and habitat suitability. In other words, *high* would be applicable to a species with an area of occupancy sympatric (within) with the geographic locality of the study site as well as the presence of suitable habitat occurring on the study site. *Medium* would pertain to a species whose area of occupancy is marginal to the study site OR its preferred habitat was found to be peripheral to the study site (in the case of distribution, the extent of occurrence of the species may well be sympatric with the study site locality). Lastly, a *low* probability of occurrence would mean that the species’ area of occupancy is peripheral to the study site AND habitat was found to be unsuitable.

Information gleaned from both the desktop assessment and field surveys was collated into a selection scoring approach. The sensitivity categories were arranged in three classes based on the following criteria:

- *Fragmented habitat*. Areas being isolated or traversed by existing or planned linear infrastructures (e.g. hard-surfaced roads, dirt roads, power lines, conveyer belts, railway lines) or are encroached by urban, mining and industrial development (e.g. ash dumps, stock piles, power stations, residential development, and discard dumps). Disturbances such as vegetation clearing, soil surface disturbances, and excavations were considered.
- *Intact vegetation*. These include areas within low disturbance regimes with a continuous vegetation canopy, in this case associated with savanna tree elements. The criteria were based on the relative homogenous structure and composition of the local vegetation type, which dominates the investigated landscape.
- *Features of ecological importance*. Typical examples include areas that qualify as intact vegetation, but with the additional occurrence of natural landscape features that contribute to ecological process and function (based on landscape ecological principles). These include drainage lines, pans, outcrops and ridges. Important ecological processes associated with these landscape features would include: dispersal corridors, areas contributing to evolutionary processes, habitat heterogeneity contributing to higher species diversity and niche differentiation. In addition, consideration was also given to areas likely to support high faunal and floristic diversities including the presence of threatened, endemic or “near-threatened” species. **This is regarded as the most sensitive site selection category**.

All five study sites were being assessed in terms of the abovementioned criteria according to an intensity scale ranging from 0 to 2. Low scoring values represent areas of higher sensitivities (e.g. presence of ecologically important features), and higher scoring values with lower environmental sensitivities (e.g. high level of habitat fragmentation). Through this process a qualitative rating was achieved. Please take note that these values are consequently influenced by subjectivity in the scoring process, due to the nature of the scoping process (lack of quantifiable data acquisition). The outcome of detailed data collection and analyses may indicate a different site rating. However, the perceived sensitivity rating is regarded as best possible means to highlight the associated ecological risk of each investigated area based on current understanding and available information.

2.1 Limitations

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

Therefore, due to the scope of the work presented in this assessment, a detailed investigation of all, or part of, the proposed sites were not possible and are not perceived as part of a scoping exercise. It should be emphasised that information, as presented in this document, only has reference to the study area(s) as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

Furthermore, additional information may come to light during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

3. RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Regional Vegetation Description

The study sites correspond to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006). The proposed development comprehends an ecological type known as (a) Limpopo Sweet Bushveld while also proving strong affinities with the (b) Western Sandy Bushveld (Figure 2 and Table 1).

(a) Limpopo Sweet Bushveld: This vegetation type extends from the lower reaches of the Crocodile and Marico Rivers down to the Limpopo River valley and into Botswana on the other side of the border. It is predominantly located on extensive plains that are irregularly interspersed by tributaries of the Limpopo River. It is a short, open woodland dominated by *Acacia mellifera* and *Dichrostachys cinerea* as well as taller tree species such as *A. erioloba*, *A nigrescens* and *Terminalia sericea*.

The high palatability of the graminoid composition makes this vegetation type very suitable for game farming practices. The Limpopo Sweet Bushveld is Least Threatened and extensive in geographic coverage. It is however poorly conserved (e.g. D'Nyala Nature Reserve) even though it straddles many privately owned game farms. It is transformed by cultivation, but future threats include the mining of coal.

(b) Western Sandy Bushveld: Based on Mucina & Rutherford (2006), it was evident that this ecological type did not physically correspond to study area. However, preliminary field surveys have found that the floristic compositions observed on the study site conform to the Western Sandy Bushveld as evidenced by the dominance of *Combretum apiculatum, Terminalia sericea, Grewia flava, G. bicolor* and *Eragrostis pallens*, especially on the farm Grootvallei.

This vegetation type is typical of the sandy flats and undulating plains west of the Waterberg Mountains and north towards Steenbokpan. The vegetation structure varies from a tall, open canopy to low woodland dominated by broad-leaved and microphyllous species on soils underlain by arenite and sandstone. Noteworthy species include *Acacia erubescens* and *Combretum apiculatum*, with *Terminalia sericea* on areas comprising of deep sandy soils.

The Western Sandy Bushveld is also Least Threatened with about 6 % statutorily conserved in the Marakele National Park.

Table 1: A list of the characteristic plant species for each stratum (e.g. grass, forb & woody layer) representing Limpopo Sweet Bushveld and Western Sandy Bushveld (Mucina & Rutherford, 2006).

Limpopo Sweet Bushveld		
Grassy Layer	**Forb Layer**	**Woody Layer**
Digitaria eriantha subsp. *eriantha, Enneapogon cenchroides, Eragrostis lehmanniana, Panicum coloratum, Schmidtia pappophoroides, Aristida congesta, Cymbopogon nardus, Eragrostis pallens, Eragrostis rigidior, Eragrostis trichophora, Ischaemum afrum, Panicum maximum, Setaria vertcillata, Stipagrostis uniplumis, Urochloa mosambicensis.*	***Succulents**: Kleinia fulgens, Plectranthus neochilus* ***Non-succulents**: Acanthosicyos naudini* subsp. *transvaalense, Hemizygia elliottii, Hermbstaedtia odorata, Felicia muricata, Indigofera daleoides.*	***Trees**:Acacia robusta, Acacia burkei, Acacia erubescens, Acacia fleckii, Acacia nilotica, Acacia senegal var. rostrata, Albizia anthelmintica, Boscia albitrunca, Combretum apiculatum, 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, Gymnosporia senegalensis.* ***Low shrubs**: Acacia tenuispina, Commiphora africana, Gossypium herbaceum* subsp. *africanum, Leucosphaera bainesii.*
Western Sandy Bushveld		
Grassy Layer	**Forb Layer**	**Woody Layer**
Anthephora pubescens, Digitaria eriantha subsp. *eriantha, Eragrostis pallens, Eragrostis rigidior, Schmidtia pappophoroides, Aristida congesta, Aristida diffusa, Aristida stipitata* subsp. *graciliflora, Eragrostis superba, Panicum maximum, Perotis patens.*	*Blepharis integrifolia, Chamaecrista absus, Evolvulus alsinoides, Geigeria burkei, Kyphocarpha angustifolia, Limeum fenestratum, Limeum viscosum, Lophiocarpus tenuissimus, Monsonia angustifolia, Clerodendrum ternatum, Indigofera filipes, Justicia flava.*	***Trees**: Acacia erioloba, Acacia nigrescens, Sclerocarya birrea* subsp. *caffra, Acacia erubescens, Acacia mellifera* subsp. *detinens, Acacia nilotica, Acacia tortilis* subsp. *heteracantha, Combretum apiculatum, Combretum imberbe, Terminalia sericea, Combretum zeyheri, Lannea discolor, Ochna pulchra, Peltophorum africanum.* ***Tall shrubs**: Combretum hereroense, Euclea undulate, Coptosperma supra – axillare, Dichrostachys cinerea, Grewia bicolor, Grewia flava, Grewia monticola.*

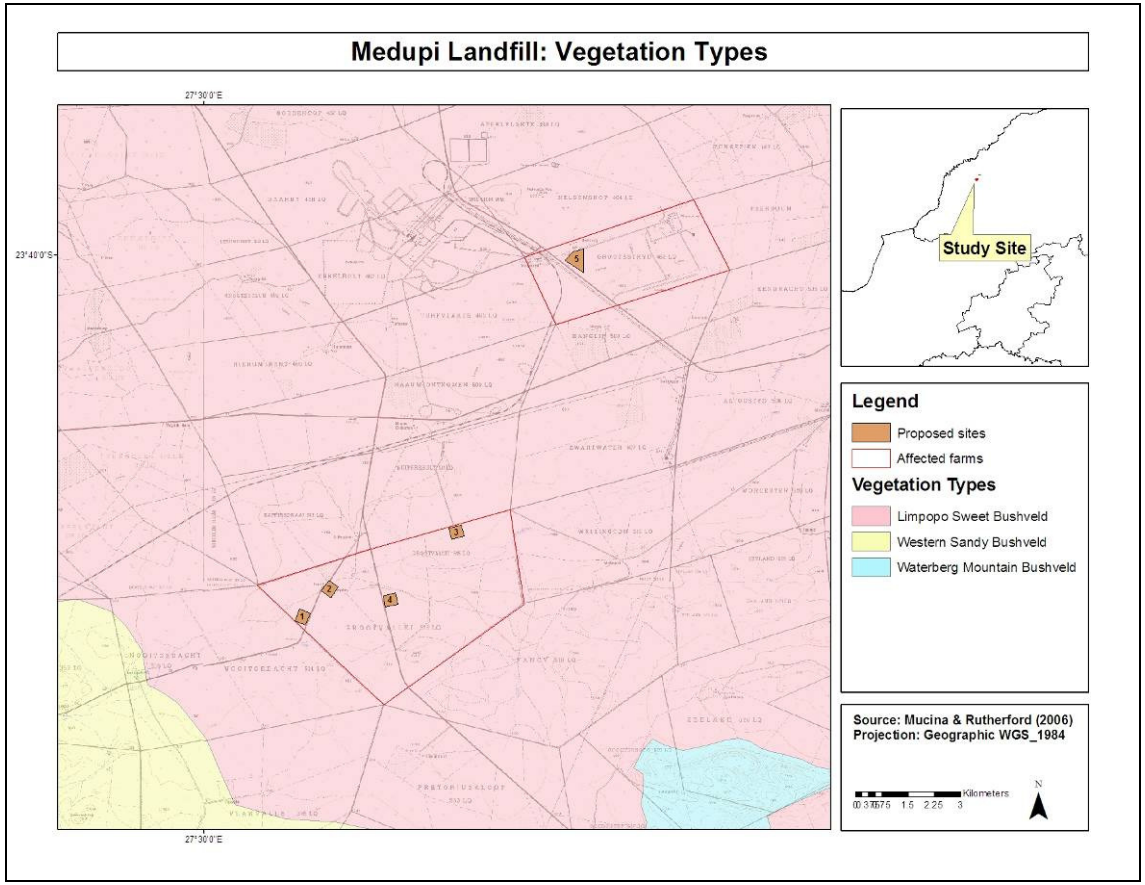

Figure 2: A map illustrating the regional vegetation types associated with the study sites. Vegetation type categories were chosen according to Mucina & Rutherford (2006).

3.2 Local Vegetation Description

3.2.1 Site 1

Site 1 is located on the western boundary of the farm Grootvallei and corresponds to a 500 m riparian buffer zone of the Sandloop River. It conforms to a *Combretum apiculatum – Eragrostis pallens* woodland, a dominant woodland alliance in the region, which is markedly very similar in composition to the Western Sandy Bushveld (Figure 3). However, the presence of both *Acacia grandicornuta* and *Spirostachys africana* also refer to an association with clayey soil conditions.

The floristic composition consists of a distinct canopy of *Combretum apiculatum* and *Dichrostachys cinerea* with a shrub layer dominated by *Grewia flavescens*. The forb layer comprises of *Indigofera nebrowniana, Pavonia senegalensis* and *Oxygonium dregeanum.* The graminoid layer was sparse and consisted of *Eragrostis pallens*, *E. rigidior, Schmidtia pappophoroides* and *Brachiaria nigropedata*.

This site is transitional to compositions typical of sandy and clayey soils as evidenced by the occurrence of both broad-leaved woodland and the presence of *Spirostachys africana* and microphyllous species. The presence of *Dichrostachys cinerea* is probably related to past disturbance events (e.g. grazing and trampling by cattle).

Figure 3: Part of Site 1 near the western boundary of the farm Grootvallei.

3.2.2 Site 2

Site 2 is located on the western part of the farm Grootvallei and consists of an old defunct farmstead, borehole and cattle kraal (Figure 4). It conforms to an area, which was previously subjected to human-induced activities and subsequently dominated by *Acacia tortilis* and *Urochloa mosambicensis*. The woody layer, apart from the dominance of *A. tortilis*, consists of large relictual tree species such as *Boscia foetida, Ziziphus mucronata* and *Spirostachys africana*. The herbaceous and graminoid layer comprise of many annual weed and pioneer species such as

Schkuhria pinnata, *Solanum panduriforme* and *Commelina benghalensis*. Based on the floristic composition, it appears that the study site is suitable for the proposed development although the risk of groundwater contamination exist due to the presence of a borehole. This site also corresponds to the 500 m riparian buffer along the Sandloop River (as evidenced by the occurrence of *Spirostachys africana*)

Figure 4: Site 2 showing a defunct farmstead and *Acacia tortilis* encroachment.

3.2.3 Site 3

Site 3 is located on the northern boundary of the farm Grootvallei and corresponds to deep sandy soils. It is very similar in composition to the Western Sandy Bushveld (Figure 5). It can be described as a *Terminalia sericea – Acacia nigrescens* woodland with a dense basal cover comprising of *Eragrostis pallens*. Other noteworthy woody species include *Combretum apiculatum, Sclerocarya birrea* subsp. *caffra*, *Pterocarpus rotundifolius* and *Grewia* spp. Typical graminoid and herbaceous taxa include *Aristida stipitata*, *Schmidtia pappophoroides, Eragrostis rigidior* and *Indigofera daleoides.*

The tall canopy constituents (e.g. *A. nigrescens*) are considered important since they provide essential breeding platforms for large bird of prey species.

Figure 5: Site 3 along the northern boundary of the farm Grootvallei, illustrating the presence of tall *Acacia nigrescens* trees.

3.2.4 Site 4

Site 4 is located on the central part of the farm Grootvallei and corresponds to deep sandy soils. It is essentially a mixed *Combretum apiculatum – Eragrostis pallens* woodland comprising of a species rich woody layer (Figure 6). Other noteworthy woody species include *Grewia flavescens*, *Sclerocarya birrea* subsp. *caffra, G. flava, Acacia nigrescens* and *Terminalia sericea*. The basal layer comprises of the graminoid *Eragrostis pallens*, and a rich fob layer consisting of many genera of the families Fabaceae (*Indigofera daleoides, Tephrosia purpurea*), Sterculiaceae (*Melhania rehmannii, M. prostrata*) including *Clerodendrum ternatum, Kyllinga alba*, and *Hibiscus* spp.

The floristic composition of Site 4 was more diverse in comparison to the other sites. It was particularly rich in woody species, which showed a high similarity to both the Western and Central Sandy Bushveld regional types. Although high in species richness, it was regionally well represented on other areas outside the study area.

Figure 6: The floristic structure and composition of Site 4 on the central section of the farm Grootvallei.

3.2.5 Site 5

Site 5 is located within the boundaries of the Matimba power station, and corresponds to an area that was previously utilised as a landfill site. It is essentially an open *Grewia monticola* woodland of which the basal layer was dominated by secondary graminoid taxa such as *Urochloa mosambicensis*, *Enneapogon cenchroides* and *Cenchrus ciliaris* (Figure 7). The latter species was established during the rehabilitation of the former landfill site. Other noteworthy woody species include *Combretum apiculatum*, *Acacia mellifera, Terminalia sericea*, *Grewia flava* and *Acacia tortilis*. Typical forb species include *Indigofera daleoides, Tephrosia purpurea, Waltherica indica* and *Melhania prostrata*.

Apart from being transformed, the composition is typical of the regional vegetation type and comprises of a number of tree species protected by national legislation (e.g. *Acacia erioloba, Sclerocarya birre*a and *Boscia albitrunca*). However, these occurred as individuals (as opposed to populations) within a confined (or enclosed) area. Secondly, these tree species are all regionally widespread on farms adjacent to the Matimba power station. Although it is anticipated that some individuals of these (if not all) are likely to become lost or removed during the construction phase, effort should be put in place to conserve at least the tall specimens of *Acacia erioloba.*

Figure 7: The floristic structure and composition of Site 5 on the western section of the Matimba power station.

3.3 Geology & Soils

Although geology was never really considered to be an important factor contributing towards faunal community structure, it does play a major role in segregating floral communities. Of even more importance is the relationship between certain geological formations and plant compositions in explaining areas with high floristic endemism and richness (so-called centres of endemism). Therefore, the arenite outcrops and clayey soils (on the Farm Grootvallei) are likely to be associated with different vegetational compositions than the surrounding sandy bushveld (e.g. the dominance of *Croton gratissimus* and *Diplorhynchus condylocarpon* on outcrops and *Spirostachys africana* bush clumps on clay).

The proposed sites are underlain by the following geological formations and lithologies (Figure 8):

- Site 1 & 2: Shale, arenite, mudstone and coal of the Karoo Supergroup (Phanerozoic Erathem);
- Site 3 & 4: Arenite and conglomerate of the Waterberg Group (Mokolian Erathem) and
- Site 5: Shale, arenite, mudstone and coal of the Karoo Supergroup (Phanerozoic Erathem).

Weathering of arenite and shale give rise to deep sandy, freely-drained soils (mainly Clovelly and Hutton forms), which is responsible for the formation of broad-leaved woodland associations. The arenite outcrops (mainly located on the central part of Grootvallei) support shallow soils of the Mispah and Glenrosa forms.

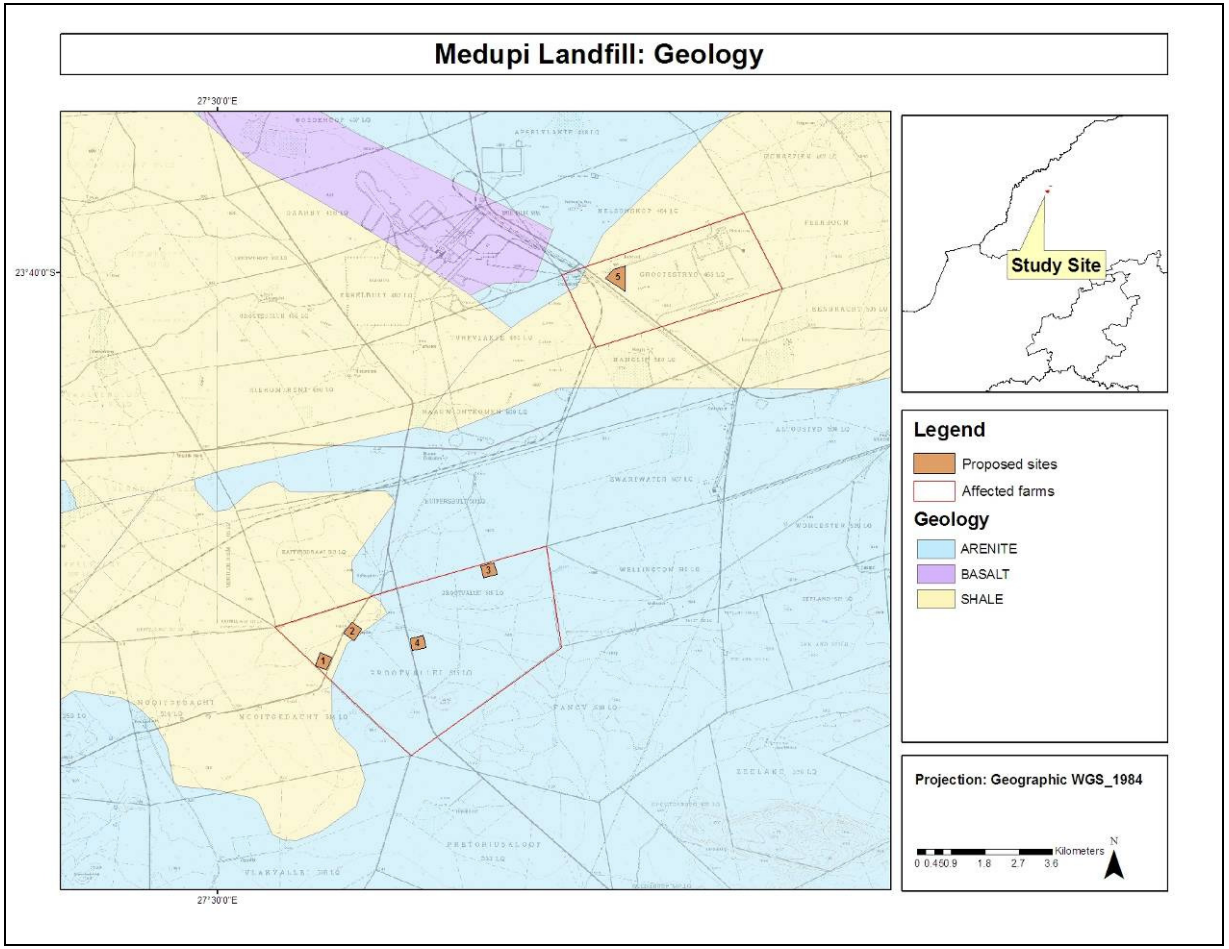

Figure 8: A map illustrating the regional geology and lithologies associated with the study sites.

3.4 Topography, Landform and Slope

An analysis of the topography and landform revealed that the majority of the sites correspond to extensive plains. However, a number of arenite “koppies” and ridges occur in close proximity to some of the sites (especially Site 2 & 3) located on the farm Grootvallei. These ridges are especially important since they provide for high spatial heterogeneities, thereby likely to sustain populations of conservation important plant and faunal species.

From a functional point of view, these hills and ridges are important landscape features assisting winged invertebrates in locating potential mating partners. On a landscape scale, these outcrops facilitate animal dispersal to other areas of suitable habitat (so-called “stepping stones”) and thereby function as important ecological linkages. In addition, the faunal populations colonising these patches of outcrops provide a balance through recruitment of individuals (e.g. immigration-emigration) among these patches, thereby maintaining meta-populations dynamics.

3.5 Conservation & Protected Areas

None of the sites will affect any conservation or protected area. The nearest conservation area, D’Nyala Nature Reserve, is approximately 12.5 km east of the Matimba power station. However, many of the surrounding farms are utilised as game and hunting farms, including Grootvallei, and support high abundances of free-roaming game (e.g. Impala, Warthog and Kudu).

3.6 Land Cover

The various land cover classes within the database were combined to represent the following (Figure 9):

Natural areas:

- Thicket & Bushland;
- Woodland;
- Water bodies & Wetlands; and
- Degraded Thicket & Bushland or Degraded Woodland.

Transformed areas:

- Cultivated land;
- Exotic plantations;
- Built-up land; and
- Mines and quarries.

From the land cover analysis, the Grootvallei farm (Sites 1-4) corresponds to woodland. Site 5 corresponds to woodland subjected to transformation by mines and quarries (e.g. Matimba power station).

3.7 Wetlands, rivers, drainage lines and impoundments

Both Site 1 and 2 are located within the 500 m buffer zone of the seasonal Sandloop River (see Figure 1). Of more importance is the sodic soil conditions pertaining to both sites as evidenced by the occurrence of a low basal cover of herbaceous vegetation and a predominance of microphyllous woody species (e.g. *Acacia grandicornuta, A. mellifera* and *A. tortilis*). In a number of cases, these sodic soils were responsible for the formation of near-homogenous stands of Tamboti trees (*Spirostachys africana*).

In addition, the sodic soils also provide essential focal congregation points for many game species. These soils are relatively high in mineral and clay content, which enhance the grazing capacity tremendously on these systems. Secondly, the *Acacia* thornveld and floodplain areas associated with the nearby drainage lines increase local faunal diversity through the provision of ephemeral foraging habitat (utilised by certain wader bird species) and surface water in an otherwise climatically arid region.

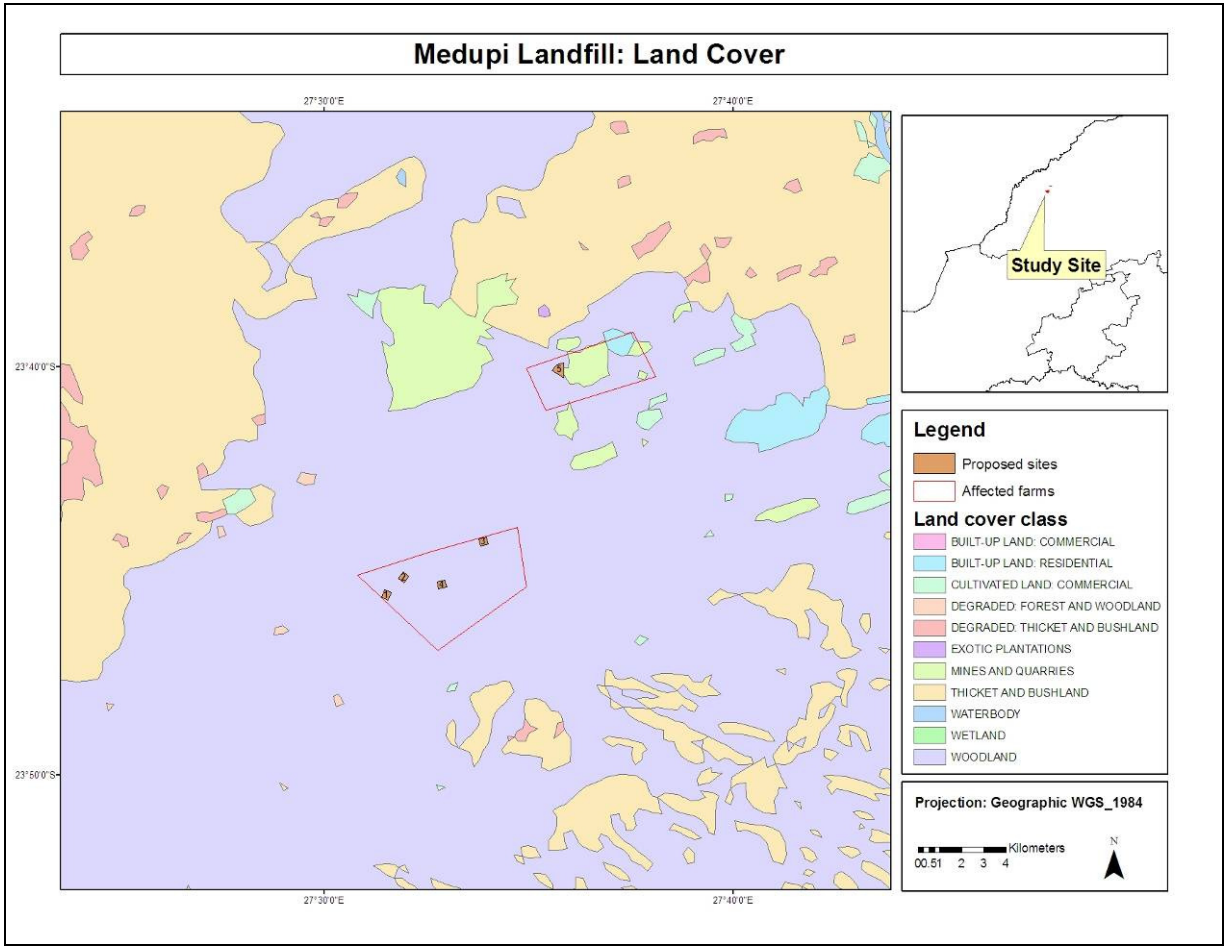

Figure 9: A map illustrating the land cover classes corresponding to the proposed study sites.

3.8 Red Listed, Biogeographically Important, Endemic and Protected Plant Taxa

Most areas that constitute natural vegetation (in particular the arenite ridge and dolomite grasslands) are considered as suitable habitat for the presence of conservation important species. Also, the direct relationship between Red Data flora species and areas where slopes are relative steep has been proven, and a subsequent high level of environmental significance is attributed to these particular areas.

3.8.1 Red Data Species

However, no threatened, "near-threatened" or any "rare and declining" species as listed by the TSP are expected to occur on the proposed study sites. The PRECIS database (SANBI) supported the absence of Red Data species on the quarter-degree grid squares corresponding to the study site.

3.8.2 Protected Taxa

Plant taxa listed as protected (see Table 2) under Schedule 12 of the Limpopo Management Act (No 7 of 2003) are likely to occur on the study site. Table 2 lists the protected taxa that could occur on the study area and provides an indication on their potential occurrence.

Table 2: Protected plant species that could occur on the proposed study sites.

Species	Status	Habitat
Spirostachys africana (Euphorbiaceae) – tree	Localised bush clumps – Confirmed from Sites 1, 2 & 3.	*Spirostachys africana* bush clumps on clay soils
Stapelia getliffei (Apocynaceae) – succulent herb	Localised – suitable habitat observed from Sites 3 & 4.	Mixed *Grewia flava – Aristida stipitata* woodland

A permit is required to remove or disturb a protected plant. It is recommended that protected plants in danger of becoming destroyed be removed prior to the commencement of construction activities and translocated to suitable habitat, or used during the rehabilitation phase.

Four tree species (Table 3) appear on the national list of protected tree species as promulgated by the National Forests Act, 1998 (No 84 of 1998). The main reasons for this list are to provide strict protection to certain tree species while others require control over harvesting and utilisation.

Although protected, these species are widespread throughout the study region and is by no means restricted in range. In addition, these species are not threatened (not Red Data listed), but should be considered during the development phase of the project based on their legal status.

In terms of the National Forests Act of 1998, a licence should be granted by the Department of Water Affairs and Forestry (or a delegated authority) prior to the removal, damage or destruction of any individual. Therefore, such activities (as mentioned above) should be directed to the responsible Forestry official in each province or area.

Table 3: Protected tree species recorded during the site visits or likely to occur on the study sites.

Species	Status	Habitat
Acacia erioloba (Mimosaceae) – Camel Thorn	Widespread – confirmed from Site 5	Widespread, in particular sandy soils
Boscia albitrunca (Capparaceae) – Shepard's Tree	Widespread – likely to occur on all the Sites (confirmed from Site 3 & 5)	Widespread
Combretum imberbe (Combretaceae) - Leadwood	Restricted to tall woodland – likely to occur on Sites 3-4	Mainly tall woodland
Sclerocarya birrea subsp. *caffra* (Anacardiaceae) - Marula	Widespread (confirmed from Site 3, 4 & 5)	Widespread, in particular sandy soils

3.8.3 Medicinal Species

A number of plant species are highly prized for their traditional healing properties, especially for "muthi" (they have ethnomedicinal value). It is estimated that more than 28 million people in South Africa consume about 19 500 tonnes of plant material per annum (Mander, 1998). For example, certain popularly traded species have become over-exploited and are now rare or extinct in the wild. This has resulted in the forced use of alternative species and a geographical shift in the harvesting pressure of previously unexploited areas. Although most of these plant species are regionally widespread and abundant, some of the more sought-after plant resources are currently declining and should be envisaged as priority conservation entities. Table 6 lists those species considered to be of economical or cultural value (according to Van Wyk *et al.,* 1997).

Table 4: A list of medicinal species observed or likely to occur on the study site (according to Van Wyk *et al.*, 1997). Important (heavily utilised) species are highlighted in grey.

Species	Parts used	Treatment
Acacia karroo	Bark, leaves & gum	Stomach ailments such as diarrhoea and dysentery. Bark, gum & leaves used as an astringent for colds and conjunctivitis.
Crinum spp. (e.g. *C. buphanoides*)	Bulb & leaves	Used as a remedy for various complaints such as scrofula and rheumatic fever.
Elephantorrhiza elephantina	Rhizomes	Treatment of a wide range of ailments including diarrhoea and dysentery.
Euclea undulata	Roots	Used as a remedy for headaches and toothaches.
Gomphocarpus fruticosus	Leaves	Treatment of headaches, tuberculosis and general body aches.
Harpagophytum procumbens	Secondary roots only	Used to treat rheumatism and arthritis.
Jatropha zeyheri	Rhizomes	Treatment of fever and wounds.
Sclerocarya birrea subsp. *caffra*	Bark and fruit	Treatment of various ailments, including malaria. Fruit rich in Vitamin C.
Terminalia sericea	Roots	An infusion is made to treat pneumonia and wounds.
Ziziphus mucronata	Roots, leaves and bark	Treatment of respiratory ailments.

3.8.4 Endemic of Near-endemic taxa

According to Mucina & Rutherford (2006), an important central bushveld endemic found within this region is *Piaranthus atrosanguineus*, a succulent stapeliad. It is scantily distributed along the Limpopo River valley from Gaborone in Botswana eastwards to Zeerust and northwards to Lephalale, and into areas north of the Soutpansberg (Bruyns, 2005).

It has been located in *Acacia-Grewia* bushveld, growing specifically under heavily grazed *Acacia tortillis* individuals. It was not recorded during the preliminary investigations although areas of *Acacia* thornveld (on the farm Grootvallei) provided suitable habitat.

3.9 Red Listed, Endemic and Conservation Important Faunal Taxa

Most areas that constitute natural vegetation (in particular sites corresponding to the farm Grootvallei) are considered as suitable habitat for the presence of conservation important species. However, Site 5 is located within the Matimba power station complex, which is also secured by means of electric and razor-wire fencing. Therefore, Site 5 is unlikely to hold large mammal species or any diverse array of conservation important taxa. In addition, the sites corresponding to the farm Grootvallei are located in close proximity to ephemeral or seasonal rivers, as well as areas corresponding to topographical features, and thus likely to sustain faunal species with specialised life histories, in particular rupicolous or lithophile species (e.g. rock-associated species).

Most large mammal species are in general highly mobile and therefore able to vacate areas should adverse environmental conditions prevail. Therefore, direct impacts associated with the proposed landfill site on adult mortality are less likely to occur, although indirect impacts will have consequences on their "fitness" (e.g. the ability of a species to reproduce). However, persistent disturbances across extended temporal scales will eventually affect any population's ability to sustain itself, and will more than likely result in the total abandoning of a particular area.

Species most likely to be affected are either K-selected species or habitat specialists e.g. substrate specialists (e.g. certain invertebrate species). K-selected species are mostly long-lived species with slow reproductive rates, while habitat specialists are those restricted to a particular type of microhabitat or niche, being it structurally, altitudinal or floristic. Most of these species are therefore threatened, "near-threatened" or Red Listed.

However, it is believed that the densities of certain opportunistic species could increase tenfold due to the establishment of a landfill site. These taxa could easily out-compete other less resilient taxa in the area. For example, it is believed that the densities of Pied Crows (*Corvus albus*) are likely to increase in the region. These species are aggressive competitors, which will eventually compete with other raptors in the area, leading to an imbalance in the natural food chain.

Table 5 provides a list of threatened, "near-threatened" and conservation important faunal species with geographic distribution ranges sympatric (overlapping) to the study area.

Table 5: A list of threatened, "near-threatened" and conservation important faunal species likely to occur on the study sites (excluding introduced game). The conservation status of mammal, amphibian, reptile, bird and invertebrate taxa was based on Friedmann and Daly (2004), Minter *et al*. (2004), Alexander & Marais (2007), Barnes (2000) and Schedule B1 of the list of threatened and protected invertebrate species issued in terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004 respectively.

Scientific Name	Common Name	Conservation Status	Probability of Occurrence	Habitat
Mammals				
Atelerix frontalis	South African Hedgehog	Near-threatened	High – likely to occur on all sites	Variety of habitat types, even suburban gardens.
Crocidura cyanea	Reddish-Grey Musk Shrew	Data Deficient	High – likely to occur on all sites	Dry terrain among rocks in dense scrub and grass, in moist places and in hedges. Wet vleis with good grass cover.
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient	High – likely to occur on all sites	Moist savanna, especially near drainage lines.
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	Data Deficient	Medium – more inclined towards riparian vegetation as found along the Sandloop on Grootvallei	Savanna although with a preference towards riparian vegetation in the Limpopo Province.
Elephantulus intufi	Bushveld Elephant-shrew	Data Deficient	High – likely to occur on Sites 1-4; status on Site 5 uncertain	Sandy soils with sparse grass cover.
Manis temminckii	Pangolin	Vulnerable	Status uncertain, but could occur on the farm Grootvallei	Dry savanna, associates with ants and termites.
Parahyaena brunnea	Brown Hyaena	Near-threatened	High - likely to occur on Sites 1-4; probably absent from Site 5	A savanna and grassland species, sometimes penetrating urban areas.
Lemniscomys rosalia	Single-striped Mouse	Data Deficient	High – likely to occur on	Tall grasslands.

Scientific Name	Common Name	Conservation Status	Probability of Occurrence	Habitat
			all sites	
Leptailurus serval	Serval	Near-threatened	Medium – could occur on sites located in close proximity to seasonal waterbodies (Sites 1-4)	Moist savanna with tall grass.
Mellivora capensis	Honey Badger	Near-threatened	Highly likely to occur on the farm Grootvallei (Site 1-4); could occur on Site 5	Varied, mainly dry woodland and semi-desert.
Miniopterus schreibersii	Schreibers' Long-fingered Bat	Near-threatened	High, could forage over all sites	Varied, but more restricted to lower-lying areas. Will utilise nearby rock crevices and manmade structures for day and night roosts.
Pipistrellus rusticus	Rusty Bat	Near-threatened	Medium – could occur on all the sites. More partial towards sites located on the farm Grootvallei (due to the presence of riparian vegetation)	Savannas with a preference for riparian vegetation.
Rhinolophus darlingi	Darling's Horseshoe Bat	Near-threatened	Medium, likely to forage over all sites.	Roosts in caves and mine shafts.
Tatera leucogaster	Bushveld Gerbil	Data Deficient	High – confirmed from both Grootvallei and Site 5; a widespread species	Savanna on sandy soils.
Amphibians				
Pyxicephalus adspersus[1]	Giant Bullfrog	Near-threatened	Medium – could breed on Grootvallei. Unlikely to occur on Site 5	Varied, breed on seasonal, shallow pans including non-permanent vleis.

[1] The bullfrogs observed from the drainage line on Grootvallei refer to the species *Pyxicephalus edulis*, a species of least concern.

Scientific Name	Common Name	Conservation Status	Probability of Occurrence	Habitat
Reptiles				
Python natalensis	Southern African Python	Vulnerable	High – likely to occur on Sites 1-4. Could occur on Site 5, albeit of low probability	Open savanna, rocky areas and riverine scrub.
Avifauna				
Aquila rapax	Tawny Eagle	Vulnerable	Irregular visitor – breeding status on Grootvallei uncertain (need to be confirmed); vagrant to Site 5	Lowveld and Kalahari savanna, especially game farming areas and reserves.
Ardeotis kori	Kori Bustard	Vulnerable	Likely to occur on Grootvallei; absent from Site 5	Arid open lowland savanna and karroid shrub.
Buphagus erythrorhynchus	Red-billed Oxpecker	Near-threatened	Confirmed from Grootvallei (Site 1 & 2) – co-occur with game and cattle; absent from Site 5	Bushveld with game and livestock.
Ciconia nigra	Black Stork	Near-threatened	Irregular visitor -Possible foraging habitat located on farm Grootvallei (drainage lines and floodplains); vagrant to Site 5	Wetlands, pans in lowland regions.
Gyps africanus	White-backed Vulture	Vulnerable	Regular visitor – breeding status on Grootvallei uncertain (need to be confirmed); unlikely to	Breed on tall, flat-topped trees.

Scientific Name	Common Name	Conservation Status	Probability of Occurrence	Habitat
			breed on Site 5	
Gyps coprotheres	Cape Vulture	Vulnerable	Occasional visitor - Unlikely to breed on study sites; likely to forage on the many game farms of the region	Breeds on steep south- and east-facing cliffs; foraging habitat varies.
Leptoptilus crumeniferus	Marabou Stork	Near-threatened	Irregular visitor to all sites	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas.
Mycteria ibis	Yellow-billed Stork	Near-threatened	Occasional non-breeding visitor to flooded floodplains along the Sandloop river (Grootvallei); absent from Site 5	Wetlands, pans and flooded grassland.
Polemaetus bellicosus	Martial Eagle	Vulnerable	Regular visitor – breeding status on Grootvallei uncertain (need to be confirmed); unlikely to breed on Site 5	Varied, from open karroid shrub to lowland savanna.
Saggitarius serpentarius	Secretarybird	Near-threatened	Irregular visitor – breeding status on sites uncertain (need to be confirmed); probably absent from Site 5	Open woodland and savannoid grassland.
Terathopius ecaudatus	Bateleur	Vulnerable	Regular visitor - breeding status uncertain (needs confirmation); absent from	Lowveld and Kalahari savanna; mainly on game farms and reserves.

Scientific Name	Common Name	Conservation Status	Probability of Occurrence	Habitat
			Site 5	
Torgos tracheliotos	Lappet-faced Vulture	Vulnerable	Irregular visitor – likely to be vagrant to the study sites	Lowveld and Kalahari savanna; mainly on game farms and reserves.
Invertebrates				
Hadogenes "troglodytes"	Rock Scorpion	Protected	Confirmed from the arenite outcrops on Grootvallei; unlikely to occur on any of the sites	Rock exfoliations.
Mantichora sp.	Monster Tiger Beetle	Protected	Likely to occur on most sites	Aggressive predator on sandy plains.
Opistacanthus asper		Protected	Likely to occur on most sites	Arboreal, particularly *Acacia nigrescens*.
Opistophthalmus "wahlbergii"	Burrowing Scorpion	Protected	High – could occur on all the sites.	Sandy soils on plains.
Opistophthalmus glabrifrons	Burrowing Scorpion	Protected	High – could occur on all the sites.	Sandy to loamy soils.
Opistophthalmus carinatus	Burrowing Scorpion	Protected	High – could occur on all the sites.	Sandy soils along rocks or on plains.

3.10 Site Selection Process

Based on Table 6, it is clear that Site 5 is the most favourable (least sensitive) area for consideration, as opposed to Site 4, which is considered as the least favourable (most sensitive) area.

The sensitivity of the farm Grootvallei and its larger surface area results in a viable conservation area with an above average habitat heterogeneity. Similarly, from a landscape perspective, this farm appears to be well connected with other intact areas outside of the study area. Future fragmentation of this area is likely to function as a nucleus for secondary developments (e.g. access roads, informal housing developments and industrial complexes), which would contribute to a further loss of biodiversity and ecological functionality.

It is recommended, based on the scoping process, that all development applications be consolidated around or on transformed landscapes with existing impacts of which Site 5 is considered to be the most ecologically favourable site for the proposed development.

3.11 Potential Impacts

The following impacts were identified that could potentially affect the natural environment:

- Impact 1 – destruction of pristine and sensitive vegetation (e.g. vegetation at a late-successional stage) within the development area;
- Impact 2 – destruction of threatened, protected and “near-threatened” flora and faunal species including habitat suitable for the occurrence of such taxa;
- Impact 3 – destruction of protected tree species and associated habitat; and
- Impact 4 – disruption of ecological function and habitat types (outcrops, riparian fringes, non-perennial streams etc.) – applicable to sites located on the farm Grootvallei.

Table 6: Site selection scoring results per study site, as defined in the methodology (red = highly sensitive areas, orange = medium to high sensitivity, yellow = medium sensitivity, and green = low sensitivity).

Site Selection Criteria	Site 1	Site 2	Site 3	Site 4	Site 5
Fragmented habitat	0.5	1	0.5	0	2
Intact vegetation	0.5	2	0	0	2
Features of ecological importance	0.5	0.5	0.5	0.5	1.5
Total	**1.5**	**3.5**	**1**	**0.5**	**5.5**
Remarks	• Limited road network • Presence of drainage lines to the north – increased migration corridors • Presence of "near-threatened" Red-billed Oxpecker (*Buphagus erythrorhynchus*) • Vegetation canopy partially disrupted	• The vegetation canopy and structure disrupted • Presence of drainage lines to the north – increased migration corridors • Presence of "near-threatened" Red-billed Oxpecker (*Buphagus erythrorhynchus*) • Potential groundwater reservoir • Area partially transformed by livestock and	• Area adjacent to existing power line • Presence of tall woodland elements – potential breeding platforms for diurnal birds of prey • Limited road network • Tall *A. nigrescens* trees – habitat for *Opistacanthus asper* • Dead *A. nigrescens* provide potential breeding habitat for hole-	• Area with intact vegetation • Area in close proximity to heterogeneous landscapes – increased spatial heterogeneity • Area provide suitable habitat for an array of species of conservation value • Limited road network • Intact vegetation canopy – increased habitat connectivity	• Area fragmented by numerous linear features (e.g. road network, fences, conveyer belt) • Increased disturbances from neighbouring activities (e.g. power station) • Disrupted vegetation canopy • Area forms a migration barrier • Vegetation composition includes a high number of

	human-induced activities	nesting birds • High overall species richness	• High overall species richness	secondary taxa

3.12 Recommendations

Due to the limited level of detail that is normally implemented during a scoping assessment, it is considered imperative to conduct detailed ecological (flora and fauna) investigations along the preferred site (in this case Site 5). This would include, but not necessarily be limited to:

Flora:

- Provide a description of the general floristic species diversity and community composition;
- Evaluating the occurrence of potential Red Data taxa;
- Mapping the occurrence of protected tree species on the site;
- Demarcating physiognomic units based on floristic relevès; and
- Provide an indication on the ecological condition (successional stage) of the predetermined physiognomic units.

Fauna:

- Provide a description of the general faunal species diversity (including mammals, small mammals, birds, epigaeic invertebrates and herpetofauna) based on accepted scientific methods (e.g. trapping methods);
- Evaluating the probability of occurrence of Red Data faunal species pertaining to the various habitat types; and
- Provide a description of faunal assemblages, based on species composition and habitat characteristics.

Ecology:

- Assess the nature and extent of the potential impacts on the ecological integrity of the study area;
- Compile sensitivity maps, highlighting areas of particular concern; and
- Propose mitigation measures, where possible, to mitigate potential adverse impacts.

On the basis of such a detailed assessment it would be possible to make pertinent and detailed recommendations in order to prevent impacts of an unacceptable nature on ecological attributes.

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