FAUNA AND FLORA REPORT

Weltevreden 381 JT and Zoekop 426 JS, Mpumalanga

Northern Coal (Pty) Ltd

11 May 2009

Environmental Solutions Provider

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Executive Summary

Digby Wells and Associates (DWA) were commissioned by Northern Coal South Africa (Pty) Ltd (Northern Coal) to conduct wet and dry season assessment studies on the farms Weltevreden 381 JT and Zoekop 426 JS.

The aims of this survey were to undertake a basic ecological assessment of the local flora and fauna in the study areas. The objectives are to establish the significance of the impacts of the construction and operation of the proposed opencast mine and associated infrastructure on the fauna and flora. Recommendations will also be made for mitigation actions that may either enhance potential benefits or minimize harmful effects. In order to meet these objectives the aforementioned flora and fauna surveys were conducted.

Weltevreden 381 JT and Zoekop 426 JS form part of the Northern Coal proposed project area, which is located in Mpumalanga Province, South Africa. The study area falls within the Highlands Local Municipality. According to the Mpumalanga Conservation Plan done by Mpumalanga Tourism and Parks Agency, this area is listed as a Least Concern and in No Natural Habitat Remaining (Grassland).

The dry season is typically not ideal for a biodiversity survey as most vegetation is dormant and many animal species are not as active as during the wet season. Fifty-eight plant species were recorded during the wet season as compared to the 38 recorded during the dry season.

The recorded grass species represented pioneer, subclimax and climax species and the areas were all in different states of succession, with areas supporting climax species like *Themeda triandra* and *Heteropogon contortus* showing more advanced stages of plant succession. The stages of succession of the various areas were dependent on the severity of disturbances such as ploughing and invasion of alien plant species. Most areas supported grasses with average to good palatability, indicating that the area could in future support grazing by livestock, which was the pre-mining capability of the area.

Furthermore the area also supported many alien invasive plant species, particularly *Cirsium vulgare, Bidens pilosa, Acacia mearnsii* and *Solanum sisymbrifolium.* An eradication and control program should be included with rehabilitation efforts to ensure that the area becomes free of

these alien invasive species which will, if uncontrolled, alter the landscape and convert the grasslands to Savanna. No endemic or Red Data plant species were recorded.

Many animal species that were observed in the area are adaptable species and by increasing the natural flora diversity during rehabilitation, one will have a natural influx of animals, with smaller animals such as insects moving into the area, followed by birds, frogs and reptiles. No frogs or reptiles (except one lizard) were observed during the field surveys and this could be attributed to temperatures that were below zero. These species tend to hibernate during cold spells

In conclusion, the field studies revealed the area is dominated by alien invasive species, and the fact that most of these species were found in the vicinity of the pan, is of biological concern as they tend to compete with indigenous vegetation.

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1   TERMS OF REFERENCE

Digby Wells and Associates (DWA) were commissioned by Northern Coal South Africa (Pty) Ltd (Northern Coal) to conduct Fauna and Flora studies on the farms Weltevreden 381 JT and Zoekop 426 JS in order to determine the current status of these farms. The studies were done in accordance to the Mpumalanga Parks Board minimum requirements. These assessments was done by combining the information and results from wet and dry season flora and fauna surveys into a comprehensive Fauna and Flora Report.

This specialist report serves to undertake a basic ecological assessment of the local flora and fauna communities associated with the study areas. Information generated from this survey has been used to address the impacts that the mining activities will have on this environment. The desktop and field results have been included to interpret the results.

This survey was completed in accordance with:

•   Section 21 of the Environment Conservation Act, 1989;

•   Section 24 of the Constitution – Environment (Act 108 of 1996);

•   Conservation of Agricultural Resources Act (CARA) no 43 of 1983;

•   Section 5 of the National Environmental Management Act (Act 108 of 1998); and

•   National Environmental Management Biodiversity Act (NEMBA, Act 10 of 2004).

2   INTRODUCTION

The National Environmental Management Biodiversity Act 10 of 2004 defines biodiversity as the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems as well as the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems. Living organisms, for the purpose of this report, include forms of plant life (with the focus on herbs, grasses, shrubs and trees), animal life (with the focus on mammals, birds, reptiles, amphibians) as well as associated environmental factors such as wetlands (water accumulation in streams and pans), soils (land use and land capability) and geology.

South Africa is the third most biologically diverse country in the world, after Indonesia and Brazil. The country occupies about 2% of the world's land area, but supports nearly 10% of the world's plants and 7% of the reptiles, birds and mammals. It also has three globally recognised biodiversity hotspots that fall within its boundaries, namely: the Cape Floristic Region, the Succulent Karroo and Maputaland-Pondoland (Driver et al, 2004).

The Biodiversity Act sets out a framework for planning the conservation and sustainable use of biological diversity within a broader framework of planning for sustainable development. Mining and its associated activities has a significant impact on the soils, land use, land capability, vegetation and animal life. The use of land for mining and agriculture leads to the destruction of vegetation and therefore the loss of suitable habitat for fauna. As a result of the destruction of natural vegetation and wetlands, change in land use and the contamination of the surrounding environment, the level of biodiversity within mining areas is normally diminished. With proper planning, responsible mining with concurrent rehabilitation and through the conscious conservation and protection of resident natural species these impacts and the associated loss of biodiversity can be addressed and minimised.

Loss of biodiversity leads to ecosystem degradation and subsequent loss of important ecological services. This puts aspects of the economy and quality of life at risk, and reduces socio-economic options for future generations. Biodiversity provides an important basis for economic growth and development and it is vital to keep it intact to ensure ongoing provision of ecosystem services (Driver et al, 2004). Mining is a driving force that exerts pressure on the natural habitat and biological diversity. This pressure arises from both current and past activities since there is often a time lag between human actions and environmental responses.

Biomes found in South Africa include desert, fynbos, succulent, Karroo, Nama Karroo, grassland, savanna, Albany thicket, forest and wetland vegetation (Low & Rebelo 1996). The Grassland biome has the highest biodiversity in South Africa after the Fynbos biome (Driver *et al*, 2004). Mpumalanga falls under the Grassland Biome. The Grassland Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Grasslands are dominated by a single layer of grasses and the amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localised habitats and geophytes are often abundant (Low & Rebelo, 1996).

Agricultural and mining activities in the region have lead to habitat fragmentation (Driver et al 2004) and therefore any further loss of natural habitat is viewed as detrimental to biodiversity functioning in this

particular region. The loss of biodiversity leads to ecosystem degradation (Driver et al, 2004) and this study will try to address and identify the species that are found in the area in terms of their Red Data status. The greatest threat to fauna species within this area is the loss of natural habitat, as a direct result of agricultural or mining activities. In an area such as Mpumalanga further habitat loss is critical as bird species are under increasing pressure from mining activities.

The objectives of the Flora and Fauna study, which are contained in the Terms of Reference, will be achieved by conducting a desktop and field investigation of the wetland for both Flora and Fauna, delineating plant communities that are found in the area, and also identifying the rare and endangered species that occur in the wetland.

3 STUDY AREA

The study area is situated in the Mpumalanga Province, in the Highlands Local Municipality between the N4 and R33 roads.The site consists of mielie fields, stands of *Eucalyptus spp.*, pans and grasslands (**Figure 1**). Evidence of agricultural activities that took place on the site (cattle grazing) is evident. A rocky area is present to the north of the pans. Approximately 219ha will be mined using open cast methods.

The area falls within the Moist Sandy Highveld Grassland vegetation type within the Grassland biome (Low & Rebelo 1996), similar to the North-eastern Sandy Highveld, (Veld type 57) and Eastern Bankenveld (Veld type 61c) of Acocks (1988). Dominant species and less dominant species are listed in **Table 1**. According to the latest vegetation map by Mucina *et al.* (2006), this area is described as both Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands (**Appendix 1**).

Table 1: Plant species typical of the North-eastern Sandy Highveld vegetation type of the Weltevreden areas

DOMINANT SPECIES		
Alloteropsis semialata	*Andropogon schirensis*	*Brachiaria serrata*
Ctenium concinum	*Digitaria tricholaenoide*	*Diheteropogon amplectens*
Elionurus muticus	*Eragrostis plana*	*Eragrostis racemosa*
Eragrostis sclerantha	*Harpochloa falx*	*Helichrysum oreophilum*
Heteropogon contortus	*Loudetia simplex*	*Microchloa caffra*
Monocymbium ceresiiforme	*Panicum natalense*	*Themeda triandra*
Trachypogon spicatus	*Tristachya leucothrix*	*Stoebe vulgaris**
SPECIES OF LESS GENERAL OCCURRENCE		
Aristida aequiglumis	*Aristida junciformis*	*Dicoma anomalla*
Diheteropogon filifolius	*Eragrostis patensissima*	*Panicum ecklonii*
Schizahyrium sanguineum	*Sporobolus pectinatus*	*Rendlia altera*

Tristachya rehmannii		

* Alien plant

Mpumalanga province is divided into 6 main areas of sensitivity, namely

- o Highly Significant;

- o Important & Necessary;

- o Irreplaceable;

- o Least Concern;

- o No Natural habitat Remaining; and

- o Protected areas (Lötter 2007).

This study area is classified as Least Concern and No Natural Habitat Remaining (**Appendix 2**).

Figure 1. Study area in Weltevreden consisting of pans, stand of Eucalyptus and mielie fields

4 EXPERTISE OF THE SPECIALIST

SPECIALIST DECLARATION OF INDEPENDENCE

I, Avhafarei Ronald Phamphe , declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project Weltevreden Flora and Fauna assessment;

- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;

- Do no have nor will have a vested interest in the proposed activity proceeding;

- Have no, and will not engage in, conflicting interests in the undertaking of the activity;

- Undertake to disclose, to the competent authority, any 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, 2006;

____Avhafarei Ronald Phamphe_____

Name of the specialist

Signature of the specialist

DIGBY WELLS & ASSOCIATES

Name of company

Date

5 METHODOLOGY

5.1 Site Visit

The dry season survey was conducted on 15th and 16th July 2008 and on the 25th and 26th May 2009. The wet season survey took place on 09th and 10th March 2009 in order to sample the species that are found on this site during both wet and dry seasons.

5.2 Vegetation and Animal Survey

5.2.1 Desktop Study

A desktop study was conducted to ascertain which fauna and flora species could be expected to occur on the site, under natural conditions. This was done for the vegetation by assessing the available literature on the vegetation types of South Africa. A brief description of the natural vegetation type of the area, according to the descriptions in Low & Rebelo (1996) and Acocks (1988) is given. All plants that have Red Data and Endemic status (Hilton-Taylor, 1996) were also investigated. A Pretoria Computerized Information System (PRECIS) List was obtained from the South African National Botanical Institute (SANBI) which lists all the plant species officially recorded by SANBI for QDS 2530 CC (**Appendix 3**). This list of species ranges from Decreaser, Increaser 1, Increaser 2, and Increaser 3. Van Oudtshoorn (1999) described Decreaser as the grasses that are abundant in good veld but that decrease in number when the veld is overgrazed or undergrazed, e.g. *Themeda triandra,* Increaser 1 as grasses that are abundant in underutilised veld and usually unpalatable, Increaser 2 as grasses that are abundant in overgrazed veld and Increaser 3 as grasses that are commonly found in overgrazed veld and usually unpalatable, e.g. *Sporobolus africanus*.

Mammals that could be found in this study were based on the distribution maps of Skinner & Chimimba (2005) and Friedman & Daly (2004). Roberts (2003), Barnes (1998) and Barnes (2000) were used to identify bird species that may occur in and around the proposed project site as well as their Red Data status. Branch (2001), Passmore & Carruthers (1995), and Henning & Henning (1989), were all used to ascertain the distribution of reptiles and amphibians.

5.2.2 Field Survey

5.2.2.1 Vegetation

During the field survey, all general observations were noted and trees, shrubs, grasses and herbs (forbs) were recorded using the Braun-Blanquet method (Braun-Blanquet 1964). Plants: Books such as, Pooley (1998), and van Oudtshoorn, (1999) were used during the field survey for identification. The sampling points (**Appendix 4**) were placed in such a way that it covers the whole area, and in cases where the area is homogenous, one or two representative samples were taken. A total of seven sample plots were distributed within the area of interest with some natural vegetation, wetlands, and disturbed areas surveyed. In order to confirm species identification, photographs were recorded of sampled flora and sent to the SANBI for verification purposes.

The sampling points were placed in such that it covers the whole area, and in cases where the area is homogenous, one or two representative samples were taken. Most of the areas were mielie fields and only few samples were taken as these fields were dominated by same species, i.e. *Zea mays*, and mostly weeds. Most of the samples were taken in areas where there were grasses and trees.

A comprehensive floristic and habitat survey was done within each of the sample plots. Taxon names were updated in accordance to the species list contained in the TURBOVEG (Hannekens, 1996b) database. The following cover-abundance scale table (**Table 2**) was therefore used:

Table 2. Braun-Blanquet cover-abundance scale

Symbol	Qualitative Braun-Blanquet scale
r	One or few individual (rare) with less than 1% of total sample plot area
+	Occasional and less than 1% of total sample plot area
1	Abundant and with very low cover or less abundant, but with higher cover, 1-5% cover of total sample plot area
2a	Covering 5-12% of the sample plot area, irrespective of the number of individuals
2b	Covering 12-25% of the sample plot area, irrespective of the number of individuals
3	>25-50% cover of the total sample plot area, irrespective of the number of individuals
4	>50-75% cover of the total sample plot area, irrespective of the number of individuals
5	>75% cover of the total sample plot area, irrespective of the number of individuals

The floristic data, which consists of 47 relevés, were subjected to the **T**wo-**W**ay **In**dicator **S**pecies **An**alysis technique (TWINSPAN) (Hill 1976b) on two levels of division in the Juice (Tichy 2002). Results of TWINSPAN indicated a first approximation of the major units in the study area.

Due to species diversity and uneven topography, a sample plot size of 10 m x 10 m was chosen. In order to give a clear reflection of the variation of the vegetation, sample plots were, as far as possible, equally distributed within the different stratification units, and one relevé was compiled in each plot. The exact position of each sample plot within the relevant stratification unit was chosen subjectively according to the methodology of the Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964).The Braun-Blanquette (BB) sampling method (Mueller-Dombois & Ellenberg 1974) has been successfully applied in other phytosociological studies in South African grasslands (e.g. Bredenkamp 1982, Bezeuidenhoudt & Bredenkamp 1990) and also in many other vegetation studies (Du Plessis 2001, Phamphe 2003).This is a standardised method used for vegetation classification within South Africa. Unknown species were taken to the University of Pretoria herbarium and SANBI for identification. A cover abundance value was estimated for each of the identified species according to the Braun-Blanquette scale.

The habitat was evaluated in terms of the topography (crest, midslope, foot slope, plain, river and plateau), aspect (north, south, east and west), slope (in degrees), altitude, soil and erosion (if present).

The following indicators were obtained for the area and for each plant community unit with regard to insects collected:

• Simpson's Species Diversity Index (Index of concentration): used to determine the relative species diversities of vegetation communities, allowing for comparisons between vegetation communities. This method is sample size independent, allowing areas with five sample plots to be compared with areas of two sample plots.

• D or λ = sum{(n x n-1)/(N x N-1)}; where n = number of individuals of a particular species and N = the sum of all individuals of all species in that sample area. This value ranges between 0 and 1 with values closer to 0 indicating higher biodiversity and therefore the reciprocal, Simpson's Index (1/ D or 1/λ), is used as a measure of diversity.

• Species Richness: a measure of the number of species that were found to be present at each sampling point, which is linked to species diversity.

• Species Uniqueness: a measure of the differences between the sampling points investigated, taking into account the number of species that were found in one sampling area only and not in others, making them unique to that area. This can be used as an indication of uniqueness of habitat.

The first two indices were determined for the area as a whole and can be used as indicators for the area and can be used for comparison to other areas. All analyses were made for each plant community unit to determine which communities had higher diversities and would therefore be most suitable for preservation.

5.2.2.2   Mammals

The mammal survey was conducted during the same time as that of the vegetation survey. All mammals that were seen during the field surveys were noted. This included mammals that were seen at the sample sites and those that were observed in the general area. Signs that would indicate the presence of certain species were also looked for such as spoor and droppings. Although mammals were recorded in areas not specific to the proposed new developments, the ability of mammals to move between areas, means the likelihood of these species occurring in the area of concern is high. Baited wire cages with trap doors were used for small mammal trapping (**Figure 2**). This method is species specific and only small mammals weighing less than 2kg can be captured.

Figure 2. A trap used to catch mammals of less than 2kg.

5.2.2.3 Birds

A visit to the proposed project site area to establish visual observations of the birds' species took place in the morning. Three Avifauna field guides were used for identification purposes. According to Barnes (1988), 49 species have been listed as having Red Data status in the Amersfoot-Bethal-Varolina District in terms of the Important Bird areas in Mpumalanga. The Secretary bird (Near Threatened) occurs in grassland habitats and the African grass owl (Vulnerable) occurs in grassland with vlei areas. Both these habitats are present within the area. As these are Red Data birds, they will need to be protected and conserved should they occur on the property.

5.2.2.4 Invertebrates

Invertebrates were sampled using a sweep net of 350 mm diameter. At each sample plot 50 sweeps were conducted. Insects were collected from the net using a pooter, placed into a jar filled with 70% ethanol, and were sent to University of Johannesburg (UJ) for identification and species counts. For each sample plot the insects were identified to at least family level and where possible to genus and species level. The number of species within each family was noted as were the number of individuals of each species.

5.2.2.5 Reptiles

Signs of reptile activity were noted such as shed skin, spoor and droppings. Lizard and snake surveys were performed in the late morning and late afternoon, when temperatures are generally conducive to reptile activity and thermoregulation. Snakes, if found, were not going to be captured, but if possible, a picture would have been taken, and specimens were going to be identified in the field. Lizards would have been captured if they could not be identified visually in their natural habitat. Any lizard captured would have been placed briefly in a jar. If identification couldn't be completed in the field, specimens would be released and subsequently identified from pictures taken while individuals were in holding containers, possibly with the help of experts. Data would be recorded in a notebook along with the time, date, habitat, weather conditions and a GPS location

6   KNOWLEDGE GAPS

During the dry season, sampling was mainly for grasses, birds, trees and insects and as it was not possible to samples species such as amphibians and reptiles due to their inactivity during this season.

7 RESULTS

7.1 Vegetation Survey

The results of both the dry and wet season vegetation surveys are summarised below. These results include both the desktop and the field surveys.

7.1.1 PRECIS List

The PRECIS List for QDS 2530CC presents all the species of plants that have officially been recorded in this particular grid by the SANBI. In order for a plant species to be included in this list a specimen collected in these grids must be supplied to SANBI. These lists are therefore not a comprehensive list, representing only those species that may occur in these grids, but rather a guideline as to what is likely to occur here. The sites sampled are also only a very small portion of the whole grid and habitats suitable for certain species in these PRECIS lists may not be present at the sites sampled. It is therefore not unusual for species in the PRECIS list to be absent from the sampling sites. From these PRECIS lists we can, therefore, only make inferences about which plant species could potentially occur at any of the sample sites. In this case it could also be used as a guideline for what species should occur here and this could aid in the management of the future rehabilitated areas.

7.1.2 Plant species recorded during the survey

The dry season survey resulted in 38 plant species recorded (**Appendix 5**). This included three tree, five shrubs, twenty grasses and eight herb species. Four species relating to the Bankenveld vegetation type (Acocks, 1988) were recorded from this site. Five Decreaser grasses were observed in the area. Five grasses are Increaser I species, usually climax grasses occurring in underutilised veld (van Oudtshoorn, 1999), and seven Increaser II grasses were recorded in the area. There were two Increaser III grass species (*Aristida junciformis* Gangoni three-awn and *Sporobolus africanus* Ratstail dropseed) observed in the area. Increaser II grasses are abundant in overgrazed veld and include pioneer and subclimax species which will establish quickly on exposed ground (van Oudtshoorn, 1999). Two of the grasses recorded in the area were Exotics (*Pennisetum clandestinum* Kikuyu grass and *Paspalum dilatatum* Dallis grass) (**Appendix 5**).

During the wet season survey, 58 plant species were recorded (**Appendix 6**). These species included three tree, five shrub, twenty five grass and nineteen herb species. Five Decreaser grasses were observed in the area. Three grasses are Increaser I species, usually climax grasses occurring in underutilised veld (van

Oudtshoorn, 1999), and ten Increaser II grasses were recorded in the area. There was one Increaser III grasses species (*Sporobolus africanus* Ratstail dropseed) observed in the area. Two grasses recorded in the area were Exotics (*Pennisetum clandestinum* Kikuyu grass and *Stenotaphrum secundatum* Buffalo-turf grass) (**Appendix 6**). Six species relating to the North-eastern Sandy Highveld (Table 2) vegetation type (Acocks, 1988) were recorded from this site.

A total of 37 species (**Table 3**) were sampled from the farm Zoekop. Of these, 16 species were grasses, 10 were herbs, one reed, five shrubs, and five trees.

Table 3. Plant species collcted from Zoekop farm

Scientific Name	English Name	Ecological Status	Form
Acacia mearnsii	Black Wattle	Alien Invasive	Tree
Aloe species		medicinal	Herb
Amaranthus hybridus	Pigweed	Alien Invasive	Herb
Andropogon eucomus	Snowflake grass	Increaser 2	Grass
Asparagus virgatus	Broom Asparagus	Medicinal	Shrub
Berkheya setifera	Buffalo-tongue Berkheya	Medicinal	Herb
Bidens pilosa	Common Black-jack	Alien Invasive	Herb
Cirsium vulgare	Scotch Thistle	Alien invasive	Herb
Conyza bonariensis			Herb
Ctenium concinnum	Sickle grass	increaser 1	Grass
Cymbopogon excavatus	Broad-leaved Turpentine Grass	Increaser 1	Grass
Diospyros mespiliformis			Shrub
Eragrostis curvula	Weepong Love Grass	Increaser 2	Grass
Eragrostis racemosa	Narrow Heart Love Grass	Increaser 2	Grass
Eragrostis superba	Saw-tooth Love Grass	Increaser 2	Grass
Eucalyptus camaldulensis	Red River Gum	Alien Invasive**	Tree
Helichrysum aureonitens	Golden everlasting	Medicinal	Herb
Hyparrhenia hirta	Common Thatching Grass	Increaser 1	Grass
Imperata cylindrica	Cotton Wool Grass	Increaser 1	Grass
Leonotis leonurus			Herb
Melinis repens	Natal Red Top	Increaser 2	Grass
Panicum maximum	Guinea Grass	Decreaser	Grass

Scientific Name	English Name	Ecological Status	Form
Phragmites australis	Common Reed	decreaser	Grass
Pinus patula	Patula pine	Alien invader	Tree
Populus canescens	grey poplar	Alien invader	Tree
Pseudognaphalium luteo-album	Jersey Cudweed	Medicinal; Cultural	Herb
Rhus species		medicinal	Shrub
Salix babylonica	Weeping Willow	Alien Invasive	Tree
Schoenoplectus corymbosus			Reed
Setaria sphacelata var. sphacelata	Common Bristle Grass	Decreaser	Grass
Setaria verticillata	Bur Bristle Grass	Increaser 2	Grass
Sporobolus africanus	Ratstail Dropseed	Increaser 3	Grass
Tagetes minuta	Tall Khaki Weed	Invasive	Herb
Themeda triandra	Red Grass	Decreaser	Grass
Tristachya leucothrix	Hairy Trident Grass	Increaser 1	Grass
Verbena bonariensis	Tall Verbena/Purple Top	Alien invasive	Shrub
Zea mays	Maize meal		shrub

7.1.2.1   Red Data Plant Species

No Red Data plant species were recorded during the both surveys.

7.1.2.2   Exotic and Invasive Plant Species

A total of 11 alien invasive species were observed during the dry season survey (**Appendix 5)** and 15 species were observed during the wet season (**Appendix 6)**. Alien invasive species tend to out compete the indigenous vegetation and this is due to the fact that they usually are vigorous growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 1995). They are tough, can withstand unfavourable conditions and are easily spread. This is indicative of early stages of succession and although these species are invasive they do aid in the prevention of erosion. Tree species like *Pinus patula* (**Figure 3**) and *Acacia mearnsii* dominate the bottom valleys of the site (**Figure 4**) whereas species such as *Datura stramonium* (**Figure 5**) is found in mielie fields areas.

Figure 3. Exotic *Pinus patula* next to the pans

Figure 4: *Acacia mearnsii* dominate the bottom valleys next to the pans

Figure 5. *Datura stramonium* growing next to the miele fields

A total of nine alien invasive species were found on Zoekop farm. The same species were also found in Weltevreden farm, except *Populus canescens* and *Salix babylonica*.

7.1.2.3 Medicinal Plant Species

During the dry season, 14 medicinal plants were observed and same amount were observed during the wet season. *Boophane disticha* (Fan-leaved Boophane) is used in traditional medicine to treat pain, wounds and as a narcotic and *Pseudognaphalium luteo-album* (Jersey Cudweed) is traditionally used to fumigate a room where a child is feverish and to make a 'mattress' on which skins are cured (Pooley 1998).

Five medicinal plants were collected from Zoekop farm, with *Asparagus virgatus* being used as a charm and also to treat syphilis and intestinal worms (Pooley 1988).

7.1.2.4 Description of dry season plant communities

The dry season results yields two main vegetation types, i.e *Bidens pilosa-Hyparrhenia hirta* grassland and *Zea mays-Themeda triandra* mielie fields (**Table 4**). The yellow blocks represent the communities and sub-communities.

Table 4. Phytosociological table for Weltevreden dry season survey

Table number	1	2	3	4	5	6	7	8	9	10	11	12	13
Species Group A													
Hyparrhenia hirta	4	4	2a	3	3	3	2m	.	3	.	2a	.	.
Verbena bonariensis	.	3	3	3	1	.	3	1	3	3	1	1	.
Bidens pilosa	2m	3	2b	3	.	1	.	1	3	2m	.	.	3
Panicum natalense	.	.	3	3	2m	2m	3	.	2a	.	3	.	.
Sporobolus africanus	3	3	.	2a	4	.	.	2a	4	3	4	3	.
Species Group B													
Stenotaphrum secundatum	2a	3	.	.	3	.	.	.	.	.	.	.	.
Sporobolus pyramidalis	2b	3	.	.	.	.	2a	.	.	.	.	.	.
Cymbopogon excavatus	4	3	3	.	.	.	.	.	.	.	.	.	.
Species Group C													
Cynodon dactylon	1	2a	.	.	3	.	1	.	2a	.	.	.	.
Pseudognaphalium luteo-album	.	2a	.	.	.	.	.	.	.	.	.	.	.
Eragrostis curvula	3	2a	.	2a	.	.	.	.	.	.	.	1	.
Species Group D													
Berkheya setifera	2a	.	.	.	.	.	.	.	.	.	.	1	.
Setaria sphacelata v. sphacelata	3	.	.	.	.	.	.	.	.	.	.	.	.
Eucalyptus camaldulensis	2m	.	.	.	.	.	.	.	.	.	1	.	.
Species Group E													
Bewsia biflora	.	2a	.	3	.	.	3	.	.	.	.	.	.
Aristida junciformis	.	.	3	2a	.	.	.	.	.	.	.	.	.
Eragrostis gummiflua	.	3	.	3	.	.	.	.	.	.	.	.	.
Pennisetum clandestinum	.	3	3	2a	2a	.	4	1	2a	1	.	3	.
Species Group F													
Eragrostis racemosa	.	.	.	.	3	4	.	.	.	.	.	.	.
Eragrostis superba	.	.	.	.	.	2a	.	.	.	.	.	.	.
Helichrysum kraussii	.	.	.	.	.	2m	.	.	.	.	.	.	.
Stoebe vulgaris	.	.	.	.	.	3	.	.	.	.	1	.	.
Species Group G													
Acacia mearnsii	.	.	.	.	.	.	2b	.	.	.	1	2a	.
Pinus patula	.	.	.	.	.	.	.	.	.	2a	1	1	.
Panicum maximum	.	.	.	1	2a	.	.	1	.	.	.	3	.
Zea mays	.	.	.	.	.	.	.	.	4	3	.	3	4
Themeda triandra	.	3	.	.	.	.	.	.	2a	.	3	4	.
Tagetes minuta	3	.	.	.	.	.	.	.	3	.	.	1	3
Datura stramonium	.	.	.	.	.	.	.	.	.	2a	1	2m	2a
Hypoxis hemerocallidea	.	.	.	.	.	.	1	1	1	.	2a	2a	.
Species Group H													
Cyperus longus	.	.	.	.	.	.	.	2a	2m	3	.	.	.
Schoenoplectus corymbosus	.	.	.	.	.	.	.	3	.	.	.	.	.
Setaria sphacelata	.	.	.	.	.	.	3	1	3	2a	.	.	.
Imperata cylindrica	.	.	.	.	.	.	.	3	.	.	.	.	.
Solanum sisymbrifolium	.	.	.	2b	.	.	.	2a	.	2m	.	.	.
Miscanthus junceus	.	.	.	.	.	.	.	.	3	3	.	.	.
Species Group I													

Species	1	2	3	4	5	6	7	8	9	10	11	12	13
Gerbera piloselloides	.	.	.	.	.	.	.	.	.	.	2b	.	.
Helichrysum rugulosum	.	.	.	.	.	.	.	.	.	.	3	.	.
Stachys aethiopica	.	.	.	.	.	.	.	.	.	.	2a	.	.
Gerbera ambigua	.	.	.	.	.	.	.	.	.	.	1	.	.
Oxalis obliquifolia	.	.	.	.	.	.	.	.	.	.	1	.	.
Species Group J													
Helichrysum aureonitens	.	1	.	.	.	.	.	.	.	.	.	3	.
Boophane disticha	.	.	.	.	.	.	.	.	.	.	.	2a	.
Haplocarpha scaposa	.	.	.	.	.	.	.	.	.	.	.	1	.
Species Group K													
Gomphrena celosioides	.	.	.	.	.	.	.	.	.	.	.	.	2b
Species Group L													
Nicandra physalodes	.	.	.	.	.	.	.	.	1	.	.	.	.
Andropogon huillensis	1	.	.	.	.	.	.	.	.	.	.	.	.
Pogonarthria squarrosa	.	.	.	1	.	.	.	.	.	.	.	.	.
Sutherlandia montana	.	.	.	.	.	.	1	.	.	.	.	.	.
Elephantorrhiza elephantina	1	.	.	.	.	.	.	.	.	.	.	.	.

The dendrogram (**Figure 6**) shows how the communities divided and sub-divided

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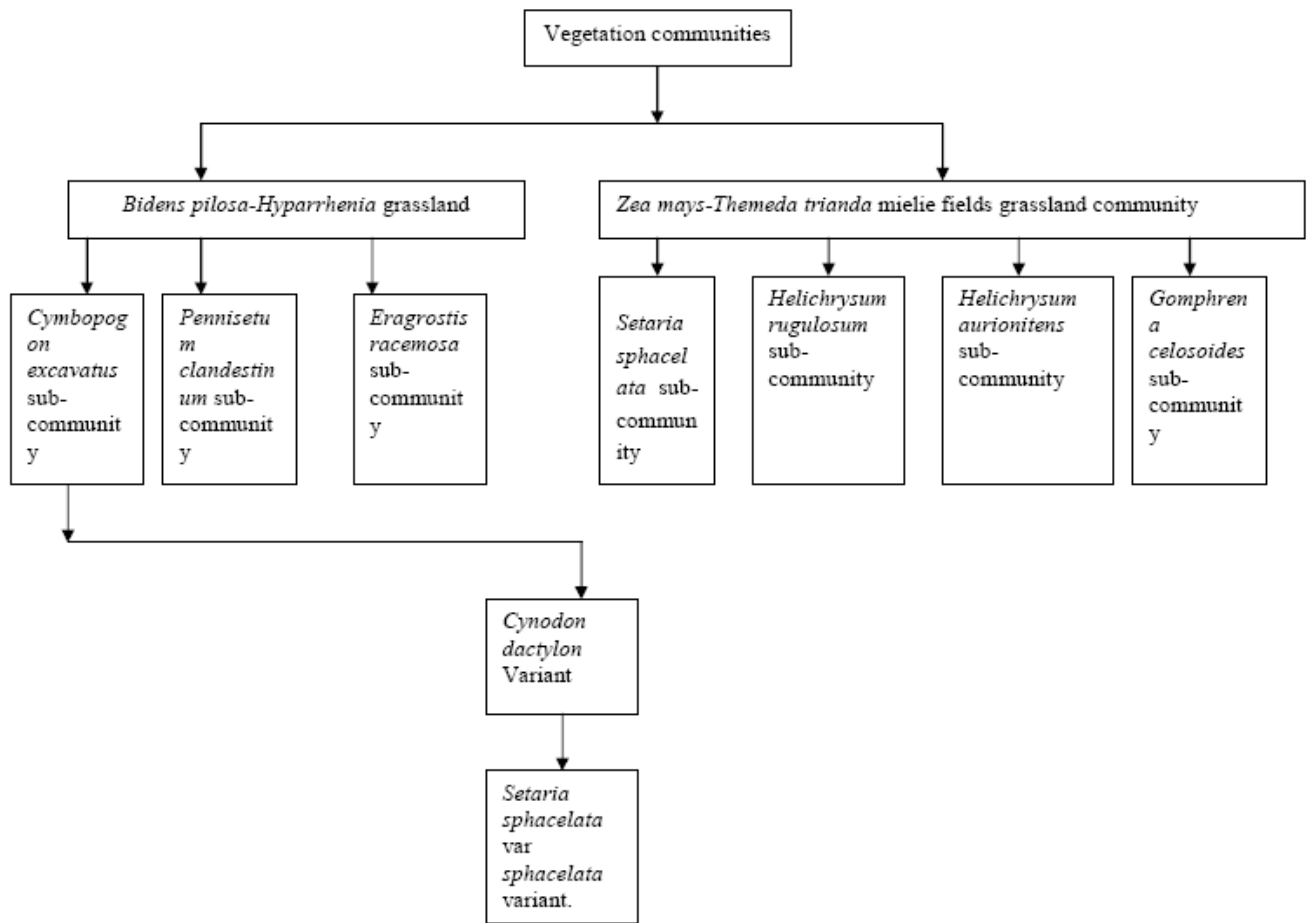
Figure 6. Dendrogram showing the cut-levels for vegetation communities in Weltevreden during the dry season

7.1.2.4.1   *Bidens pilosa-Hyparrhenia hirta* grassland

This grassland community is found in areas where the vegetation is highly disturbed. The diagnostic species are the invasive alien plants such as *Bidens pilosa* and *Verbena bonariensis*. Most of the herbs found in this grassland are mainly alien invasives.

The diagnostic species of this community are the grasses, *Sporobolus africanus* and *Panicum natalense*, and the herbs such *Verbena bonariensis* and *Bidens pilosa* (Species Group A).

The prominent grasses are *Sporobolus pyramidalis* (Species Group B), *Eragrostis curvula* (Species Group C), and *Pennisetum clandestinum* (Species Group E).

The herbaceous layer is dominated by species such as *Berkheya setifera* (Species Group D), alien invasive *Stoebe vulgaris* (Species Group F), *Tagetes minuta, Zea mays,* (Species Group G), *Helichrysum rugulosum* (Species Group I). The tree layer is dominated by the alien invasive *Pinus patula* (Species Group G).

This grassland community is sub-divided into three sub communities and two variants, namely *Cymbopogon excavatus* sub-community, *Pennisetum clandestinum* sub-community, *Eragrostis racemosa* sub-community and *Cynodon dactylon* Variant and *Setaria sphacelata* var *sphacelata* variant.

7.1.2.4.1.1   Cymbopogon excavatus sub-community

This sub-community is found in flat grasslands areas. The diagnostic species are grasses such as *Sporobolus pyramidalis* and *Stenotaphrum secundatum* (Species Group B).

The prominent species are the grasses *Hyparrhenia hirta*, *Sporobolus africanus* (Species Group A), *Eragostis curvula* (Species Group C), *Setaria sphacelatha* var *sphacelatha* (Species Group D), and *Eragrostis gummiflua* (Species Group E).

7.1.2.4.1.1.1   *Cynodon dactylon* Variant

This variant is found in highly disturbed and in flat areas. This variant is characterised by Species Group C. The diagnostic species are *Eragrostis curvula* and *Pseudognaphalium luteo-album.*

The prominent species in the grass layer are *Sporobolus africanus, Hyparrhenia hirta* (Species Group A), *Sporobolus pyramidalis, Cymbopogon excavatus* and *Stenotaphrum secundatum* (Species Group B), *Setaria sphacelatha* var *sphacelatha* (Species Group D), and *Eragrostis gummiflua* (Species Group E), *Themeda triandra* (Species Group G).

The herbaceous layer is dominated by species such as *Bidens pilosa* (Species Group A), *Berkheya setifera* (Species group D), *Tagetes minuta,* (Species Group G).

The tree layer is dominated by *Eucalyptus camaldulensis.*

7.1.2.4.1.1.1.1   Setaria sphacelata var sphacelata variant

This variant is characterised by Species Group D. The diagnostic species are *Berkheya setifera,* and *Eucalyptus camaldulensis.*

The dominant species are the grasses *Hyparrhenia hirta* (Species Group A), *Sporobolus pyramidalis, Cymbopogon excavatus* and *Stenotaphrum secundatum* (Species Group B), *Abdropogon huilensis* (Species Group L).The herbaceous layer is dominated by species such as *Bidens pilosa* (Species Group A), *Tagetes minuta,* (Species Group G), and *Elephantorhiza elephantine* (Species Group L).

7.1.2.4.1.2   Pennisetum clandestinum sub-community

This sub community is also found in highly disturbed grasslands and is represented by Species Group E. The diagnpostic species are *Eragrostis gummiflua, Bewsia biflora,* and *Aristida junciformis.*

The dominant species in the grass layer are *Hyparrhenia hirta, Panicum natalense, Sporobolus africanus (*Species Group A), *Sporobolus pyramidalis, Cymbopogon excavatus* and *Stenotaphrum secundatum* (Species Group B), *Eragostis curvula, Pseudognaphalium luteo-album, Cynodon dactylon* (Species Group C), *Eragrostis racemosa* (Species Group F), *Panicum maximum, Themeda triandra* (Species Group G). The herbaceous layer is dominated by species such as *Bidens pilosa, Verbena bonariensis* (Species Group A) and *Solanum sisymbifolium* (Species GroupH).

7.1.2.4.1.3   Eragrostis racemosa sub-community

This sub-community is Species Group F. The diagnostic species are *Eragrostis superba, Helichrysum kraussii* and *Stoebe vulgaris*. The prominent species in this grass layer are *Hyparrhenia hirta* and *Panicum natalense* (Species Group A),

There are no species in the herbaceous layer.

7.1.2.4.2   *Zea mays-Themeda triandra* mielie fields

This community is found next to the meilie fields. It is characterised by Species Group G with the diagnostis species being the grasses *Panicum maximum* and *Themeda triandra* and the herbs such as *Zea mays, Tagetes minuta, Datuta stramonium,* and *Hypoxis hemerocallidea.*

The prominent grasses are *Hyparrhenia hirta, Panicum natalense, Sporobolus africanus (*Species Group A)*, Cynodon dactylon* (Species Group C), Bewsia *biflora, Pennisetum clandestinum* (Species Group E), *Setaria sphacelata* and *Imperata cylindrica* (Species Group H). The herbaceous layer is dominated by *pilosa, Verbena bonariensis* (Species Group A), *Cyperus longus, Solanum sisymbifolium* (Species GroupH), *Gerbera piloselloides, Helichrysum rugulosum, Stachys aethiopica, Helichrysum aurionitens, Boophane disticha* (Species Group I) and *Gomphrena celosoides* (Species Group K).

This community is dived into four sub-communities, namely *Setaria sphacelata* sub-community, *Helichrysum rugulosum* sub-community, *Helichrysum aurionitens* sub-community, and *Gomphrena celosoides* sub-community.

7.1.2.4.2.1   Setaria sphacelata sub-community

This sub-community is found in grassland areas and is characterised by Species Group H. The diagnostic species are the grasses *Setaria sphacelata, Imperata cylindrica* and the herbs such as *Cyperus longus, Solanum sisymbifolium* and *Miscanthus junceus*.

The prominent species in the grass layer are *Hyparrhenia hirta, Panicum natalense, Sporobolus africanus* (Species Group A) *Cynodon dactylon* (Species Group C) *Pennisetum clandestinum* (Species Group E). The herbaceous layer is dominated by *Bidens pilosa, Verbena bonariensis, Bidens pilosa* (Species Group A), *Zea mays* (Species Group C), *Themeda triandra, Datura*

stramonium and *Hypoxis hemerocallidea* (Species Group G). The tree layer is dominated by *Acacia mearnsii* and *Pinus patula* (Species Group G).

7.1.2.4.2.2 Helichrysum rugulosum sub-community

This sub-community is characterized by Species Group I. The diagnostic species are *Gerbera piloselloides, Stachys aethiopica, Gerbera ambigua,* and *Oxalis obliquifolia.*

The prominent species in grass layer are *Hyparrhenia hirta, Panicum natalense, Sporobolus africanus* (Species Group A) and *Themeda triandra* (Species Group G). The herbaceous layer is dominated by *Stoebe vulgaris* (Species Group F), *Datura stramonium* and *Hupoxis hemerocallidea* (Species Group G). The tree layer is dominated by *Eucalyptus camaldulensis* (Species Group D), and *Acacia mearnsii* (Species Group G).

7.1.2.4.2.3 Helichrysum aurionitens sub-community

This sub-community is characterized by Species Group J. The diagnostic species are *Boophane disticha* and *Haplocarpha scaposa.*

The prominent species in grass layer are *Sporobolus africanus (*Species Group A), *Eragrostis curvula* (Species group C), *Pennsisetum clandestinum* (Species Group E), *Panicum maximum* and *Themeda triandra* (Species Group G).

The herbaceous layer is dominated by *Verbena bonariensis* (Species Group A), *Berkhera setifera* (Species Group D), *Zea mays, Tagetes minuta, Datura stramonium* and *Hypoxis hemerocallidea* (Species Group G).

The tree layer is dominated by *Acacia mearnsii,* and *Pinus patula* (Species Group G).

7.1.2.4.2.4 Gomphrena celosoides *sub-community*

This sub-community is characterized by Species Group K. It is only species that charaterized this group. It is found in highly disturbed and overgrazed areas.

No grasses are prominent in this group.

The herbaceous layer is dominated by *Zea mays, Tagetes minuta,* and *Datura stramonium* (Species Group G).

Descriprion of dry season plant communities from the farm Zoekop 426 JS

Due to time constrains, only dry season survey was done on this farm and the following two main vegetation types were found, namely *Ctenium concinnum- Andropogon eucomus* grassland and *Pinus patula- Eucalyptus camaldulensis* woodland. **Table 5** shows the phytosociological table created after species were analysed using the Juice 7.0 program. This table can also be represented graphical by a dendrogram (**Figure 7**). Detail descriptions of all plant communities follows below:

Table 5. Phytosociological table for the farm Zoekop 426 JS

Table number	1	4	2	3	5
Species Group A					
Phragmites australis	3	.	.	.	.
Imperata cylindrica	2a	.	.	.	.
Helichrysum aureonitens	2b	.	.	.	.
Populus alba	3	.	.	.	.
Verbena bonariensis	2b	.	.	.	.
Themeda triandra	3	.	.	.	.
Setaria verticillata	2a	.	.	.	.
Ctenium concinnum	3	.	.	.	.
Andropogon eucomus	3	.	.	.	.
Eragrostis racemosa	3	.	.	.	.
Eragrostis superba	3	.	.	.	.
Species Group B					
Rhus species	.	.	2b	.	.
Asparagus virgatus	.	.	3	.	.
Aloe species	.	.	3	.	.
Species Group C					
Tristachya leucothrix	.	4	.	.	.
Diospyros mespiliformis	.	1	.	.	.
Species Group D					
Melinis repens	.	.	2b	.	.
Leonotis leonurus	.	.	4	.	.
Berkheya setifera	.	3	4	.	.
Species Group E					
Sporobolus africanus	3	.	3	.	.
Acacia mearnsii	2b	4	.	.	.
Hyparrhenia hirta	3	.	2b	.	.
Pseudognaphalium luteo-album	3	3	3	.	.
Species Group F					
Eragrostis curvula	.	.	.	2b	.
Salix babylonica	.	.	.	1	.
Cirsium vulgare	.	.	.	2b	.
Cymbopogon excavatus	.	.	3	3	.

Species Group G					
Schoenoplectus corymbosus	3	.	.	4	.
Species Group H					
Zea mays	.	.	.	.	4
Setaria sphacelata v. sphacelata	.	.	.	.	3
Amaranthus hybridus	.	.	.	3	4
Species Group I					
Tagetes minuta	.	.	2a	.	4
Pinus patula	.	3	1	.	3
Eucalyptus camaldulensis	.	.	3	2a	4
Species Group J					
Conyza bonariensis	3	.	.	.	3
Bidens pilosa	2b	3	3	2b	4
Panicum maximum	3	3	2a	2a	3
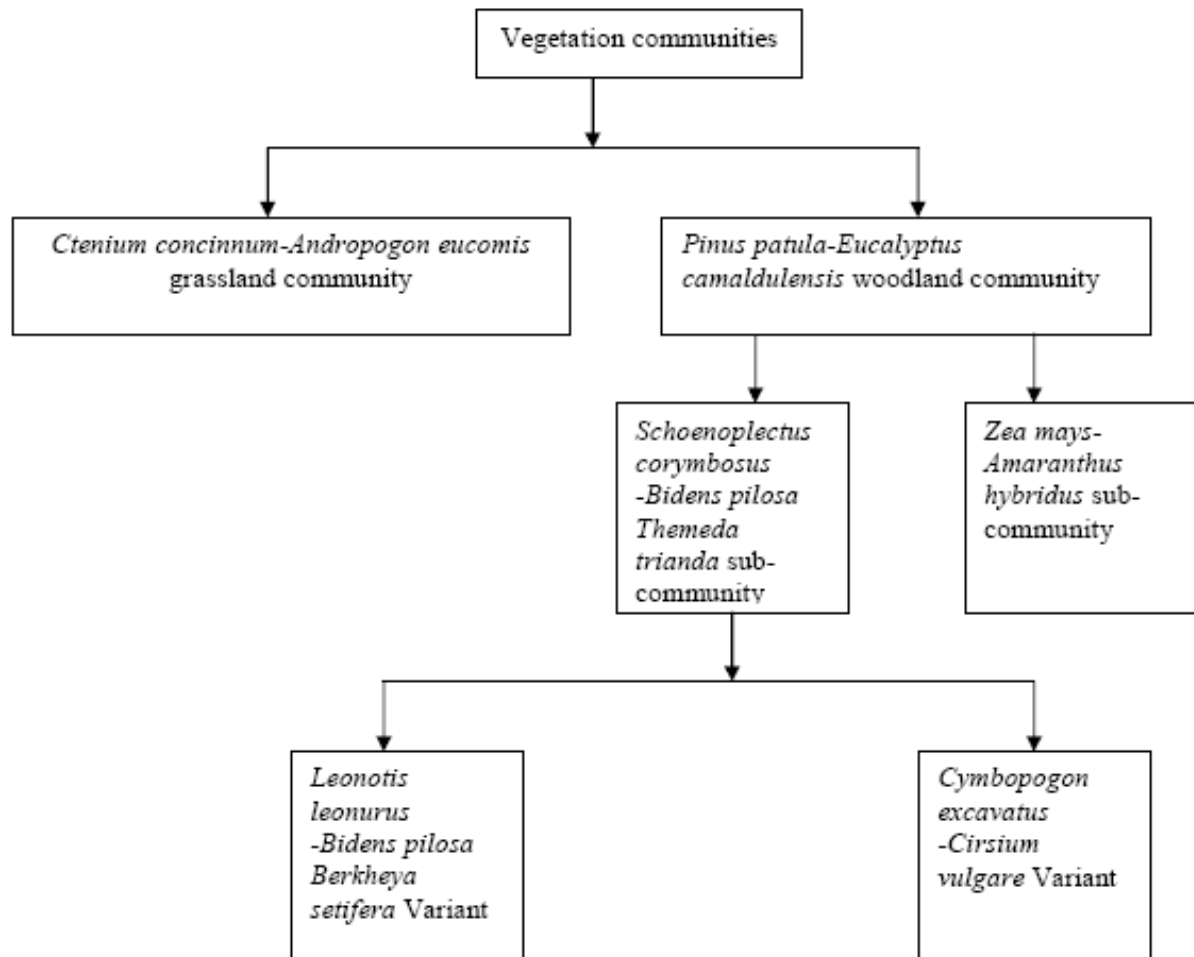
Figure 7. Dendrogram showing plant communities found in Zoekop 426JS.

7.1.2.5.1   *Ctenium concinnum- Andropogon eucomus* grassland

This community is found in the open grassland near the pan. It is characterized by Species Group A. The diagnostic species are *Phragmites australis*, *Imperata cylindrica*, *Helichrysum aureonitens*, *Populus alba*, *Verbena bonariensis*, *Themeda triandra*, *Setaria verticillata*, *Eragrostis racemosa*, and *Eragrostis superba.*

The grass layer is dominated by *Sporobolus africanus, Hyparrhenia hirta* (Species Group E) and *Panicum maximum* (Species Group J).

The herbaceous layer is dominated by *Pseudognaphalium luteo-album* (Species Group E), *Schoenoplectus corymbosus* (Species Group G), *Conyza bonariensis* and *Bidens pilosa* (Species Group J).

The tree layer is dominated by *Acacia mearnsii* (Species Group E).

7.1.2.5.2   *Pinus patula- Eucalyptus camaldulensis* woodland community

This community is dominated by alien invasive species and is characterized by Species Group I. The diagnostic species are *Pinus patula, Eucalyptus camaldulensis* and *Tagetes minuta*. This community is divided into 2 sub-communities, namely *Schoenoplectus corymbosus-Bidens pilosa* sub-community and *Zea mays- Amaranthus hybridus* sub-community.

The grass layer is dominated by *Tristachya leucothrix* (Species Group C), *Melinis repens* (Species Group D)*, Sporobolus africanus, Hyparrhenia hirta* (Species Group E)*, Ergagrostis curvula, Cymbopogon excavatus* (Species Group F), *Setaria sphacelata v. sphacelata* (Species Group H) and *Panicum maximum* (Species Group J).

The herbaceous layer is dominated by *Asparagus virgatus, Aloe sp.*(Species Group B), *Leonotis leonurus, Berkheya setifera* (Species Group D)*, Pseudognaphalium luteo-album* (Species Group E), *Circium vulgare* (Species Group F), *Schoenoplectus corymbosus* (Species Group G), *Zea mays, Amaranthus hybridus* (Species Group H), *Conyza bonariensis* and *Bidens pilosa* (Species Group J).

The shrub or tree layer is dominated by *Rhus* sp (Species Group B), *Diospyros mespiliformis* (Species Group C), *Acacia mearnsii* (Species Group E), and *Salix babylonica* (Species Group F).

7.1.2.5.2.1   *Schoenoplectus corymbosus-Bidens pilosa sub-community*

This sub-community is characterized by Species Group G. The diagnostic species is the sedge *Schoenoplectus corymbosus.*There are two variants in this sub-community, namely *Leonotis leonurus-Berkheya setifera* Variant and *Cymbopogon excavatus- Circium vulgare* Variant.

The grass layer is dominated by *Tristachya leucothrix* (Species Group C), *Melinis repens* (Species Group D)*, Sporobolus africanus, Hyparrhenia hirta* (Species Group E), *Ergagrostis curvula, Cymbopogon excavatus* (Species Group F), *Circium vulgare* (Species Group F) and *Panicum maximum* (Species Group J).

The herbaceous layer is dominated by *Asparagus virgatus, Aloe sp* (Species Group B, *Leonotis leonurus, Berkheya setifera* (Species Group D)*, Pseudognaphalium luteo-album* (Species Group E), *Amaranthus hybridus* (Species Group H) and *Tagetes minuta* (Species Group I).

The shrub or tree layer is dominated by *Rhus* sp (Species Group B), *Diospyros mespiliformis* (Species Group C), *Acacia mearnsii* (Species Group E), and *Salix babylonica* (Species Group F), *Pinus patula* and *Eucalyptus camaldulensis* (Species Group I).

7.1.2.5.2.2   *Zea mays- Amaranthus hybridus sub-community*

This variant is dominated by mielie fields. It is characterized by Species Group H. the diagnostic species are *Zea mays, Amaranthus hybridus* and *Setaria sphacelata var. sphacelata.*

The grass layer is dominated by *Panicum maximum* (Species Group J). The herbaceous layer is dominated by *Tagetes minuta* (Species Group I). The shrub or tree layer is dominated by *Pinus patula, Eucalyptus camaldulensis* (Species Group I).

7.1.2.6   Descriprion of wet season plant communities

The wet season survey is divided into two main grasslands vegetation types (**Table 6**), namely *Tristachya leucothrix-Monocymbium ceresiiforme* grassland and *Setaria sphacelata v. sphacelata- Hyparrhenia hirta* grassland. The two main grassland communities will be discussed in detail below.

Table 6. Phytosociological table for Weltevreden wet season survey

Table number	12	10	6	11	2	1	4	3	5	7	8	9
Species Group A												
Bidens bipinnata	3	.	.	.	.	.	.	.	.	.	.	.
Melinis nerviglumis	2b	.	.	.	.	.	.	.	.	.	.	.

Species Group B												
Typha capensis	.	4	.	.	.	.	.	.	.	.	.	.
Setaria pumila		2b	.	.	.	.	.	.	.	.	.	.
Cyperus esculentus	.	3	.	.	.	.	.	.	.	.	.	.
Bothriochloa radicans	2b	2b	.	.	.	.	.	.	.	.	.	.
Species Group C												
Berkheya setifera	.	.	.	3	.	.	.	.	.	.	.	.
Eragrostis superba	.	.	2b	.	.	.	.	.	.	.	.	.
Pseudognaphalium luteo-album	.	.	2a	2a	.	.	.	.	.	.	.	.
Diospyros mespiliformis	.	.	.	2b	.	.	.	.	.	.	.	.
Gerbera ambigua	.	.	2a	.	.	.	.	.	.	.	.	.
Species Group D												
Tristachya leucothrix	3	.	2a	3	.	.	.	.	.	.	.	.
Monocymbium ceresiiforme	2b	.	.	3	.	.	.	.	.	.	.	.
Species Group E												
Schoenoplectus corymbosus	.	.	.	.	.	2a	.	.	.	.	.	.
Sebaea grandis	.	.	.	.	.	2b	.	.	.	.	.	.
Aloe arborescens	.	.	.	.	.	2a	.	.	.	.	.	.
Hypoxis hemerocallidea	.	.	.	.	.	r	.	.	.	.	.	.
Pinus patula	.	.	.	.	.	1	.	.	.	.	.	.
Zea mays	.	.	.	.	.	3	.	.	.	.	.	.
Heteropogon contortus	.	.	.	.	2a	2b	.	.	.	.	.	.
Species Group F												
Verbena officinalis	.	.	.	.	2a	.	.	.	.	.	.	.
Stoebe vulgaris	.	.	.	2a	.	2b	.	.	.	.	.	.
Eragrostis gummiflua	.	.	2b	.	2a	.	.	.	.	.	.	.
Eragrostis racemosa	.	2b	2b	.	.	.	.	2b	.	.	.	.
Themeda triandra	3	.	4	3	3	3	.	.	.	.	.	.
Species Group G												
Cynodon dactylon	.	.	.	.	.	.	.	.	3	.	.	.
Chamaesyce inaequilatera	.	.	.	.	.	.	2b	.	.	.	.	.
Pennisetum clandestinum	.	.	.	.	.	.	4	3	.	.	.	.
Species Group H												
Sutherlandia frutescens	.	.	.	.	.	.	.	.	.	2b	.	.
Enneapogon cenchroides	.	.	.	.	.	.	.	.	.	2b	.	.
Lippia javanica	.	.	.	.	.	.	.	.	.	r	.	.
Gomphocarpus fruticosus	.	.	.	.	2a	.	.	.	.	2a	.	.
Andropogon appendiculatus	.	.	.	.	.	2b	.	.	.	3	.	.
Species Group I												
Helichrysum aureonitens	.	.	.	2a	2b	2b	.	2b	.	2b	.	.
Aristida congesta s. congesta	.	2b	.	.	.	2b	2a	2b	.	2b	.	.
Acacia mearnsii	3	.	.	.	.	1	.	.	.	2a	.	.
Species Group J												
Gladiolus dalenii	.	.	.	.	.	.	.	.	.	.	2b	.
Hibiscus trionum	.	.	.	.	2b	.	.	.	2a	.	r	.
Andropogon eucomus	.	.	.	.	.	2b	.	2a	2b	.	2b	.
Helichrysum acutatum	.	.	2b	.	.	3	.	.	3	.	2b	.
Cortaderia selloana	.	3	.	.	.	.	.	.	.	1	2b	.
Species Group K												
Cirsium vulgare	3	2b	.	.	.	.	.	.	2b	2a	2b	.
Hypochaeris radicata	2b	.	2a	3	2b	2b	3	2a	2a	2a	2b	.
Species Group L												
Amaranthus hybridus	.	.	.	.	.	.	.	.	.	.	.	2b

Species												
Digitaria eriantha	.	4	.	.	.	.	.	.	.	.	.	3
Brachiaria brizantha	.	.	.	.	.	.	.	.	.	.	.	2a
Datura stramonium	.	.	.	.	.	.	.	.	.	.	.	2b
Species Group M												
Setaria sphacelata v. sphacelata	.	.	.	.	2b	3	.	.	2a	3	.	3
Hyparrhenia hirta	.	.	2a	3	3	3	3	2a	3	.	2a	4
Conyza bonariensis	.	2b	.	.	.	2b	3	.	3	3	3	3
Species Group O												
Paspalum dilatatum	.	2b	2a	.	.	.	.	.	.	2b	3	2b
Oxalis obliquifolia	.	3	3	.	3	2a	.	2a	2b	.	r	2a
Cyperus longus	.	2b	2a	.	.	2a	.	2a	2a	2a	3	2a
Bidens pilosa	3	.	.	.	2b	2a	2a	.	.	.	.	2b
Sporobolus africanus	2b	.	.	2b	2b	4	2a	2b	2b	.	2b	2a
Sporobolus pyramidalis	2b	.	.	3	.	.	.	2a	.	.	2b	2b
Panicum maximum	2b	.	2b	2b	2a	2b	2b	2a	3	2a	2b	2b
Verbena bonariensis	3	3	2a	2b	3	3	3	3	4	2b	2b	2a

7.1.2.6.1 Tristachya leucothrix- Monocymbium ceresiiforme grassland

This grassland communitiy is found in disturbed and overgrazed areas. The presence of alien invasive species such as *Bidens bipinnata* (Commom Black-jack), which is a widespread weed (Pooley 1998), is an indication of disturbed areas. The diagnostic species are in Species Group D. This community has two sub-communities, namely *Bidens bipinnatus-Melinis nerviglumis* sub-community and *Berkheya setifera-Diospyros mespiliformis* sub-community.

The prominent species in grass layer are *Melinis nerviglumis* (Species Group A), *Typha capensis Bothriochloa radicans* (Species Group B), *Eragrostis superba* (Species Group C), *Eragrostis gummiflua, Eragrostis racemosa, Themeda triandra* (Species Group F), *Aristida congesta s. congesta*(Species Group I) and exotic grass *Cortaderia selloana*(Species Group J).

The herbaceous layer is dominated by *Bidens bipinnata* (Species Group A), reed *Cyperus esculentus* (Species Group B), *Berkheya setifera* (Species Group C) and *Cirsium vulgare* (Species Group K).

The tree or shrub layer is characterized by *Diospyros mespiliformis* (Species Group C) and *Acacia mearnsii* (Species Group I).

7.1.2.6.1.1 Bidens bipinnatus-Melinis nerviglumis sub-community

This sub-community is characterized by Species Group A. The diagnostic species are *Bidens bipinnatus* and *Melinis nerviglumis.*

The prominent species in the grass layer are *Bothriochloa radicans* (Species Group B), *Tristachya leucothrix, Monocymbium ceresiiforme* (Species Group D), *Themeda triandra* (Species Group F), *Sporobolus africanus*, *Sporobolus pyramidalis* and *Panicum maximum* (Species Group O).

The herbaceous layer is dominated by *Cirsium vulgare, Hypochaeris radicata* (Species Group K), *Bidens pilosa* and *Verbena bonariensis* (Species Group O).

Tree or shrub layer is characterized by *Acacia mearnsii* (Species Group I).

7.1.2.6.1.2 Berkheya setifera-Diospyros mespiliformis sub-community

The prominent species in the grass layer are *Typha capensis, Bothriochloa radicans* (Species Group B), *Tristachya leucothrix, Monocymbium ceresiiforme* (Species Group D), *Eragrostis racemosa, Themeda triandra* (Species Group F), *Aristida congesta s. congesta*(Species Group I), *Cortaderia selloana*(Species Group J), *Digitaria eriantha*(Species Group L), *Hyparrhenia hirta*(Species Group M), *Paspalum dilatatum, Sporobolus pyramidalis* and *Panicum maximum* (Species Group O).

The herbaceous layer is dominated by *Cyperus esculentus* (Species Group B), *Helichrysum acutatum* (Species Group J), *Cirsium vulgare, Hypochaeris radicata* (Species Group K), *Conyza bonariensis* (Species Group M), *Oxalis obliquifolia*, *Cyperus longus and Verbena bonariensis* (Species Group O).

No tree or shrub layer is present in this sub-community.

7.1.2.6.2 *Setaria sphacelata v. sphacelata- Hyparrhenia hirta* grassland

This communitiy is found in tall grassland and it is not highly disturbed and undergrazed. It is charaterized by Species Group M. The diagnostic species are *Hyparrhenia hirta, Setaria sphacelata v. sphacelata* and *Conyza bonariensis*. This community has two sub-communities, namely *Amaranthus hybridus-Datura stramonium* sub-community and *Helichrysum aureonitens-Aristida congesta s. congesta* sub-community.

The prominent species in the grass layer are *Heteropogon contortus* (Species Group E), *Eragrostis gummiflua Themeda triandra* (Species Group F), *Pennisetum clandestinum* (Species Group G), *Andropogon appendiculatus* (Species Group H), *Aristida congesta s. congesta*

(Species Group I), *Andropogon eucomus*(Species Group J), *Digitaria eriantha* (Species Group L), *Paspalum dilatatum, Sporobolus africanus*, *Sporobolus pyramidalis* and *Panicum maximum* (Species Group O).

The herbaceous layer is dominated by *Stoebe vulgaris* (Species Group F), *Gomphocarpus fruticosus* (Species Group H), *Helichrysum aureonitens* (Species Group I), *Hibiscus trionum, Helichrysum acutatum* (Species Group J), *Cirsium vulgare, Hypochaeris radicata* (Species Group K), *Oxalis obliquifolia*, *Cyperus longus*, *Bidens pilosa* and *Verbena bonariensis* (Species Group O).

Tree or shrub layer is characterized by *Acacia mearnsii* (Species Group I).

7.1.2.6.2.1   Amaranthus hybridus-Datura stramonium sub-community

This sub-community is characterized by Species Group L. The diagnostic species in the grass layer are *Digitaria eriantha* and *Brachiaria brizantha*, while the diagnostic species in herbaceous layer are alien invasive species *Amaranthus hybridus* and *Datura stramonium.*

The prominent species in the grass layer are *Andropogon eucomus, Cortaderia selloana* (Species Group J), *Setaria sphacelata v. sphacelata*, *Hyparrhenia hirta* (Species Group M), *Paspalum dilatatum, Sporobolus africanus*, *Sporobolus pyramidalis* and *Panicum maximum* (Species Group O).

The herbaceous layer is dominated by *Gladiolus dalenii, Helichrysum acutatum* (Species Group J), *Cirsium vulgare, Hypochaeris radicata* (Species Group K), *Conyza bonariensis* (Species Group M), *Oxalis obliquifolia*, *Cyperus longus*, *Bidens pilosa* and *Verbena bonariensis* (Species Group O).

No tree or shrub layer is present in this sub-community.

7.1.2.6.2.2   Helichrysum aureonitens-Aristida congesta s. congesta sub-community

This sub-community is characterized by Species Group I. The diagnostic species are *Helichrysum aureonitens, Aristida congesta s. congesta* and *Acacia mearnsii.*

The prominent species in the grass layer are *Heteropogon contortus* (Species Group E), *Eragrostis racemosa*, *Themeda triandra* (Species Group F), *Cynodon dactylon*, *Pennisetum*

clandestinum (Species Group G), *Andropogon appendiculatus* (Species Group H), *Andropogon eucomus* (Species Group J), *Setaria sphacelata v. sphacelata* and *Hyparrhenia hirta*(Species Group M).

The herbaceous layer is dominated by *Sebaea grandis, Zea mays* (Species Group E), *Stoebe vulgaris*(Species Group F), *Sutherlandia frutescens*, *Enneapogon cenchroides*(Species Group H), *Hibiscus trionum*, *Helichrysum acutatum* (Species Group J), *Cirsium vulgare, Hypochaeris radicata* (Species Group K) and *Conyza bonariensis*(Species Group M).

Tree or shrub layer is characterized by *Pinus patula* (Species Group E).

7.2 Animal Survey

7.2.1 Mammals

7.2.1.1 Mammal desktop study: Red Data Mammals that could occur in the area

Table 7 below indicates the Red Data species that could be found in the area of interest. The species in bold are species of the high status, and if found, measures should be put in place to conserve them and minimise the threats posed to them.

Table 7. Red Data mammals that could be found in Weltevreden

Order	Scientific Name	Common Name	Status
Artiodactyla	*Antidorcas marsupialis*	Springbok	Least concern
Artiodactyla	*Damaliscus pygargus phillipsi*	Blesbok	Least concern
Artiodactyla	*Raphicerus campestris*	Steenbok	Least concern
Artiodactyla	*Redunca arundinum*	Reedbuck	Least concern
Artiodactyla	*Sylvicapra grimmia*	Grey /Common Duiker	Least concern
Carnivora	*Aonyx capensis*	Common Clawless Otter	Least concern
Carnivora	*Atilax paludinosus*	Water Mongoose	Least concern
Carnivora	***Canis adustus***	**Side-striped Jackal**	**Near Threatened**
Carnivora	*Canis mesomelas*	Black-backed Jackal	Least concern
Carnivora	*Caracal caracul*	Caracal	Least concern
Carnivora	*Cynictis penicillata*	Yellow Mongoose	Least concern
Carnivora	*Felis nigripes*	Black-footed Cat	Least concern
Carnivora	*Felis silvestris*	African Wild Cat	Least concern
Carnivora	*Galerella sanguinea*	Slender Mongoose	Least concern
Carnivora	*Genetta genetta*	Small-spotted Genet	Least concern
Carnivora	*Genetta tigrina*	Large-spotted Genet	Least concern
Carnivora	*Ictonyx striatus*	Striped Polecat	Least concern

Order	Scientific Name	Common Name	Status
Carnivora	***Leptailurus serval***	**Serval**	**Near Threatened**
Carnivora	*Suricata suricatta*	Suricate	Least concern
Carnivora	*Vulpes chama*	Cape Fox	Least concern
Insectivora	***Atelerixs frontalis***	**South African Hedgehog**	**Near Threatened**
Lagomorpha	*Lepus capensis*	Cape/desert Hare	Least concern
Lagomorpha	*Lepus saxatilis*	Scrub/Savannah Hare*	Least concern
Rodentia	*Cryptomys hottentotus*	Common Molerat	Least concern
Rodentia	*Hystrix africeaustralis*	Porcupine	Least concern
Rodentia	*Otomys angoniensis*	Angoni Vlei Rat	Least concern
Rodentia	*Otomys irroratus*	Vlei Rat	Least concern
Rodentia	*Pedetes capensis*	Springhare	Least concern
Rodentia	*Rhabdomys pumilio*	Striped Mouse	Least concern
Rodentia	*Tatera brantsi*	Highveld Gerbil	Least concern
Tubulidentata	*Orycteropus afer*	Aardvark	Least concern

7.2.1.2   Mammals observed and recorded in the area

Actual sightings, spoor, calls, dung and nesting sites were used to establish the presence of animals on the proposed project site. The evidence of dung and spoor suggests that these animals were in the area even though very few were observed during the surveys. Traps were also placed in frontof fresh burrows in an attempt to identify smaller animals in the area. **Table8** and **Table 9** list all animals observed during both dry and wet season surveys respectively. Only two mammals (**Table 10**) were observed on Zoekop farm.

Table 8. Mammals observed at the site during the dry season

Order:	Family:	Genus	Species	English name	Status
Artiodactyla	Bovidae	*Sylvicapra*	*grimmia*	Common duiker	Least concern
Hyracoidea	Procavidae	*Procavia*	*capensis*	Rock dassie	Least concern
Rodentia	Pedetidae	*Pedetes*	*capensis*	Springhare	Least concern
Rodentia		*Unknown*			

Table 9. Mammals observed at the site during the wet season

Order:	Family:	Genus	Species	English name	Status
Carnivora	Herpestidae	*Ichneumia*	*albicauda*	White-tailed Mongoose	Least concern
Artiodactyla	Bovidae	*Sylvicapra*	*grimmia*	Grey /Common Duiker	Least concern

Table 10. Mammals observed in Zoekop farm during the winter survey

Order:	Family:	Genus	Species	English name	Status
Artiodactyla	Bovidae	*Sylvicapra*	*grimmia*	Common duiker	Least concern
Rodentia		*Unknown*			

7.2.2 Birds

7.2.2.1 Bird desktop study: Birds that could occur in the area

A list of all the birds that could possibly be found in the area is provided in **Appendix 7.** Roberts (2003) lists 388 species for grid reference 2530CC. This list is compiled using historical data and recorded sightings for the entire grid.

7.2.2.2 Birds observed and recorded in the area

A total of 15 bird species were identified during the dry season survey (**Table 11**) and 20 were observed during the wet season survey (**Table12**). Most of these birds were observed in the vicinity of less disturbed areas where bush clumps of *Acacia mearnsii* and *Pinus patula* occur. A total of six bird species were observed on Zoekop farm (**Table 13**), and most of these birds were found in and around the pan.

Table 11. Bird species recorded during the dry season

Robert's No.	English name:	Scientific name:
203	Helmeted Guineafowl	*Numida meleagris*
415	Whiterumped Swift	*Apus caffer*
71	Cattle Egret	*Bubulcus ibis*
349	Rock pigeon	*Columba guinea*
548	Pied Crow	*Corvus albus*
601	Cape Robin-Chat	*Cossypha caffra*
520	Whitethroated Swallow	*Hirundo albigularis*
732	Fiscal shrike	*Lanius collaris*
713	Cape Wagtail	*Motacilla capensis*
801	House sparrow	*Passer domesticus*
803	Cape sparrow	*Passer melanurus*
811	Spottedbacked Weaver	*Ploceus cucullatus*
814	Southern Masked Weaver	*Ploceus velatus*
354	Cape Turtle Dove	*Streptopelia capicola*
619	Garden Warbler	*Sylvia borin*

Table 12. Bird species recorded during the wet season

NUMBER	COMMON NAME	SCIENTIFIC NAME
58	Reed Cormorant	*Phalacrocorax africanus*
63	Black-headed Heron	*Ardea melanocephala*
71	Cattle Egret	*Bubulcus ibis*
95	African Spoonbill	*Platalea alba*
102	Egyptian Goose	*Alopochen aegyptiacus*
104	Yellow-billed Duck	*Anas undulata*
116	Spur-winged Goose	*Plectropterus gambensis*
127	Black-shouldered Kite	*Elanus caeruleus*
203	Helmeted Guineafowl	*Numida meleagris*
228	Red-knobbed Coot	*Fulica cristata*
355	Laughing Dove	*Streptopelia senegalensis*
520	White-throated Swallow	*Hirundo albigularis*
527	Lesser Striped Swallow	*Hirundo abyssinica*
814	Southern Masked-Weaver	*Ploceus velatus*
824	Southern Red Bishop	*Euplectes orix*
826	Yellow-crowned Bishop	*Euplectes afer*
832	Long-tailed Widowbird	*Euplectes progne*
68	Yellow-billed Egret	*Egretta intermedia*
99	White-faced Duck	*Dendrocygna viduata*
352	Red-eyed Dove	*Streptopelia semitorquata*

Table 13. Birds observed in Zoekop farm

NUMBER	COMMON NAME	SCIENTIFIC NAME
228	Red-knobbed Coot	*Fulica cristata*
732	Fiscal shrike	*Lanius collaris*
102	Egyptian Goose	*Alopochen aegyptiacus*
58	Reed Cormorant	*Phalacrocorax africanus*
677	Levaillant's Cisticola	*Cisticola tinniens*
94	Hadeda Ibis	*Bostrychia hagedash*

7.2.2.3   Red Data birds

No rare or endangered species were observed during the wet and dry season's survey.

7.2.3 Reptiles

Only one lizard was observed during the dry season survey on Zoekop farm but could not be identified.

7.2.4 Terrestrial Invertebrates

7.2.4.1 Insects

The area is highly disturbed with most parts covered with mielie fields. The vegetation is characteristic of the grassland biome, with herbs and grasses making up the major plant groups. Some invasive trees also occur in the area. It would be expected that with the vegetation type of the area one would find members of the Orthoptera (grasshoppers, locusts and crickets), Hemiptera (bugs, cicadas, and leaf hoppers), Lepidoptera (butterflies and moths), Coleoptera (beetles), Hymenoptera (wasps and ants) and flies (Diptera) (Picker, *et al.*, 2002). **Appendix 8** and **Appendix 9** shows the insects that were collected during the dry and wet season surveys respectively. The Chironomidae family had the highest species richness (**Table 14**) and Reduviidae family had the highest species richness during the wet season (**Table 15**). **Table 16** shows the insects collected from Zoekop farm and their abundances is shown in **Table 17**, with Mantidae and Pieridae showing the highest species abundances.

Table 14. Total number of families found in Weltevreden during the dry season

Family	Total number	Family	Total number
Acanthosomatidae	1	Issidae	2
Acrididae	10	Lygaeidae	5
Anthicidae	2	Mantidae	2
Apionidae	6	Meloidae	2
Aradidae	1	Muscidae	16
Asilidae	29	Pentatomidae	2
Calliphoridae	7	Pompilidae	2
Cerambycidae	1	Reduviidae	4
Ceratopogonidae	5	Sepsidae	8
Chironomidae	172	Sphecidae	12
Chrysomelidae	8	Staphylinidae	1
Cicadellidae	42	Syrphidae	7
Cixiidae	10	Tabanidae	2
Coccinellidae	11	Tachinidae	3
Coreidae	6	Tachnidae	1
Culicidae	4	Tenebrionidae	1
Cydnidae	1	Tenthredinidae	8
Dolichopodidae	9	Tephritidae	8

Table 15. Total number of families found during the wet season

Number	Different Families	Total Abundance	Number	Different Families	Total Abundance
1	Acrididae	12	20	Pentatomidae	4
2	Alydidae	4	21	Pompilidae	1
3	Aradidae	4	22	Reduviidae	151
4	Asilidae	4	23	Scarabaeidae	5
5	Carabidae	2	24	Sepsidae	8
6	Cercopidae	1	25	Sphecidae	2
7	Chironomidae	17	26	Staphylinidae	4
8	Chrysomelidae	20	27	Tenebrionidae	18
9	Cicadellidae	4	28	Tipulidae	16
10	Coccinellidae	6			
11	Coenagrionidae	7			
12	Curculionidae	43			
13	Dictyopharidae	4			
14	Elateridae	1			
15	Formicidae	14			
16	Languriidae	1			
17	Mantidae	4			
18	Meloidae	17			
19	Muscidae	47			

Table 16. Insects collceted from Zoekop farm during dry season

Site	Family	Abundance
KOOS 1	Acrididae	1
	Chironomidae	1
	Chrysomelidae	1
	Mantidae	3
KOOS 2	Alydidae	2
	Mantidae	4
	Notodontidae	2
	Pompilidae	1
	Reduviidae	1
KOOS 3	Coccinellidae	1
	Mantidae	1
	Pieridae	2
	Pompilidae	3
KOOS 4	Acrididae	1
	Cercopidae	1
	Cicadellidae	1
	Chrysomelidae	1
	Pentatomidae	1
	Pieridae	6

	Reduviidae	2
	Tenebrionidae	1
KOOS 5	Alydidae	2
	Muscidae	1
	Sepsidae	1
	Sphecidae	1

Table 17. Total abundance of insects collected from Zoekop during dry seasn

| Different Families Found Throughout all Samples	Total Abundance
Acrididae	2
Alydidae	4
Cercopidae	1
Chironomidae	1
Chrysomelidae	2
Cicadellidae	1
Coccinellidae	1
Mantidae	8
Muscidae	1
Notodontidae	2
Pentatomidae	1
Pieridae	8
Pompilidae	4
Reduviidae	3
Sepsidae	1
Sphecidae	1
Tenebrionidae	1

8   DISCUSSION

The typical vegetation in this region is savanna, containing both a tree, shrub layer and a grass layer. Due to the extensive grazing by livestock in some areas, the relationship between these two layers has become unbalanced, resulting in the tree and shrub layer becoming dominant over the grass layer. This then allows the tree and shrub layer to continually out-compete the grass layer, resulting in a dense tree and shrub layer and limited grass cover.

8.1   Vegetation

Grass plays an essential role as a food source and shelter in most habitats. The main reason for this is that grass occurs widely over the sub-continent and is almost always edible. Grass usually forms the basis of food chains with animals at the bottom of the food chain being directly dependent on it and therefore predators indirectly dependent on it.

Simpson's Index (SI) was used to measure vegetation biodiversity for the area. From **Figure 8** it was evident that the vegetation sample plots with the highest biodiversity during the wet season are plots 1, 2, 7, 8 and 9 with an SI value of 15.00 or above. Those plots with medium biodiversity are 3, 4, 5, 6, 10, 11 and 12 with an SI value of between 10.00 and 15.
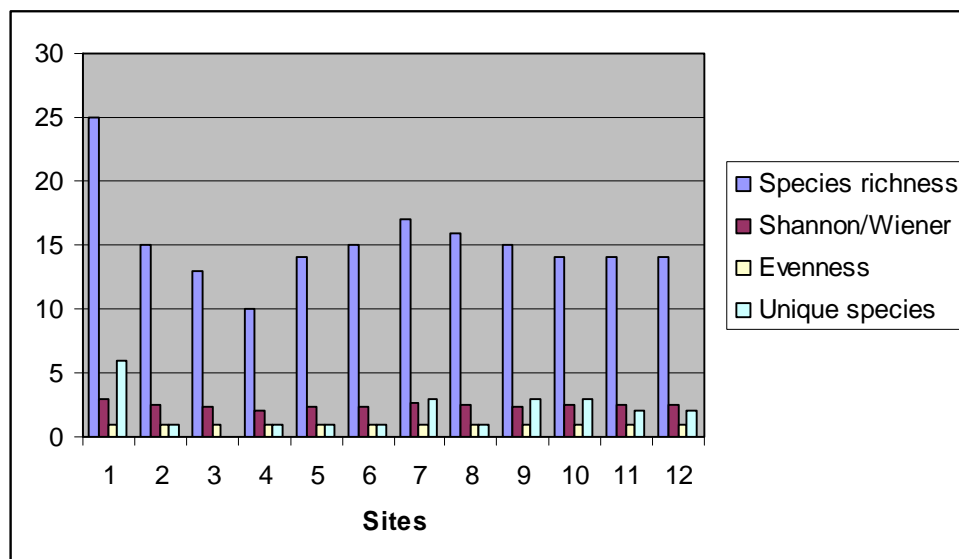
Figure 8. Depiction of vegetation biodiversity for Weltevreden during wet season using Simpson's index and species richness

Figure 9 shows that the vegetation sample plots with the highest biodiversity during the dry season are plots 2,9,11 and 12 with a SI value of 15.00 or above. Those plots with low biodiversity are 3, 6 and 13 with an SI value of below 8.
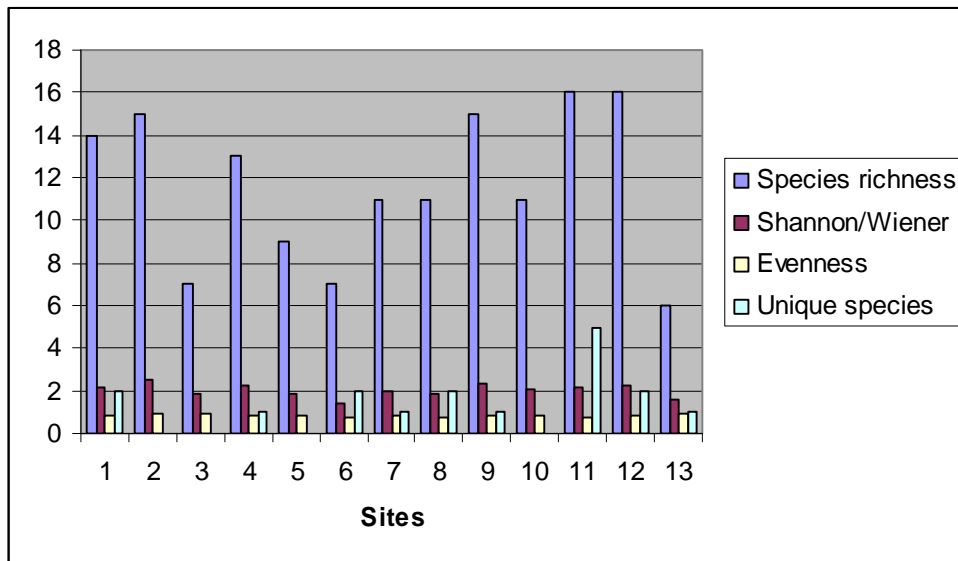
Figure 9. Depiction of vegetation biodiversity for Weltevreden during **dry** season using Simpson's index and species richness

Table 18 below compares the species found during the dry season and wet season surveys. The three species identified during the dry season were *Acacia mearnsii, Eucalyptus camaldulensis* and *Pinus patula* whereas the three trees identified during summer were *Acacia mearnsii, Diospyros mespiliformis* and *Pinus patula.* The *Eucalyptus camaldulensis* species which was identified during the dry season were chopped down during the wet season survey and *Diospyros mespiliformis* was collected next to the mielie fields.

Table 18. Comparison between dry and wet season flora surveys

	Dry season	Wet season	Zoekop farm
Trees	3	3	5
Shrubs	5	5	4
Grasses	20	25	16
Herbs	8	19	10
Total number of species	**38**	**58**	**35**

It is difficult to identify herbs and grasses during winter or dry season and this is due to the fact that grasses do not have inflorscences and herbs are not flowering. The high numbers of herbs and grasses during the wet season is a testimony to that. The dry and wet season communities are

represented in **Appendix 10,** and this map only shows the major communities and excludes the sub-communities and variants. This map also includes the Cherry orchard in Zoekop farm.

8.2   Mammals

Common/Grey duiker was observed during both he dry and wet seasons surveys. These species can survive and flourish in a wide range of habitats (Skinner & Chimimba 2005) and the fact that it could be identified in both seasons proves that point. The local people also hunt in these areas. As a result very few wild animals were expected to occur here. The very low numbers of actual wild animal sightings confirmed this. The pans provide watering points for the existing wildlife.

8.3   Birds

Fifteen bird species were observed during the dry season survey as compared to 20 that were observed during the wet season survey. The two birds species, namely Cattle Egret *Bubulcus ibis* and White throated swallow *Hirundo albigularis* were observed during both the seasons. Birds migrate during the seasons as a result of food availability and the threats posed to them.

8.4   Insects

Interestingly the high species richness was in dry season with 429 species whereas in wet season there were 421species. Insects are normally found in abundance after big rains and they stay dormant during colder or winter season (Elzinga 2000). Of the 429 species found during dry season, 172 (40%) fall under Chironomidae family, mostly dominated by flies. The larvae need water and as there are two pans in the study area, water is not an issue, and hence lots of these species were found during winter. During the wet season, Reduviidae family has 151 (35.8%) and species in this family, especially the nymph feed on green leaves and also on mielie fields, and that explains why there were abundant during the wet season.

8.5   Reptiles

No reptiles were found during the field surveys. One lizard was seen during the dry season survey and ran away before the picture could be taken.

9 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

9.1 EIA Methodology

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though DWA, and the majority of environmental impact assessment practitioners, propose a numerical methodology for impact assessment, one has to accept that the process of environmental significance determination is inherently subjective. The weight assigned to the each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, as well as that of the interested and affected parties (IAPs) and authorities who provide input into the process. Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved.

It has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. The methodology employed for environmental impact assessment is divided into two distinct phases, namely, impact identification and impact assessment.

9.1.1 Impact Identification

Impact identification is performed by use of an Input-Output model which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the project.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. Negative impacts could include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive

vegetation, construction of infrastructure, skills transfer or benefits to the socio-economic environment. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

9.1.2   Impact Rating

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. As discussed above, it has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. This gives the project proponent a greater understanding of the impacts of his project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability

Where

Consequence = Severity + Spatial Scale + Duration

And

Probability = Likelihood of an impact occurring

The matrix first calculates the rating out of 75, and then converts this into a percentage out of 100. The percentage is the figure quoted in the matrix. The weight assigned to the various parameters for positive and negative impacts in the formula is presented in (**Table 19)** below**.**

Table 19. Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
55	Very significant impact/total destruction of a highly valued species, habitat or ecosystem or extremely positive impact over baseline environmental condition.	Irreparable damage to/destruction of highly valued items of great cultural significance or complete breakdown of social order or Extremely positive impact on social, economic and cultural environment.	National/ International	Permanent/ Irreversible (more than 50 years)	Certain/ Normally happens in cases of this nature (80-100% chance of happening)
54	Serious impairment of ecosystem function. or very positive impact over baseline environmental condition	Serious social issues/Permanent damage to items of cultural significance or very positive impact on social, economic and cultural environment.	Provincial/ Regional	Long Term (25 to 49 years or beyond closure)	Will more than likely happen (60-79% chance)
33	Moderate negative alteration of ecosystem functioning or Moderately positive impact over baseline environmental condition	Moderately important social issues and/or moderately significant damage to items of cultural significance or Moderately positive impact on social, economic and cultural environment.	Regional (substantially beyond site boundary)	Medium Term (5-24 years)	Could happen and has happened here or elsewhere (40-59% chance)
22	Minor effects not affecting ecosystem functioning or Slightly positive impact over baseline environmental condition	Minor Impacts on the local population, repairable over time. Temporary impairment of the availability of items of cultural significance or Minor positive impact on social, economic and cultural environment	Local (beyond site boundary and affects neighbours)	Medium-Short Term (1-4 years)	Has not happened yet, but could (20-39% chance)
11	Insignificant effects on the biophysical environment or Insignificantly positive impact over baseline environmental condition	Insignificant social issues / low-level repairable damage to commonplace structures. positive impact on social, economic and cultural environment or Insignificant positive impact on social, economic and cultural environment	Site (does not extend beyond site boundary)	Short term (Less than a year)	Conceivable, but only in a set of very specific and extreme circumstances (0-19% chance)

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP. The significance of an impact is then determined and categorised into one of four categories, as indicated in (**Table 20**). In accordance with Regulation 51 of the MPRDA, management actions will be assigned for all impacts, irrespective of significance. The environmental impact assessment for each relevant activity is presented in Table 21. Additionally, the suggested management for each identified impact is presented in Table 22.

Table 20: Significance threshold limits

Category	Description	Colour
High	76 % - 100%	
Medium – High	51% – 75%	
Medium - Low	26% – 50%	
Low	0% - 25%	

Table 21: The listed activities described for each phase and the impact description and significance rating thereof

No	Activity Description	Phase	Affected environment	Impact	Positive or Negative Impact	Impact significance before mitigation							Mitigation
						EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
CONSTRUCTION PHASE												
1	**Removal of topsoil**												
		Construction	Natural vegetation	Removal of topsoil will lead to the removal of vegetation that is binding the soil and this activity will increase the erosion potential of the area.	N		4	3	3	10	5	67	Removal of vegetation during stripping and dump construction will be minimised to reduce the erosion potential. Topsoil will only be removed off areas proposed for immediate mining. All soils should be stored and managed correctly for rehabilitation
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	topsoil removal results in the destruction of natural habitats for animals	N		4	3	3	10	5	67	Removal of vegetation during stripping and dump construction will be minimised to reduce the erosion potential. Topsoil will only be removed off areas proposed for immediate mining. All soils should be stored and managed correctly for rehabilitation to create natural habitats for animals
2	**Construction of haul roads**												
		Construction	Natural vegetation	When the haul road is constructed, vegetation will be removed.	N		4	3	3	10	4	53	All construction activities will be planned and managed to ensure that there will not be dramatic vegetation clearing. Efforts will be made to limit the construction of haul roads next to the pan. Haul roads will be low in gradient to limit reduce runoff velocity.
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	removal of vegetation will destroy the natural habitats of animals	N		4	3	3	10	4	53	All construction activities will be planned and managed to ensure that there will not be dramatic vegetation clearing. Efforts will be made to limit the construction of haul roads next to the pan where mammals and birds depend on pan for water.
3	**Construction of hydrocarbon storage facility**												
		Construction	Natural vegetation	Potential contamination of soil due to hydrocarbon spillage and leaks could lead to death of plants.	N		3	3	3	9	3	36	In the event of hydrocarbon spillage, the contaminated soil will be removed off-site

No	Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Potential contamination of soil due to hydrocarbon spillage and leaks could lead to death of plants and habitats.	N		3	3	3	9	3	36	In the event of hydrocarbon spillage, the contaminated soil will be removed off-site
4	Construction of offices and change houses												
		Construction	Natural vegetation	construction of offices and change house will lead to clearing of vegetation	N		4	3	3	10	4	53	Removal of vegetation due to construction of house should only be restricted to the area where the houses will be built to avoid excess removal of vegetation
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	construction of offices and change house will lead to clearing of vegetation and destroying the natural habitats of animals	N		4	3	3	10	4	53	Natural habitats will be destroyed, houses should only be restricted to areas where duiker population does not exist
5	Construction of pollution control dams												
		Construction	Natural vegetation	construction of pollution control dams could lead to removal of vegetation on site	N		3	3	3	9	3	36	pollution control dams should not be constructed near the pan as this will destroy the natural vegetation
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	habitat loss of animals due to vegetation removal	N		3	3	3	9	3	36	pollution control dams should not be constructed near the pan as this will destroy the natural vegetation and also the habitats for animals
6	Construction of storm water diversion berms												
		Construction	Natural vegetation	Loss of vegetation due to construction of storm water and diversion berms.	N		3	3	3	9	4	48	construction of storm water and diversion berms should be limited to designated avoid to avoid further vegetation loss
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Loss of habitat due to construction of storm water and diversion berms.	N		3	3	3	9	4	48	construction of storm water and diversion berms should be limited to designated avoid to avoid further habitat loss
7	Construction of portable crusher plant												
		Construction	Natural vegetation	loss of vegetation due to construction of portable crasher	N		3	2	2	7	3	28	construction should be limited to areas where the vegetation is already disturbed

No	Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
				Impact significance before mitigation									**Mitigation**
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	loss of habitat due to construction of portable crasher	N		3	2	2	7	3	28	construction vehicles should adhere to the required speed
8	**Construction of a workshop**												
		Construction	Natural vegetation	loss of vegetation due to construction of workshop	N		3	3	3	9	3	36	construction should be limited to areas where the vegetation is already disturbed
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	loss of habitat due to construction of workshop	N		3	3	3	9	3	36	construction vehicles should adhere to the required speed
11	**Development of initial open cast cuts**												
		Construction	Natural vegetation	vegetation will be cleared and removed during the development of opencast	N		4	3	3	10	4	53	Minimise the removal of vegetation, especially in wetland areas
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	habitats will be destroyed during the development of opencast	N		4	3	3	10	4	53	Minimise the removal of vegetation, especially in wetland areas
12	**Stockpiling of soil and overburden from initial cuts**												
		Construction	Natural vegetation	movement of trucks will create dust that could lead to the closure of stomatas	N		2	3	3	8	3	32	Soil and overburden stockpiles will be vegetated to prevent erosion
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Compaction of soil during stockpiling could lead due habitat loss.	N		2	3	3	8	3	32	Soil and overburden stockpiles will be vegetated to prevent erosion and create habitats for animals

No	Activity					Impact significance before mitigation							Mitigation
	Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
	Perceived significance of impacts according to IAPs		Affected Environment										Proposed management/mitigation measures
	Fauna and Flora	Construction	Fauna and Flora	The mining development will have a significant impact on the biodiversity of the area.	N		5	3	1	9	5	60	The area has been disturbed by agricultural activities such as grazing and maize farming. Impacts on small mammals and birds must be monitored.
OPERATIONAL PHASE													
1	**Removal of topsoil**												
		Operational	Natural environment	Removal of topsoil will lead to vegetation loss	N		4	3	3	10	4	53	Topsoil will only be removed off areas proposed for immediate mining.
		Operational	Fauna (mammals, birds, reptiles, insects)	Habitat will be destructed by the removal of topsoil	N		4	3	3	10	4	53	Topsoil will only be removed off areas proposed for immediate mining.
13	**Transportation of coal**												
		Operational	Natural environment	Coal dust could cause detrimental effects on the growth of plants	N		3	3	3	9	3	36	cover the transportation trucks
14	**Use and maintenance of haul roads**												
		Operational	Natural environment	Dust emitted from the haul roads could cause blockage to stomatas	N		3	3	3	9	3	36	Trucks should be covered to minimise dust and haul roads should be frequently watered.
		Operational	Fauna (mammals, birds, reptiles, insects)	Accidental death of animals caused by trucks	N		3	3	3	9	3	36	speed limit should be adhered to so that animals shouldn't be killed on these roads,

No	Activity Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
15	Domestic and industrial waste storage and removal												
		Operational	Natural environment	Potential contamination of soil due to incorrect handling of industrial wastes could have negative impacts on the growth of the plants.	N		3	3	3	9	4	48	Appropriate waste management system must be implemented. In the event of soil contamination, the contaminated soil should be removed off-site
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of chemicals could cause death to animals	N		3	3	3	9	4	48	Appropriate waste management system must be implemented
16	Hazardous waste storage and removal												
		Operational	Natural environment	Potential wilting and eventual death of vegetation due to leakage of fuels and lubricants	N		3	3	3	9	3	36	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimised
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of hazardous, industrial and domestic wastes and sewerage may impact negatively on the animal's diet	N		3	3	3	9	3	36	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimised
18	Operation of fuel depot												
		Operational	Natural environment	Potential wilting and eventual death of vegetation due to leakage of fuels and lubricants			3	2	2	7	3	28	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimised
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of hazardous, industrial and domestic wastes and sewerage may impact negatively on the animal's diet			3	2	2	7	3	28	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimised

No	Activity Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Management/Mitigation Measure
						Impact significance before mitigation							**Mitigation**
20	**Removal of overburden and backfilling**												
		Operational	Natural vegetation	Removal of vegetation due to topsoil removal and overburden stripping	N		3	2	2	7	3	28	Removal of vegetation during stripping will be minimised to reduce the erosion potential. Topsoil will only be removed off areas proposed for immediate mining.
21	**Mining process removal of coal**												
		Operational	Natural environment	Coal dust could suppress the growth of the plants by closing stomatas	N		3	3	3	9	3	36	trucks should be covered to reduce the coal dust from the trucks
25	**Rehabilitation as mining progresses**												
		Operational	Natural environment	Rehabilitation will improve the growth of natural vegetation and limit the erosion	P		2	3	3	8	3	32	removal of alien invasive species and also maintaining the erosion gullies
		Operational	Fauna (mammals, birds, reptiles, insects)	Rehabilitation could increase the natural habitat and thereby increase the animals influx back to their habitats	P		2	3	3	8	3	32	removal of alien invasive species and also maintaining the erosion gullies
	Perceived significance of impacts according to IAPs		**Affected Environment**										**Proposed management/mitigation measures**
	Fauna & Flora	Operational	Fauna & Flora	The mining development will have a significant impact on the biodiversity of the area.	N		5	3	3	11	5	73	The area has been disturbed by agricultural activities such as grazing and maize farming. Impacts on small mammals and birds must be monitored.

No	Activity Description	Phase	Affected environment	Impact	Positive or Negative Impact	Impact significance before mitigation							Mitigation Management/Mitigation Measure
						EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	
				DECOMMISIONING PHASE									
26	**Removal of infrastructure**												
		Decommissioning	Natural environment	Heavy trucks could destroy the vegetation	N		2	2	2	6	2	16	Heavy vehicles will be restricted to areas where infrastructure is to be removed.
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Potential destruction of small mammals' habitats when infrastructures are removed.	N		2	2	2	6	2	16	Heavy vehicles will be restricted to areas where infrastructure is to be removed.
28	**Spreading of sub-soils and topsoil**												
		Decommissioning	Natural environment	Spreading of sub-soil and topsoil would restore the vegetation	P		2	2	2	6	2	16	during rehabilitation, topsoil will be placed according to the recommended soil profiles and specifications
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	spreading of sub-soil and topsoil would restore the vegetation and the habitats of animals	P		2	2	2	6	2	16	during rehabilitation, topsoil will be placed according to the recommended soil profiles and specifications
29	**Re-vegetation of disturbed areas**												
		Decommissioning	Natural environment	Revegetating areas will improve the natural environment	P		3	3	3	9	3	36	revegetate the disturbed areas according to topsoil specifications and profiles to minimise soil erosion
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Revegetating areas will improve the natural habitats	P		3	3	3	9	3	36	revegetate the disturbed areas according to topsoil specifications and profiles to minimise soil erosion

No	Activity Description	Phase	Affected environment	Impact	Positive or Negative Impact	EIA Reference	Severity	Spatial Scale	Duration	CONSEQUENCE	PROBABILITY	Significance / 100	Mitigation Management/Mitigation Measure
							Impact significance before mitigation						
30	**Profiling and contouring of the area to preserve natural drainage lines**												
		Decommissioning	Natural environment	Contouring of the area will prevent soil erosion and water run-offs	P		3	2	2	7	3	28	Contours will be created to match the original contour profiles for the area. Alien plants will be removed.
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Contouring of the area will prevent soil erosion and water run-offs	P		3	2	2	7	3	28	Contours will be created to match the original contour profiles for the area.
31	**Environmental monitoring of decommissioning activities**												
		Decommissioning	Natural environment	Monitoring will increase the natural vegetation	P		3	3	3	9	3	36	monitoring programme should include the removal of alien invasive species and also maintaining the erosion gullies
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Monitoring will increase the natural habitats of animals	P		3	3	3	9	3	36	monitoring programme should include the removal of alien invasive species and also maintaining the erosion gullies
	Perceived significance of impacts according to I&Aps		**Affected Environment**										**Proposed management/mitigation measures**
	Fauna & Flora	Decommissioning	Fauna & Flora	Small mammals and birds may return to the site after closure if efficiently rehabilitated	P		5	2	2	9	3	36	Ensure efficient rehabilitation

10 MANAGEMENT OF IDENTIFIED ENVIRONMENTAL IMPACTS

Table 22: The described management plans for the listed activities per phase and the significance rating thereof

	Activity		Activity and Impact Description		Mitigation	Responsible Person	Frequency/ Duration	Significance Rating		Financial Plan	
No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure			Before Mitigation	After Mitigation	Concurrent	Final
					CONSTRUCTION PHASE						
1	Removal of topsoil							Medium-high	Medium-low		
		Construction	Natural vegetation	Removal of topsoil will lead to the removal of vegetation that is binding the soil and this activity will increase the erosion potential of the area.	Removal of vegetation during stripping and dump construction will be minimized to reduce the erosion potential. Topsoil will only be removed off areas proposed for immediate mining. All soils should be stored and managed correctly for rehabilitation	environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Topsoil removal results in the destruction of natural habitats for animals	Removal of vegetation during stripping and dump construction will be minimized to reduce the erosion potential. Topsoil will only be removed off areas proposed for immediate mining. All soils should be stored and managed correctly for rehabilitation to create natural habitats for animals	environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
2	Construction of haul roads							Medium-high	Medium-low		
		Construction	Natural vegetation	When the haul road is constructed, vegetation will be removed.	All construction activities will be planned and managed to ensure that there will not be dramatic vegetation clearing. Efforts will be made to limit the construction of haul roads next to the pan. Haul roads will be low in gradient to limit reduce runoff velocity.	environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Removal of vegetation will destroy the natural habitats of animals	All construction activities will be planned and managed to ensure that there will not be dramatic vegetation clearing. Efforts will be made to limit the construction of haul roads next to the pan where mammals and birds depend on pan for water.	environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
3	Construction of hydrocarbon storage facility										
		Construction	Natural vegetation	Potential contamination of soil due to hydrocarbon spillage and leaks could lead to death of plants.	In the event of hydrocarbon spillage, the contaminated soil will be removed off-site	Environmental co-ordinator	Throughout construction phase	Medium - low	Medium - low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Potential contamination of soil due to hydrocarbon spillage and leaks could lead to death of plants and habitats.	In the event of hydrocarbon spillage, the contaminated soil will be removed off-site	Environmental co-ordinator	Throughout construction phase	Medium - low	Medium - low		

	Activity	Activity and Impact Description			Mitigation	Responsible Person	Frequency/ Duration	Significance Rating		Financial Plan	
No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure			Before Mitigation	After Mitigation	Concurrent	Final
4	Construction of offices and change houses										
		Construction	Natural vegetation	Construction of offices and change house will lead to clearing of vegetation	Removal of vegetation due to construction of house should only be restricted to the area where the houses will be built to avoid excess removal of vegetation	Environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Construction of offices and change house will lead to clearing of vegetation and destroying the natural habitats of animals	Natural habitats will be destroyed, houses should only be restricted to areas where duiker population does not exist	Environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
5	Construction of pollution control dams										
		Construction	Natural vegetation	Construction of pollution control dams could lead to removal of vegetation on site	Pollution control dams should not be constructed near the pan as this will destroy the natural vegetation	Environmental co-ordinator	Throughout construction phase	Medium - low	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Habitat loss of animals due to vegetation removal	Pollution control dams should not be constructed near the pan as this will destroy the natural vegetation and also the habitats for animals	Environmental co-ordinator	Throughout construction phase	Medium - low	Medium-low		
6	Construction of storm water diversion berms										
		Construction	Natural vegetation	Loss of vegetation due to construction of storm water and diversion berms.	Construction of storm water and diversion berms should be limited to designated avoid to avoid further vegetation loss	Environmental co-ordinator	Throughtout construction phase	Medium - low	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Loss of habitat due to construction of storm water and diversion berms.	Construction of storm water and diversion berms should be limited to designated avoid to avoid further habitat loss	Environmental co-ordinator	Throughout construction phase	Medium - low	Medium-low		
7	Construction of portable crusher plant										
		Construction	Natural vegetation	Loss of vegetation due to construction of portable crasher	Construction should be limited to areas where the vegetation is already disturbed	Environmental co-ordinator	Throughtout construction phase	Medium - low	Low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Loss of habitat due to construction of portable crasher	Construction vehicles should adhere to the required speed	Environmental co-ordinator	Throughout construction phase	Medium - low	Low		

No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure	Responsible Person	Frequency/ Duration	Before Mitigation	After Mitigation	Concurrent	Final
	Activity			**Activity and Impact Description**	**Mitigation**			**Significance Rating**		**Financial Plan**	
8	**Construction of a workshop**										
		Construction	Natural vegetation	Loss of vegetation due to construction of workshop	Construction should be limited to areas where the vegetation is already disturbed	Environmental co-ordinator	Throughtout construction phase	Medium - low	Low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Loss of habitat due to construction of workshop	Construction vehicles should adhere to the required speed	Environmental co-ordinator	Throughout construction phase	Medium - low	Low		
11	**Development of initial open cast cuts**										
		Construction	Natural vegetation	Vegetation will be cleared and removed during the development of opencast	Minimize the removal of vegetation, especially in wetland areas	Environmental co-ordinator	Throughtout construction phase	Medium-high	Medium-low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Habitats will be destroyed during the development of opencast	Minimise the removal of vegetation, especially in wetland areas	Environmental co-ordinator	Throughout construction phase	Medium-high	Medium-low		
12	**Stockpiling of soil and overburden from initial cuts**										
		Construction	Natural vegetation	Movement of trucks will create dust that could lead to the closure of stomatas	Soil and overburden stockpiles will be vegetated to prevent erosion	Environmental co-ordinator	Throughout construction phase	Medium-low	Low		
		Construction	Fauna (mammals, birds, amphibians, reptiles, insects)	Compaction of soil during stockpiling could lead due habitat loss.	Soil and overburden stockpiles will be vegetated to prevent erosion and create habitats for animals	Environmental co-ordinator	Throughout construction phase	Medium-low	Low		
	OPERATIONAL PHASE										
1	**Removal of topsoil**										
		Operational	Natural environment	Removal of topsoil will lead to vegetation loss	Topsoil will only be removed off areas proposed for immediate mining.	Environmental co-ordinator	Throughout operational phase	Medium-high	Medium-low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Habitat will be destructed by the removal of topsoil	Topsoil will only be removed off areas proposed for immediate mining.	Environmental co-ordinator	Throughout operational phase	Medium-high	Medium-low		
13	**Transportation of coal**										
		Operational	Natural environment	Coal dust could cause detrimental effects on the growth of plants	Cover the transportation trucks	Environmental co-ordinator	Throughout operational	Medium-high	Low		

No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure	Responsible Person	Frequency/ Duration	Before Mitigation	After Mitigation	Concurrent	Final
							phase				
14	Use and maintenance of haul roads										
		Operational	Natural environment	Dust emitted from the haul roads could cause blockage to stomatas	Trucks should be covered to minimise dust and haul roads should be frequently watered.	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Accidental death of animals caused by trucks	Speed limit should be adhered to so that animals shouldn't be killed on these roads,	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
15	Domestic and industrial waste storage and removal										
		Operational	Natural environment	Potential contamination of soil due to incorrect handling of industrial wastes could have negative impacts on the growth of the plants.	Appropriate waste management system must be implemented. In the event of soil contamination, the contaminated soil should be removed off-site	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of chemicals could cause death to animals	Appropriate waste management system must be implemented	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
16	Hazardous waste storage and removal										
		Operational	Natural environment	Potential wilting and eventual death of vegetation due to leakage of fuels and lubricants	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimised	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of hazardous, industrial and domestic wastes and sewerage may impact negatively on the animal's diet	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimized	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
18	Operation of fuel depot										
		Operational	Natural environment	Potential wilting and eventual death of vegetation due to leakage of fuels and lubricants	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimized	Environmental co-coordinator	Throughout operational phase	Medium-low	Low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Incorrect handling of hazardous, industrial and domestic wastes and sewerage may impact negatively on the animal's diet	Fuel and lubricant management will be ongoing throughout the life of the mine. This will ensure that the potential pollution of the water to natural vegetation due to the incorrect handling of hazardous wastes will be minimized	Environmental co-coordinator	Throughout operational phase	Medium-low	Low		

	Activity		Activity and Impact Description		Mitigation	Responsible Person	Frequency/ Duration	Significance Rating		Financial Plan	
No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure			Before Mitigation	After Mitigation	Concurrent	Final
20	Removal of overburden and backfilling										
		Operational	Natural environment	Coal dust could suppress the growth of the plants by closing stomatas	Trucks should be covered to reduce the coal dust from the trucks	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
21	Mining process removal of coal	Operational									
		Operational	Natural environment	Coal dust could suppress the growth of the plants by closing stomatas	Trucks should be covered to reduce the coal dust from the trucks	Environmental co-ordinator	Throughout operational phase	Medium-low	Low		
25	Rehabilitation as mining progresses										
		Operational	Natural environment	Rehabilitation will improve the growth of natural vegetation and limit the erosion	Removal of alien invasive species and also maintaining the erosion gullies	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
		Operational	Fauna (mammals, birds, reptiles, insects)	Rehabilitation could increase the natural habitat and thereby increase the animals influx back to their habitats	Removal of alien invasive species and also maintaining the erosion gullies	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
DECOMMISSIONING PHASE											
26	Removal of all infrastructure										
		Decommissioning	Natural environment	Heavy trucks could destroy the vegetation	Heavy vehicles will be restricted to areas where infrastructure is to be removed.	Environmental co-ordinator	Throughout decommissioning phase	Low	Low		
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Potential destruction of small mammals' habitats when infrastructures are removed.	Heavy vehicles will be restricted to areas where infrastructure is to be removed.	Environmental co-ordinator	Throughout decommissioning phase	Low	Low		
28	Spreading of sub-soils and topsoil										
		Decommissioning	Natural environment	Spreading of sub-soil and topsoil would restore the vegetation	During rehabilitation, topsoil will be placed according to the recommended soil profiles and specifications	Environmental co-ordinator	Throughout decommissioning phase	Low	Low		
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Spreading of sub-soil and topsoil would restore the vegetation and the habitats of animals	During rehabilitation, topsoil will be placed according to the recommended soil profiles and specifications	Environmental co-ordinator	Throughout decommissioning phase	Low	Low		
29	Re-vegetation of disturbed areas										
		Decommissioning	Natural environment	Revegetating areas will improve the natural environment	Revegetate the disturbed areas according to topsoil specifications and profiles to minimise soil erosion	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Revegetating areas will improve the natural habitats	Revegetate the disturbed areas according to topsoil specifications and profiles to minimise soil erosion	Environmental co-ordinator	During rehabilitation	Medium-low	Low		

	Activity	Activity and Impact Description			Mitigation	Responsible Person	Frequency/ Duration	Significance Rating		Financial Plan	
No	Description	Phase	Affected environment	Impact	Management/Mitigation Measure			Before Mitigation	After Mitigation	Concurrent	Final
30	**Profiling and contouring of the area to preserve natural drainage lines**										
		Decommissioning	Natural environment	Contouring of the area will prevent soil erosion and water run-offs	Contours will be created to match the original contour profiles for the area. Alien plants will be removed.	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Contouring of the area will prevent soil erosion and water run-offs	Contours will be created to match the original contour profiles for the area.	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
31	**Environmental monitoring of decommissioning activities**										
		Decommissioning	Natural environment	Monitoring will increase the natural vegetation	Monitoring programme should include the removal of alien invasive species and also maintaining the erosion gullies	Environmental co-ordinator	During rehabilitation	Medium-low	Low		
		Decommissioning	Fauna (mammals, birds, reptiles, insects)	Monitoring will increase the natural habitats of animals	Monitoring programme should include the removal of alien invasive species and also maintaining the erosion gullies	Environmental co-ordinator	During rehabilitation	Medium-low	Low		

11 RECOMMENDATIONS

11.1 Flora

When removing alien invasive species and weeds, care must be taken to eradicate the plants fully. According to the Conservation of Agricultural Resources Act (Act 43 of 1983) *eradicate* means to treat plants by any suitable method in order to prevent such plants from growing, multiplying and propagating. Therefore, when removing plants from the site it should be done at such a time when they are not producing seeds that could easily be spread by wind during cutting and transportation. Plants that are known to grow back easily need to be uprooted in order to remove all possible avenues for re-growth and any juvenile plants spotted growing during the operation need to be removed before they become a problem.

11.2 Fauna

The animal survey revealed a very poor abundance and diversity of fauna in the area. For this reason management of fauna during the operation will be minimal. It is likely that small mammals such as mongoose or hares are living on the site, as there was evidence of dung found. However, should any such animals be disturbed by the activities, the operators will be required to call in qualified people to handle and relocate the animals in question. The same methodology must be applied to bird life. A number of birds were spotted during the site visit but the species were of the common garden variety thereby making it easier for them to relocate naturally to nearby residential areas.

12 CONCLUSION

The study areas are mostly dominated by maize fields and pans. The alien invasive species which were found indicate how disturbed this environment is and as such a proper eradication programme should be implemented. Alien species have negative impacts on the natural vegetation as they tend to be more efficient in terms of water and sunlight use.

The pan provides a natural habitat for many bird species. Birds play critical roles in wetland systems by acting as herbivores, predators and prey, and being facilitators for plant dispersal as well as providing aesthetic values for bird watchers and other nature enthusiasts.

In terms of mammal surveys, only common duiker species was visually observed and proposed mining could destroy the natural habitats where this species occur.

Reptiles and amphibians were not found due to low temperatures but the pan provides suitable habitat for frogs. The wet season surveys could have proved more efficient in terms of reptiles and amphibian sampling as these species are dormant during cold or winter seasons. It appears that most frog species are closely associated to the habitat in which they breed. Thus the preservation of this pan which will include viable breeding sites as well as areas for foraging can be very effective in maintaining and protecting frog species. In addition to this some frog species have very specific breeding requirements and thus any impact or alteration to the breeding environment could be significant.

Insects are normally found in abundance after big rains and they stay dormant during colder or winter season (Elzinga 2000). Even though there were no rains and the temperatures were below zero, insects species from the family Reduviidae were abundant.

13 COMMENTS RECEIVED

No comments were received for this project from the authorities

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Appendix 1. Vegetation types found in the study area (Mucina *et al* 2006).

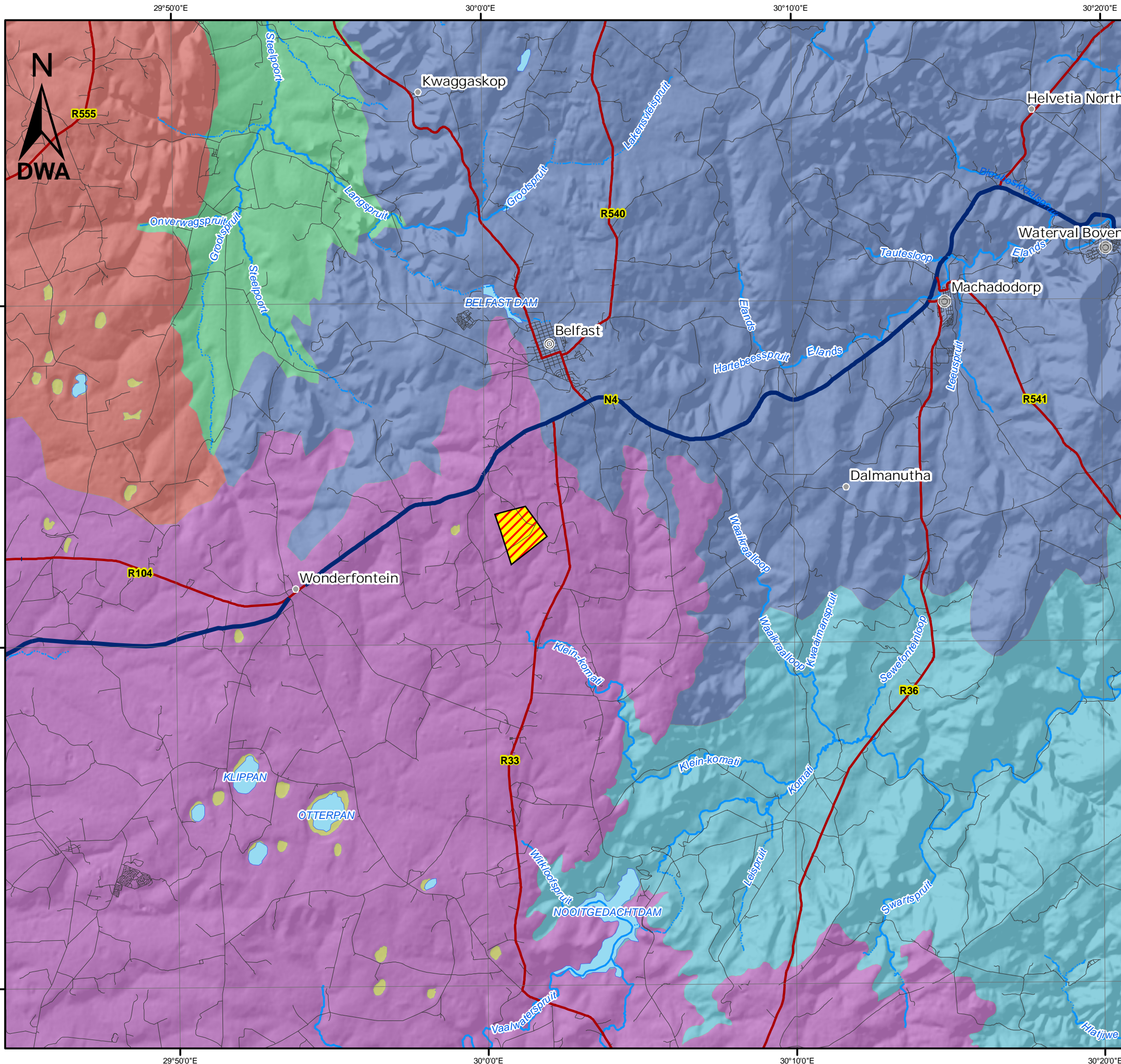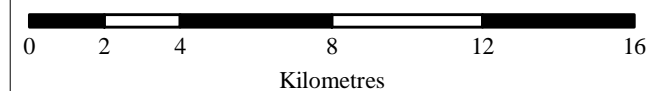Plan 12

Northern Coal
Weltevreden
Vegetation Types

Legend

(yellow hatched)	Weltevreden Site
(purple)	Eastern Highveld Grassland
(olive/yellow)	Eastern Temperate Freshwater Wetlands
(cyan)	KaNgwane Montane Grassland
(red)	Rand Highveld Grassland
(green)	Sekhukhune Montane Grassland
(blue)	Steenkampsberg Montane Grassland
(red star)	Capital City
(black circle)	Major Town
(circle)	Other Town
(double circle)	Secondary Town
(small dot)	Settlement
(dark blue line)	National Route
(red line)	Main Road
(thin grey line)	Minor Road
(dashed blue line)	Non-Perennial Stream
(blue line)	Perennial Stream
(light blue)	Water Area

(Source: Mpumalanga Biodiversity Conservation Plan)

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Projection: Transverse Mercator
Central Meridian: Lo31
Datum: WGS84

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Kilometres

Ref:/bjt.NOR335.200804.084

Appendix 2. Map indicating the Sensitivity areas within the study area.

Northern Coal Weltevreden
Biodiversity Assessment

Legend

Terrestrial Biodiversity Assessment

- ☐ Weltevreden Site
- Irreplaceable
- Highly Significant
- Important & Necessary
- No Natural Habitat Remaining
- Least Concern
- Protected Areas
- ⊛ Capital City
- ● Major Town
- ◎ Other Town
- ◎ Secondary Town
- • Settlement
- ▬ National Route
- ▬ Main Road
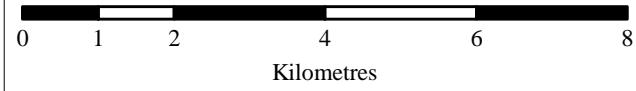- — Minor Road
- ┅ Non-Perennial Stream
- — Perennial Stream
- ▭ Water Area
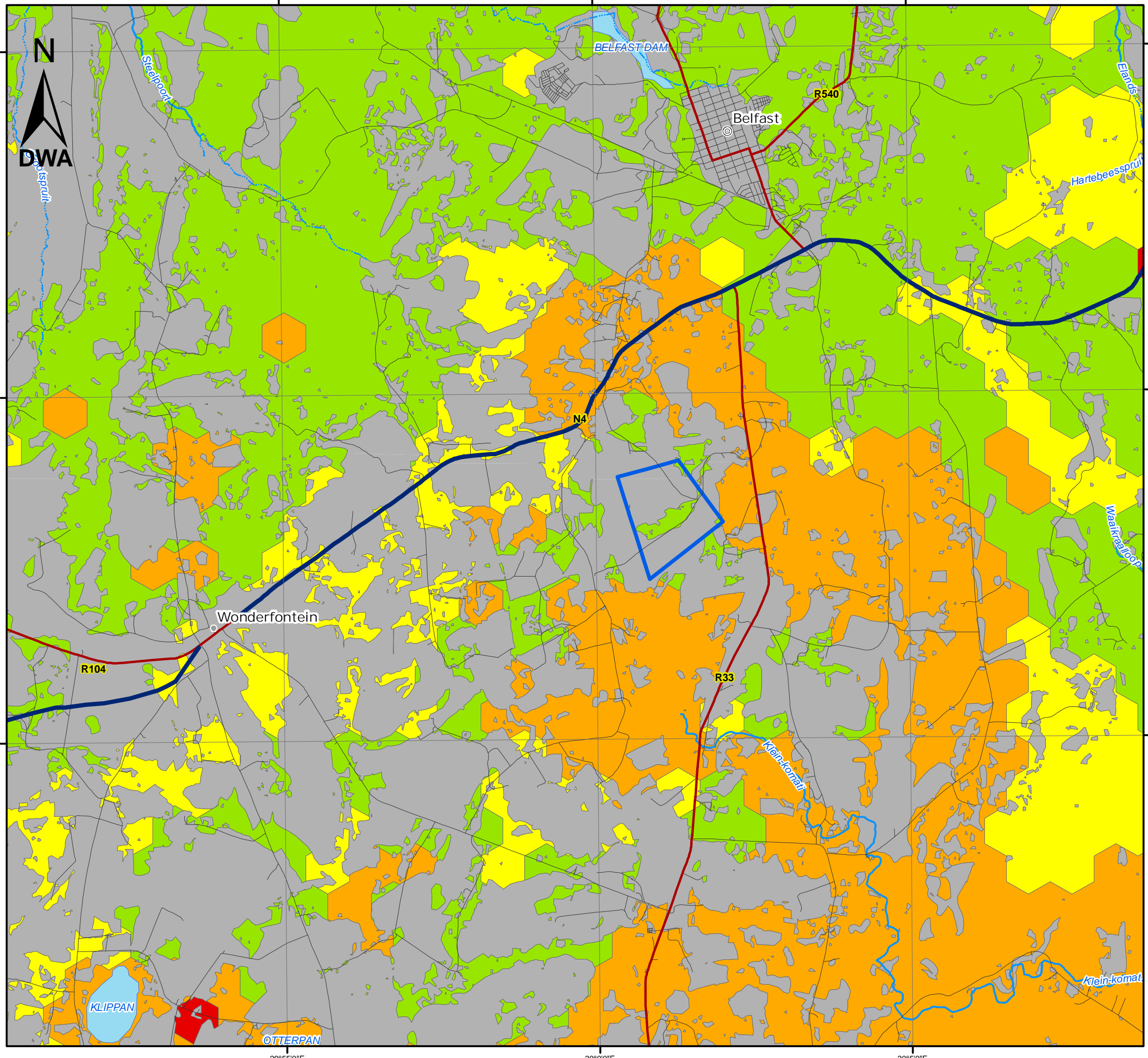
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Projection: Transverse Mercator
Central Meridian: Lo31
Datum: WGS84

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0 1 2 4 6 8
Kilometres

Ref:/bjt.NOR335.200804.084

Map labels:
- BELFAST DAM
- Belfast
- R540
- Steelpoort
- Elands
- Hartebeesspruit
- N4
- Waaikraalloop
- Wonderfontein
- R104
- R33
- Kleinkomati
- Klein-komati
- KLIPPAN
- OTTERPAN

Coordinates:
25°40'0"S, 25°45'0"S, 25°50'0"S
29°55'0"E, 30°0'0"E, 30°5'0"E

Appendix 3. Precis list for QDS 2530CC

Minis for: 2530CC	English	Ecological status	Hilton	Form
Aeollanthus rehmannii				Herb
Alepidea peduncularis				Herb
*Amaranthus hybridus ssp. hybridus var. hybridus	Pigweed	weed		Herb
Argyrolobium transvaalense				Herb
Asplenium rutifolium				
Brachylaena transvaalensis				Herb
Brachystelma coddii				Herb
Brachystelma dyeri				Herb
Brachystelma macropetalum				Herb
Bryum andicola				
Bryum argenteum				
Bersama transvaalensis				
Campylopus flaccidus				
Cineraria geraniifolia				Herb
Chamaecrista mimosoides	Fishbone Dwarf Cassia			Herb
Cheilanthes multifida				
Chloris virgata	feather-top chloris	increaser II		Grass
Corycium dracomontanum				Herb
Crassula setulosa var. rubra	Furry Crassula			Herb
Crassula vaginata ssp. vaginata	white stonecrop			Herb
Crotalaria recta				Herb
Cyperus esculentus var. esculentus				Reed
Cyperus keniensis				Reed
Dicerocaryum senecioides				
Digitaria sp.				Grass
Disa fragrans ssp. fragrans	Fragrant Disa			Herb
Endostemon obtusifolius				
Eragrostis plana N	tough love grass	increaser II		Grass
Eriosema cordatum	Heart-leaved Eriosema	Medicinal		Herb
Erica caffrorum var. caffrorum				
Eriocaulon africanum				Herb
Euryops pedunculatus				Herb
Felicia filifolia ssp. filifolia	Fine-leaved Felicia	Medicinal		Herb
Fissidens ovatus				
Freesia laxa ssp. laxa	small red iris	garden plant		Herb
Funaria hygrometrica				
Gerbera ambigua	pink and white gerbera			Herb
Gerbera galpinii				Herb
Gnidia albosericea				Herb

Haemanthus humilis ssp. hirsutus	rabbit's ears	Medicinal		Herb
Harveya sp.				Herb
Hermannia oblongifolia				Herb
Helichrysum acutatum	sticky everlasting	Medicinal		Herb
Helichrysum argyrolepis				Herb
Helichrysum obductum				Herb
Helichrysum reflexum				Herb
Helichrysum spiralepis				Herb
Helichrysum subglomeratum				Herb
Helichrysum truncatum				Herb
Hypericum lalandii	spindly hypericum	Medicinal		Herb
Hypericum revolutum ssp. revolutum				Herb
*Hypochaeris radicata	hairy wild lettuce	used as spinach		Herb
Ipomoea oblongata				Herb
Juncus dregeanus ssp. dregeanus				Sedge
Juncus oxycarpus				Sedge
Kiggelaria africana				
Kniphofia porphyrantha	dwarf red-hot poker	Medicinal		Herb
Kniphofia rigidifolia				Herb
Ledebouria cooperi	cooper's squill	Medicinal		Herb
Ledebouria revoluta	common ledebouria	Medicinal		Herb
Leptochloa fusca				Grass
Lotononis mucronata				Herb
Lotononis pulchra				Herb
Lycopodium clavatum				
Melanospermum transvaalense				
Melhania prostrata				
Microcharis galpinii				
Monocymbium ceresiiforme	boat grass	decreaser		Grass
Monsonia angustifolia	pink monsonia			Herb
Monsonia attenuata				Herb
Neonotonia wightii	robust pioneer creeper	browsed by bushbuck		Creeper
Panicum sp.				Grass
Panicum natalense	natal panicum	decreaser		Grass
Paspalum scrobiculatum	veld paspalum	increaser II		Grass
Pavonia columella	pink panonia	garden plant		Herb
Phylica paniculata				Herb
Pimpinella transvaalensis				
Plectranthus fruticosus	forest spur-flower	fly repellent		Herb
Plectranthus laxiflorus	citronella spur-flower	Medicinal		Herb
Plectranthus madagascariensis var. ramosior	madagascar spur-flower	Medicinal		Herb
Podocarpus latifolius				Tree

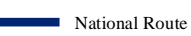|				
Pycreus rehmannianus				Herb
Rhus tumulicola var. meeuseana				Tree
Rhynchosia caribaea		medicinal		Herb
Rhynchosia totta var. totta	yellow carpet bean	edible		Herb
Rumex acetosella ssp. angiocarpus				Herb
Selaginella mittenii				
Setaria sphacelata var. torta	common bristle grass	decreaser		Grass
Schizochilus cecilii ssp. culveri				Herb
Schizochilus zeyheri				Herb
Sporobolus centrifugus	olive dropseed	increaser I		Grass
Stachys natalensis var. galpinii	white stachys			Herb
Stachys natalensis var. natalensis	white stachys			Herb
Syncolostemon albiflorus				Herb
Teedia lucida				
Tetraselago longituba				Herb
Teramnus labialis ssp. labialis				
Tephrosia longipes ssp. longipes var. longipes				Creeper
Trichostomum brachydontium				
Vigna vexillata var. vexillata	narrow-leaved wild sweetpea	Medicinal		Creeper
Wahlenbergia epacridea				Herb
Xyris capensis	common xyris	making beer strainers		Herb
Zantedeschia albomaculata ssp. macrocarpa	arrow-leaved arum	Medicinal		Herb
Zantedeschia rehmannii	pink arum	garden plant		Herb
Zornia capensis ssp. capensis	caterpillar bean			Herb
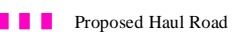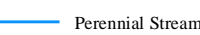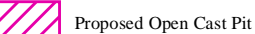
Appendix 4. Sampling points in the study areas.

Plan 13

Northern Coal
Weltevreden
Fauna & Flora

Legend

■	Fauna & Flora Sampling Points
★	Capital City
●	Major Town
◎	Other Town
◉	Secondary Town
•	Settlement
▬	National Route
▬	Main Road
▬	Minor Road
▪▪▪	Proposed Haul Road
▬	Perennial Stream
▬	Non-Perennial Stream
▬	Contours 20m
▨	Proposed Open Cast Pit
▭	Weltevreden Site
▭	Farms Boundary
▭	Farm Portion Boundary
▬	Dam
▬	Perennial Pan
▬	Non-Perennial Pan

(2002 Ikonos Satellite Imagery)

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Projection: Transverse Mercator
Central Meridian: Lo31
Datum: WGS84

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Kilometres

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Appendix 5. Plant species recorded during dry season survey in Weltevreden

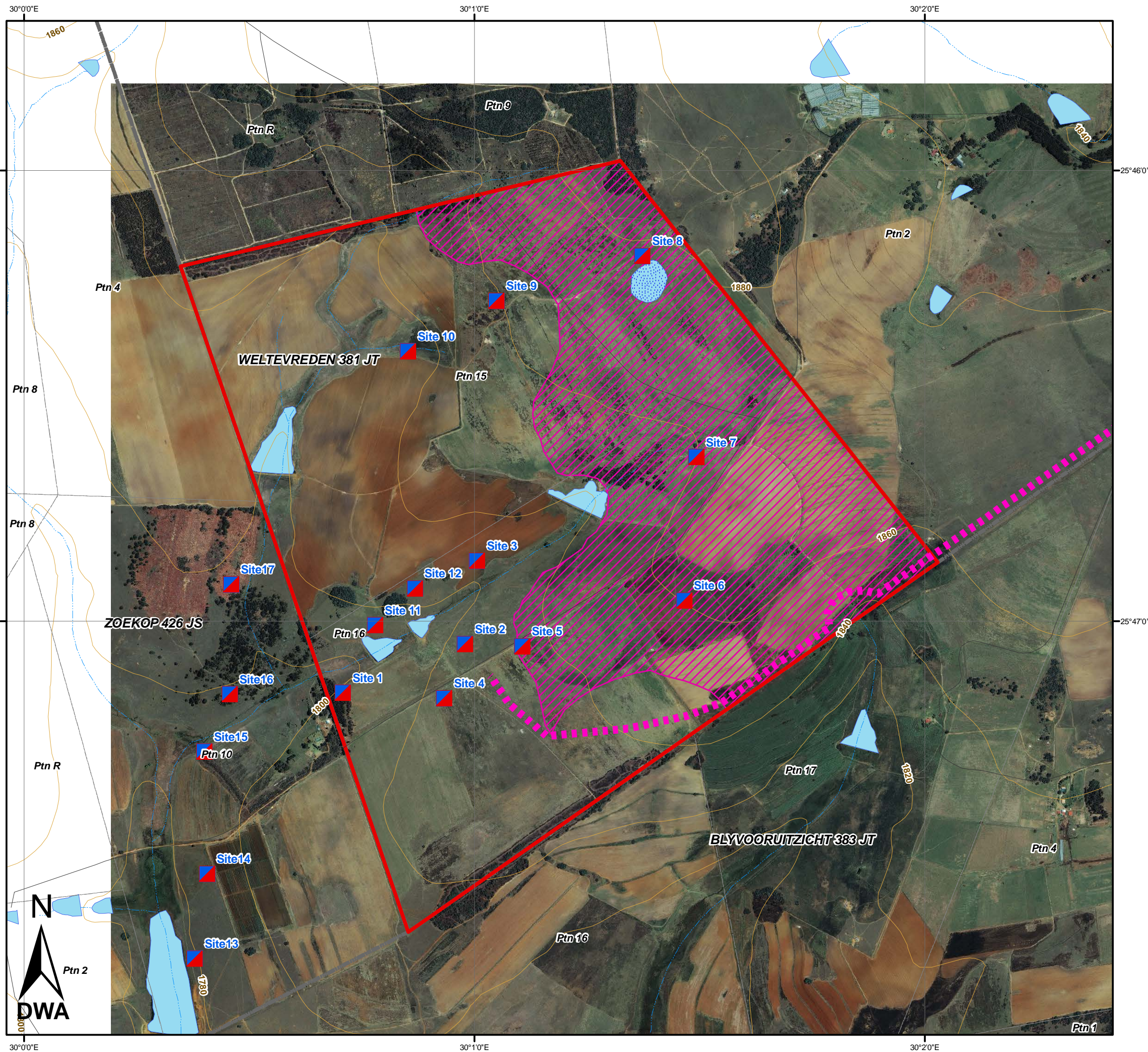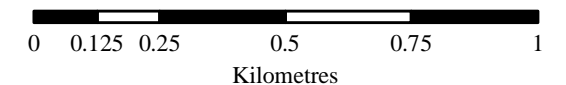| Scientific names	Common Name	Form	Ecological Importance	Succession Status
Acacia mearnsii	Black wattle	Tree	Category 2 invasive	
Andropogon huillensis	Large silver andropogon	Grass	Increaser 1	Climax
Aristida junciformis	Gangoni three-awn	Grass	Increaser 3	Climax
Berkheya setifera *	Buffalo-tongue	Herb		
Bewsia biflora	False love grass	Grass		Climax
Bidens pilosa	Common black-jack	Weed	Alien invasive	
Boophane disticha	Fan-leaved boophane	Herb		
Cymbopogon excavatus	Broad-leaved turpentine grass	Grass	Increaser 1	Climax
Cynodon dactylon	Couch grass	Grass	Increaser 2	Pioneer
Cyperus longus	Waterbiesie	Reed		
Datura stramonium	Common thorn apple	Herb	Declared weed	
Elephantorrhiza elephantina	Elephant's root	Herb		
Eragrostis curvula	Weeping love grass	Grass	Increaser 2	Sub-climax - climax
Eucalyptus camaldulensis	Red gum	Tree	Category 2/3 invasive	
Eragrostis gummiflua	Gum grass	Grass	Increaser 2	Sub-climax
Eragrostis racemosa	**Narrow heart love grass**	**Grass**	**Increaser 2**	**Sub-climax**
Eragrostis superba	Saw-tooth love grass	Grass	Increaser 2	sub-climax
Gerbera ambigua	Pink and white gerbera	Herb		
Gerbera piloselloides	Small yellow gerbera	Herb		
Gomphrena celosioides	Batchelor's button	Herb	Alien invasive	
Haplocarpha scaposa	False gerbera	Herb		
Helichrysum aureonitens	Golden everlasting	Herb		
Helichrysum kraussii	Straw everlasting	Shrublet		
Helichrysum rugulosum	Marotole	Herb		
Hyparrhenia hirta	Common thatching grass	Grass	Increaser 1	Sub-climax - climax
Hypoxis hemerocallidea	Star-flower	Herb		
Imperata cylindrica	Cottonwool grass	Grass	Increaser 1	
Miscanthus junceus	Wireleaf daba grass	Grass	Increaser 1	Climax
Nicandra physalodes	Apple of Peru	Herb	Alien invasive	
Oxalis obliquifolia	Oblique-leaved sorrel	Herb		
Panicum natalense	**Natal panicum**	**Grass**	**Decreaser**	**Climax**
Panicum maximum	Guinea grass	Grass	Decreaser	Sub-climax - climax
Pennisetum clandestinum	Kikuyu grass	Grass	Exotic grass	
Pinus patula	Patula pine	Tree		
Pogonarthria squarrosa	Herringbone grass	Grass	Increaser 2	sub climax
Pseudognaphalium luteo-album	Jersey cudweed	Herb		
Schoenoplectus corymbosus		Herb		
Setaria sphacelata	Bristle grass	Grass	Decreaser	Climax

Scientific names	Common Name	Form	Ecological Importance	Succession Status
Setaria sphacelata v. sphacelata	Bristle grass	Grass	Decreaser	Climax
Solanum sisymbrifolium		Herb	Invasive	
Sporobolus africanus	Ratstail dropseed	Grass	Increaser 3	sub climax
Sporobolus pyramidalis	Catstail dropseed	Grass	Increaser 2	sub climax
Stachys aethiopica	African stachys	Herb		
Stenotaphrum secundatum	Buffalo-turf grass	Grass	Exotic grass	Pioneer
Stoebe vulgaris	**Bankrupt bush**	**Herb**	**Alien invasive**	
Sutherlandia montana	Mountain balloon pea	Shrub		
Tagetes minuta	Tall khakhi weed	Herb	Alien invasive	
Themeda triandra	**Red grass**	**Grass**	**Decreaser**	**Climax**
Verbena bonariensis	Tall verbena	Herb		
Zea mays	Mielies	Herb		

Bold –species of general occurrence of the Near-Bankenveld Variation (Acocks, 1988). * - species of less general occurrence of the Near-Bankenveld variation

Appendix 6. Plant species recorded during wet season survey in Weltevreden

Species no	Scientific Name	Common Name	Ecological Status	Form
72	*Acacia mearnsii*	Black Wattle	Alien Invasive**	Tree
935	*Aloe arborescens*	Kransaalwyn	Medicinal	Herb
1175	*Amaranthus hybridus*	Pigweed	Alien Invasive	Succulent
1385	*Andropogon appendiculatus*	Vlei Bluestem	Decreaser - Climax	Grass
1389	*Andropogon eucomus*	Snowflake grass	Increaser 2 - Subclimax	Grass
1937	*Aristida congesta ssp. congesta*	Tassel Tree-awn	Increaser 2 - Pioneer	Grass
3178	*Berkheya setifera*	Buffalo-tongue Berkheya	Medicinal	Herb
3237	*Bidens formosa*	Cosmos	Alien Invasive	Herb
3239	*Bidens pilosa*	Common Black-jack	Alien Invasive	Herb
3422	*Bothriochloa radicans*	Stinking grass	Subclimax Increaser 2	Grass
3438	*Brachiaria brizantha*	Common signal grass	Climax Increaser 1	Grass
4566	*Chamaesyce inaequilatera*			Herb
4952	*Cirsium vulgare*	Scotch Thistle	Alien Invasive*	Herb
5741	*Conyza bonariensis*	Flax-leaf fleabane		Herb
5807	*Cortaderia selloana*		Alien invasive	Grass
6686	*Cynodon dactylon*	Couch Grass	Increaser 2 - Pioneer	Grass
6789	*Cyperus esculentus*	Yellow Nut Sedge	Medicinal/Edible/Alien Invasive	Sedge
6791	*Cyperus longus*		Medicinal	Sedge
7037	*Datura stramonium*	Common Thorn Apple	Alien Invasive*	Herb
7578	*Digitaria eriantha*	Common Finger Grass	Decreaser - Climax	Grass
7733	*Diospyros mespiliformis*	Jakkalsbessie		Tree
8644	*Enneapogon cenchroides*	Nine awned grass	Pioneer Subclimax Increaser 2	Grass
8734	*Eragrostis gummiflua*	Gum Grass	Increaser 2 - Subclimax	Grass
8770	***Eragrostis racemosa***	**Narrow Heart Love Grass**	**Increaser 2 - Subclimax**	**Grass**
8783	*Eragrostis superba*	Saw-tooth love grass	Subclimax Increaser 2	Grass
11672	*Gerbera ambigua*	Pink and white gerbera	Medicial	Herb
11822	*Gladiolus dalenii*	African gladiolus	Medicinal	Herb
12203	*Gomphocarpus fruticosus*	Milkweed		Herb
12759	*Helichrysum acutatum*		Medicinal	herb
12791	*Helichrysum aureonitens*	Golden everlasting	Medicinal	Herb
13581	***Heteropogon contortus***	**Spear grass**	**Subclimax Increaser 2**	**Grass**
13670	*Hibiscus trionum*	Bladder Hibiscus	Medicinal	Herb
14001	*Hyparrhenia hirta*	Common Thatching Grass	Increaser 1 - Subclimax to climax	Grass

Species no	Scientific Name	Common Name	Ecological Status	Form
14060	*Hypochaeris radicata*	Hairy wild lettuce/Spotted cat's ear	Alien Invasive/Edible	Herb
14116	*Hypoxis hemerocallidea*	Star-flower	Medicinal	Herb
16380	*Lippia javanica*	Fever-tea	Medicinal	Shrub
17401	*Melinis nerviglumis*	Bristle leaved red top	Climax Increaser 1	Grass
17865	***Monocymbium ceresiiforme***	**Boat grass**	**Decreaser - Climax**	**Grass**
19373	*Oxalis obliquifolia*	Oblique-leaved Sorrel		Herb
19641	*Panicum maximum*		Decreaser	Grass
19730	*Paspalum dilatatum*	Dallis Grass	Exotic	Grass
20130	*Pennisetum clandestinum*	Kikuyu Grass	Exotic	Grass
20829	*Pinus patula*	Patula pine	Alien invader	Tree
21585	*Pseudognaphalium luteo-album*	Jersey Cudweed	Medicinal/Cultural	Herb
23796	*Schoenoplectus corymbosus*		Cultural-weaving	Reed
23964	*Sebaea grandis*	Large-Flowered Sebaea/Primrose Gentian	Charm	Herb
24635	*Setaria pallide-fusca*	garden bristle grass	Pioneer increaser 2	Grass
24641	*Setaria sphacelata var. sphacelata*	Bristle Grass	Decreaser - Climax	Grass
25166	*Sporobolus africanus*	Ratstail dropseed	Subclimax Increaser 3	Grass
25191	*Sporobolus pyramidalis*	Catstail dropseed	Subclimax increaser 2	Grass
25504	***Stoebe vulgaris***	**Bankrupt Bush**	**Alien invader**	**Shrub**
25876	*Sutherlandia frutescens*	Balloon pea	Medicinal	Shrub
26416	***Themeda triandra***	**Red Grass**	**Decreaser - Climax**	**Grass**
27126	***Tristachya leucothrix***	**Hairy Trident Grass**	**Increaser 1 - Climax**	**Grass**
27376	*Typha capensis*	Bulrush	Medicinal	Reed
27573	*Verbena bonariensis*	Tall Verbena	Alien invasive	Shrub
27576	*Verbena officinalis*		Alien invasive	Herb
55604	*Zea mays*	Maize meal		Shrub

Bold –species of general occurrence of the Near-Bankenveld Variation (Acocks, 1988).

Appendix 7. Birds that could possibly be found in the area

Title:	QDS	2530CC
Species:	388	
Rob	English Name	Scientific
1	Ostrich	*Struthio camelus*
6	Great Crested Grebe	*Podiceps cristatus*
8	Dabchick	*Tachybaptus ruficollis*
55	Whitebreasted Cormorant	*Phalacrocorax lucidus*
58	Reed Cormorant	*Phalacrocorax africanus*
60	Darter	*Anhinga rufa*
62	Grey Heron	*Ardea cinerea*
63	Blackheaded Heron	*Ardea melanocephala*
64	Goliath Heron	*Ardea goliath*
65	Purple Heron	*Ardea purpurea*
66	Great White Egret	*Egretta alba*
67	Little Egret	*Egretta garzetta*
68	Yellowbilled Egret	*Egretta intermedia*
69	Black Egret	*Egretta ardesiaca*
71	Cattle Egret	*Bubulcus ibis*
72	Squacco Heron	*Ardeola ralloides*
74	Greenbacked Heron	*Butorides striatus*
76	Blackcrowned Night Heron	*Nycticorax nycticorax*
78	Little Bittern	*Ixobrychus minutus*
80	Bittern	*Botaurus stellaris*
81	Hamerkop	*Scopus umbretta*
83	White Stork	*Ciconia ciconia*
84	Black Stork	*Ciconia nigra*
85	Abdim's Stork	*Ciconia abdimii*
89	Marabou Stork	*Leptoptilos crumeniferus*
90	Yellowbilled Stork	*Mycteria ibis*
91	Sacred Ibis	*Threskiornis aethiopicus*
92	Bald Ibis	*Geronticus calvus*
93	Glossy Ibis	*Plegadis falcinellus*
94	Hadeda Ibis	*Bostrychia hagedash*
95	African Spoonbill	*Platalea alba*
96	Greater Flamingo	*Phoenicopterus ruber*
97	Lesser Flamingo	*Phoenicopterus minor*
99	Whitefaced Duck	*Dendrocygna viduata*
100	Fulvous Duck	*Dendrocygna bicolor*
101	Whitebacked Duck	*Thalassornis leuconotus*
102	Egyptian Goose	*Alopochen aegyptiacus*
103	South African Shelduck	*Tadorna cana*
104	Yellowbilled Duck	*Anas undulata*
105	African Black Duck	*Anas sparsa*
106	Cape Teal	*Anas capensis*
107	Hottentot Teal	*Anas hottentota*
108	Redbilled Teal	*Anas erythrorhyncha*

112	Cape Shoveller	*Anas smithii*
113	Southern Pochard	*Netta erythrophthalma*
114	Pygmy Goose	*Nettapus auritus*
115	Knobbilled Duck	*Sarkidiornis melanotos*
116	Spurwinged Goose	*Plectropterus gambensis*
117	Maccoa Duck	*Oxyura maccoa*
118	Secretarybird	*Sagittarius serpentarius*
122	Cape Vulture	*Gyps coprotheres*
126	Black Kite	*Milvus migrans*
126.1	Yellowbilled Kite	*Milvus aegyptius*
127	Blackshouldered Kite	*Elanus caeruleus*
128	Cuckoo Hawk	*Aviceda cuculoides*
130	Honey Buzzard	*Pernis apivorus*
131	Black Eagle	*Aquila verreauxii*
133	Steppe Eagle	*Aquila nipalensis*
136	Booted Eagle	*Hieraaetus pennatus*
137	African Hawk Eagle	*Hieraaetus spilogaster*
138	Ayres' Eagle	*Hieraaetus ayresii*
140	Martial Eagle	*Polemaetus bellicosus*
141	Crowned Eagle	*Stephanoaetus coronatus*
142	Brown Snake Eagle	*Circaetus cinereus*
143	Blackbreasted Snake Eagle	*Circaetus pectoralis*
148	African Fish Eagle	*Haliaeetus vocifer*
149	Steppe Buzzard	*Buteo vulpinus*
150	Forest Buzzard	*Buteo trizonatus*
152	Jackal Buzzard	*Buteo rufofuscus*
155	Redbreasted Sparrowhawk	*Accipiter rufiventris*
157	Little Sparrowhawk	*Accipiter minullus*
158	Black Sparrowhawk	*Accipiter melanoleucus*
159	Little Banded Goshawk	*Accipiter badius*
160	African Goshawk	*Accipiter tachiro*
161	Gabar Goshawk	*Melierax gabar*
164	Eurasian Marsh Harrier	*Circus aeruginosus*
165	African Marsh Harrier	*Circus ranivorus*
166	Montagu's Harrier	*Circus pygargus*
167	Pallid Harrier	*Circus macrourus*
168	Black Harrier	*Circus maurus*
169	Gymnogene	*Polyboroides typus*
170	Osprey	*Pandion haliaetus*
171	Peregrine Falcon	*Falco peregrinus*
172	Lanner Falcon	*Falco biarmicus*
173	Northern Hobby Falcon	*Falco subbuteo*
179	Western Redfooted Kestrel	*Falco vespertinus*
180	Eastern Redfooted Kestrel	*Falco amurensis*
181	Rock Kestrel	*Falco rupicolis*
182	Greater Kestrel	*Falco rupicoloides*
183	Lesser Kestrel	*Falco naumanni*
188	Coqui Francolin	*Peliperdix coqui*

190	Greywing Francolin	*Scleroptila africanus*
191	Shelley's Francolin	*Scleroptila shelleyi*
192	Redwing Francolin	*Scleroptila levaillantii*
196	Natal Francolin	*Pternistis natalensis*
198	Rednecked Francolin	*Pternistis afer*
199	Swainson's Francolin	*Pternistis swainsonii*
200	Common Quail	*Coturnix coturnix*
201	Harlequin Quail	*Coturnix delegorguei*
203	Helmeted Guineafowl	*Numida meleagris*
205	Kurrichane Buttonquail	*Turnix sylvatica*
207	Wattled Crane	*Grus carunculatus*
208	Blue Crane	*Anthropoides paradisea*
209	Crowned Crane	*Balearica regulorum*
210	African Rail	*Rallus caerulescens*
211	Corncrake	*Crex crex*
213	Black Crake	*Amaurornis flavirostris*
215	Baillon's Crake	*Porzana pusilla*
217	Redchested Flufftail	*Sarothrura rufa*
222	Whitewinged Flufftail Rare	*Sarothrura ayresi*
223	Purple Gallinule	*Porphyrio madagascariensis*
226	Common Moorhen	*Gallinula chloropus*
228	Redknobbed Coot	*Fulica cristata*
229	African Finfoot	*Podica senegalensis*
231	Stanley's Bustard	*Neotis denhami*
233	Whitebellied Korhaan	*Eupodotis barrowii*
234	Blue Korhaan	*Eupodotis caerulescens*
238	Blackbellied Korhaan	*Eupodotis melanogaster*
240	African Jacana	*Actophilornis africanus*
242	Old World Painted Snipe	*Rostratula benghalensis*
245	Ringed Plover	*Charadrius hiaticula*
248	Kittlitz's Plover	*Charadrius pecuarius*
249	Threebanded Plover	*Charadrius tricollaris*
252	Caspian Plover	*Charadrius asiaticus*
255	Crowned Plover	*Vanellus coronatus*
257	Blackwinged Plover	*Vanellus melanopterus*
258	Blacksmith Plover	*Vanellus armatus*
260	Wattled Plover	*Vanellus senegallus*
262	Ruddy Turnstone	*Arenaria interpres*
264	Common Sandpiper	*Actitis hypoleucos*
265	Green Sandpiper	*Tringa ochropus*
266	Wood Sandpiper	*Tringa glareola*
269	Marsh Sandpiper	*Tringa stagnatilis*
270	Greenshank	*Tringa nebularia*
272	Curlew Sandpiper	*Calidris ferruginea*
274	Little Stint	*Calidris minuta*
281	Sanderling	*Calidris alba*
284	Ruff	*Philomachus pugnax*

286	Ethiopian Snipe	*Gallinago nigripennis*
290	Whimbrel	*Numenius phaeopus*
294	Pied Avocet	*Recurvirostra avosetta*
295	Blackwinged Stilt	*Himantopus himantopus*
297	Spotted Dikkop	*Burhinus capensis*
298	Water Dikkop	*Burhinus vermiculatus*
300	Temminck's Courser	*Cursorius temminckii*
305	Blackwinged Pratincole	*Glareola nordmanni*
315	Greyheaded Gull	*Larus cirrocephalus*
322	Caspian Tern	*Sterna caspia*
338	Whiskered Tern	*Chlidonias hybridus*
339	Whitewinged Tern	*Chlidonias leucopterus*
348	Feral Pigeon	*Columba livia*
349	Rock Pigeon	*Columba guinea*
350	Rameron Pigeon	*Columba arquatrix*
352	Redeyed Dove	*Streptopelia semitorquata*
354	Cape Turtle Dove	*Streptopelia capicola*
355	Laughing Dove	*Streptopelia senegalensis*
356	Namaqua Dove	*Oena capensis*
358	Greenspotted Dove	*Turtur chalcospilos*
359	Tambourine Dove	*Turtur tympanistria*
361	African Green Pigeon	*Treron calva*
371	Purplecrested Lourie	*Musophaga porphyreolopha*
373	Grey Lourie	*Corythaixoides concolor*
374	Eurasian Cuckoo	*Cuculus canorus*
375	African Cuckoo	*Cuculus gularis*
377	Redchested Cuckoo	*Cuculus solitarius*
378	Black Cuckoo	*Cuculus clamosus*
380	Great Spotted Cuckoo	*Clamator glandarius*
381	Striped Cuckoo	*Clamator levaillantii*
382	Jacobin Cuckoo	*Clamator jacobinus*
385	Klaas's Cuckoo	*Chrysococcyx klaas*
386	Diederik Cuckoo	*Chrysococcyx caprius*
391	Burchell's Coucal	*Centropus burchellii*
392	Barn Owl	*Tyto alba*
393	Grass Owl	*Tyto capensis*
395	Marsh Owl	*Asio capensis*
397	Whitefaced Owl	*Ptilopsus granti*
400	Cape Eagle Owl	*Bubo capensis*
401	Spotted Eagle Owl	*Bubo africanus*
404	Eurasian Nightjar	*Caprimulgus europaeus*
405	Fierynecked Nightjar	*Caprimulgus pectoralis*
408	Freckled Nightjar	*Caprimulgus tristigma*
411	Eurasian Swift	*Apus apus*
412	Black Swift	*Apus barbatus*
415	Whiterumped Swift	*Apus caffer*
416	Horus Swift	*Apus horus*

417	Little Swift	*Apus affinis*
418	Alpine Swift	*Tachymarptis melba*
421	Palm Swift	*Cypsiurus parvus*
424	Speckled Mousebird	*Colius striatus*
426	Redfaced Mousebird	*Urocolius indicus*
428	Pied Kingfisher	*Ceryle rudis*
429	Giant Kingfisher	*Megaceryle maxima*
430	Halfcollared Kingfisher	*Alcedo semitorquata*
431	Malachite Kingfisher	*Alcedo cristata*
432	Pygmy Kingfisher	*Ispidina picta*
433	Woodland Kingfisher	*Halcyon senegalensis*
435	Brownhooded Kingfisher	*Halcyon albiventris*
438	Eurasian Bee-eater	*Merops apiaster*
443	Whitefronted Bee-eater	*Merops bullockoides*
444	Little Bee-eater	*Merops pusillus*
446	Eurasian Roller	*Coracias garrulus*
451	African Hoopoe	*Upupa africana*
452	Redbilled Woodhoopoe	*Phoeniculus purpureus*
454	Scimitarbilled Woodhoopoe	*Rhinopomastus cyanomelas*
464	Blackcollared Barbet	*Lybius torquatus*
465	Pied Barbet	*Tricholaema leucomelas*
470	Yellowfronted Tinker Barbet	*Pogoniulus chrysoconus*
473	Crested Barbet	*Trachyphonus vaillantii*
474	Greater Honeyguide	*Indicator indicator*
475	Scalythroated Honeyguide	*Indicator variegatus*
476	Lesser Honeyguide	*Indicator minor*
478	Sharpbilled Honeyguide	*Prodotiscus regulus*
480	Ground Woodpecker	*Geocolaptes olivaceus*
483	Goldentailed Woodpecker	*Campethera abingoni*
486	Cardinal Woodpecker	*Dendropicos fuscescens*
488	Olive Woodpecker	*Dendropicos griseocephalus*
489	Redthroated Wryneck	*Jynx ruficollis*
494	Rufousnaped Lark	*Mirafra africana*
495.2	Eastern Clapper Lark	*Mirafra fasciolata*
496	Flappet Lark	*Mirafra rufocinnamomea*
498	Sabota Lark	*Calendulauda sabota*
499	Rudd's Lark	*Heteromirafra ruddi*
500.2	Eastern Longbilled Lark	*Certhilauda semitorquata*
506	Spikeheeled Lark	*Chersomanes albofasciata*
507	Redcapped Lark	*Calandrella cinerea*
508	Pinkbilled Lark	*Spizocorys conirostris*
518	Eurasian Swallow	*Hirundo rustica*
520	Whitethroated Swallow	*Hirundo albigularis*
523	Pearlbreasted Swallow	*Hirundo dimidiata*
524	Redbreasted Swallow	*Hirundo semirufa*
526	Greater Striped Swallow	*Hirundo cucullata*

528	South African Cliff Swallow	*Hirundo spilodera*
529	Rock Martin	*Hirundo fuligula*
530	House Martin	*Delichon urbica*
531	Greyrumped Swallow	*Pseudhirundo griseopyga*
532	Sand Martin	*Riparia riparia*
533	Brownthroated Martin	*Riparia paludicola*
534	Banded Martin	*Riparia cincta*
536	Black Sawwing Swallow	*Psalidoprocne holomelaena*
538	Black Cuckooshrike	*Campephaga flava*
541	Forktailed Drongo	*Dicrurus adsimilis*
542	Squaretailed Drongo	*Dicrurus ludwigii*
545	Blackheaded Oriole	*Oriolus larvatus*
547	Black Crow	*Corvus capensis*
548	Pied Crow	*Corvus albus*
554	Southern Black Tit	*Parus niger*
558	Grey Penduline Tit	*Anthoscopus caroli*
560	Arrowmarked Babbler	*Turdoides jardineii*
568	Blackeyed Bulbul	*Pycnonotus tricolor*
576	Kurrichane Thrush	*Turdus libonyanus*
577	Olive Thrush	*Turdus olivaceus*
579	Orange Thrush	*Zoothera gurneyi*
580	Groundscraper Thrush	*Psophocichla litsipsirupa*
581	Cape Rockthrush	*Monticola rupestris*
582	Sentinel Rockthrush	*Monticola explorator*
586	Mountain Chat	*Oenanthe monticola*
587	Capped Wheatear	*Oenanthe pileata*
588	Buffstreaked Chat	*Oenanthe bifasciata*
589	Familiar Chat	*Cercomela familiaris*
593	Mocking Chat	*Thamnolaea cinnamomeiventris*
595	Anteating Chat	*Myrmecocichla formicivora*
596	Stonechat	*Saxicola torquata*
598	Chorister Robin	*Cossypha dichroa*
600	Natal Robin	*Cossypha natalensis*
601	Cape Robin	*Cossypha caffra*
602	Whitethroated Robin	*Cossypha humeralis*
613	Whitebrowed Robin	*Cercotrichas leucophrys*
619	Garden Warbler	*Sylvia borin*
621	Titbabbler	*Parisoma subcaeruleum*
625	Icterine Warbler	*Hippolais icterina*
628	Great Reed Warbler	*Acrocephalus arundinaceus*
631	African Marsh Warbler	*Acrocephalus baeticatus*
633	Eurasian Marsh Warbler	*Acrocephalus palustris*
634	Eurasian Sedge Warbler	*Acrocephalus schoenobaenus*

635	Cape Reed Warbler	*Acrocephalus gracilirostris*
637	Yellow Warbler	*Chloropeta natalensis*
638	African Sedge Warbler	*Bradypterus baboecala*
643	Willow Warbler	*Phylloscopus trochilus*
645	Barthroated Apalis	*Apalis thoracica*
648	Yellowbreasted Apalis	*Apalis flavida*
651	Longbilled Crombec	*Sylvietta rufescens*
661	Grassbird	*Sphenoeacus afer*
664	Fantailed Cisticola	*Cisticola juncidis*
665	Desert Cisticola	*Cisticola aridulus*
666	Cloud Cisticola	*Cisticola textrix*
667	Ayres' Cisticola	*Cisticola ayresii*
668	Palecrowned Cisticola	*Cisticola cinnamomeus*
670	Wailing Cisticola	*Cisticola lais*
677	Levaillant's Cisticola	*Cisticola tinniens*
678	Croaking Cisticola	*Cisticola natalensis*
679	Lazy Cisticola	*Cisticola aberrans*
681	Neddicky	*Cisticola fulvicapillus*
683	Tawnyflanked Prinia	*Prinia subflava*
685	Blackchested Prinia	*Prinia flavicans*
686.1	Spotted Prinia	*Prinia hypoxantha*
689	Spotted Flycatcher	*Muscicapa striata*
690	Dusky Flycatcher	*Muscicapa adusta*
693	Fantailed Flycatcher	*Myioparus plumbeus*
694	Black Flycatcher	*Melaenornis pammelaina*
698	Fiscal Flycatcher	*Sigelus silens*
700	Cape Batis	*Batis capensis*
706	Fairy Flycatcher	*Stenostira scita*
708	Bluemantled Flycatcher	*Trochocercus cyanomelas*
710	Paradise Flycatcher	*Terpsiphone viridis*
711	African Pied Wagtail	*Motacilla aguimp*
712	Longtailed Wagtail	*Motacilla clara*
713	Cape Wagtail	*Motacilla capensis*
714	Yellow Wagtail	*Motacilla flava*
716	Grassveld Pipit	*Anthus cinnamomeus*
717	Longbilled Pipit	*Anthus similis*
718	Plainbacked Pipit	*Anthus leucophrys*
719	Buffy Pipit	*Anthus vaalensis*
720	Striped Pipit	*Anthus lineiventris*
725	Yellowbreasted Pipit	*Anthus chloris*
727	Orangethroated Longclaw	*Macronyx capensis*
728	Yellowthroated Longclaw	*Macronyx croceus*
731	Lesser Grey Shrike	*Lanius minor*
732	Fiscal Shrike	*Lanius collaris*
733	Redbacked Shrike	*Lanius collurio*
736	Southern Boubou	*Laniarius ferrugineus*
740	Puffback	*Dryoscopus cubla*

741	Brubru	*Nilaus afer*
743	Threestreaked Tchagra	*Tchagra australis*
744	Blackcrowned Tchagra	*Tchagra senegala*
746	Bokmakierie	*Telophorus zeylonus*
748	Orangebreasted Bush Shrike	*Telophorus sulfureopectus*
750	Olive Bush Shrike	*Telophorus olivaceus*
751	Greyheaded Bush Shrike	*Malaconotus blanchoti*
753	White Helmetshrike	*Prionops plumatus*
758	Indian Myna	*Acridotheres tristis*
759	Pied Starling	*Spreo bicolor*
760	Wattled Starling	*Creatophora cinerea*
761	Plumcoloured Starling	*Cinnyricinclus leucogaster*
764	Glossy Starling	*Lamprotornis nitens*
769	Redwinged Starling	*Onychognathus morio*
772	Redbilled Oxpecker	*Buphagus erythrorhynchus*
775	Malachite Sunbird	*Nectarinia famosa*
783	Lesser Doublecollared Sunbird	*Cinnyris chalybea*
785	Greater Doublecollared Sunbird	*Cinnyris afra*
787	Whitebellied Sunbird	*Cinnyris talatala*
791	Scarletchested Sunbird	*Chalcomitra senegalensis*
792	Black Sunbird	*Chalcomitra amethystina*
796	Cape White-eye	*Zosterops virens*
799	Whitebrowed Sparrowweaver	*Plocepasser mahali*
801	House Sparrow	*Passer domesticus*
803	Cape Sparrow	*Passer melanurus*
804	Southern Greyheaded Sparrow	*Passer diffusus*
805	Yellowthroated Sparrow	*Petronia superciliaris*
807	Thickbilled Weaver	*Amblyospiza albifrons*
810	Spectacled Weaver	*Ploceus ocularis*
811	Spottedbacked Weaver	*Ploceus cucullatus*
813	Cape Weaver	*Ploceus capensis*
814	Masked Weaver	*Ploceus velatus*
815	Lesser Masked Weaver	*Ploceus intermedius*
816	Golden Weaver	*Ploceus xanthops*
819	Redheaded Weaver	*Anaplectes rubriceps*
820	Cuckoofinch	*Anomalospiza imberbis*
821	Redbilled Quelea	*Quelea quelea*
824	Red Bishop	*Euplectes orix*
826	Golden Bishop	*Euplectes afer*
827	Yellowrumped Widow	*Euplectes capensis*
828	Redshouldered Widow	*Euplectes axillaris*
829	Whitewinged Widow	*Euplectes albonotatus*
831	Redcollared Widow	*Euplectes ardens*
832	Longtailed Widow	*Euplectes progne*

840	Bluebilled Firefinch	*Lagonosticta rubricata*
842	Redbilled Firefinch	*Lagonosticta senegala*
844	Blue Waxbill	*Uraeginthus angolensis*
845	Violeteared Waxbill	*Granatina granatina*
846	Common Waxbill	*Estrilda astrild*
850	Swee Waxbill	*Estrilda melanotis*
852	Quail Finch	*Ortygospiza atricollis*
854	Orangebreasted Waxbill	*Amandava subflava*
855	Cutthroat Finch	*Amadina fasciata*
856	Redheaded Finch	*Amadina erythrocephala*
857	Bronze Mannikin	*Lonchura cucullata*
860	Pintailed Whydah	*Vidua macroura*
862	Paradise Whydah	*Vidua paradisaea*
864	Black Widowfinch	*Vidua funerea*
867	Steelblue Widowfinch	*Vidua chalybeata*
869	Yelloweyed Canary	*Serinus mozambicus*
870	Blackthroated Canary	*Serinus atrogularis*
872	Cape Canary	*Serinus canicollis*
877	Bully Canary	*Serinus sulphuratus*
881	Streakyheaded Canary	*Serinus gularis*
884	Goldenbreasted Bunting	*Emberiza flaviventris*
885	Cape Bunting	*Emberiza capensis*
886	Rock Bunting	*Emberiza tahapisi*

Appendix 8. Insects collected in Weltevreden during the dry season

Site Name	Family	Abundance
Site 1	Acrididae	2
	Muscidae	2
	Sepsidae	4
	Tachnidae	1
	Chironomidae	15
	Asilidae	2
	Cixiidae	10
	Cicadellidae	8
	Syrphidae	3
	Dolichopodidae	8
	Tingidae	1
Site 2	Acrididae	2
	Chironomidae	41
	Sphecidae	8
	Asilidae	8
	Staphylinidae	1
	Issidae	2
	Tingidae	3
	Dolichopodidae	1
Site 3	Chironomidae	12
	Meloidae	2
	Pentatomidae	1
	Asilidae	2
	Coreidae	1
	Cicadellidae	6
	Chrysomelidae	2
	Muscidae	2
	Calliphoridae	2
Site 4	Coccinellidae	1
	Chrysomelidae	2
	Pentatomidae	1
	Mantidae	1
	Asilidae	9
	Chironomidae	11
	Cicadellidae	4
	Calliphoridae	2
	Sphecidae	1
	Tephritidae	3
	Sepsidae	4
Site 5	Acrididae	2
	Coreidae	5
	Sphecidae	2
	Syrphidae	2
	Cicadellidae	4
	Chrysomelidae	1

Site Name	Family	Abundance
	Anthicidae	1
	Chironomidae	3
	Tabanidae	2
Site 6	Acrididae	1
	Chironomidae	7
	Coccinellidae	1
	Tingidae	2
	Cicadellidae	7
	Tephritidae	3
	Tenebrionidae	1
	Cerambycidae	1
	Syrphidae	2
	Aradidae	1
Site 7	Cicadellidae	3
	Chironomidae	15
	Coccinellidae	3
	Reduviidae	3
	Apionidae	3
	Anthicidae	1
	Muscidae	2
	Cydnidae	1
Site 8	Cicadellidae	4
	Apionidae	1
	Coccinellidae	1
	Chironomidae	2
	Culicidae	4
	Muscidae	4
	Ceratopogonidae	5
	Chrysomelidae	2
	Tipulidae	1
	Calliphoridae	2
	Tachinidae	3
Site 9	Coccinellidae	4
	Acrididae	1
	Lygaeidae	5
	Reduviidae	1
	Chironomidae	2
	Apionidae	1
	Cicadellidae	2
	Muscidae	2
	Thripidae	5
Site 10	Tingidae	5
	Cicadellidae	2
	Chironomidae	6
	Coccinellidae	1
	Tenthredinidae	8
	Tephritidae	2

Site Name	Family	Abundance
	Asilidae	7
	Sphecidae	1
	Muscidae	3
	Calliphoridae	1
Site 11	Chironomidae	20
	Mantidae	1
	Acrididae	1
	Pompilidae	2
	Acanthosomatidae	1
Site 12	Acrididae	1
	Asilidae	1
	Chironomidae	38
	Muscidae	1
	Tipulidae	1
	Apionidae	1
	Cicadellidae	2
	Chrysomelidae	1
Site 13	No insects	

Appendix 9. Insects collected in Weltevreden during the wet season

Site Name	Family	Abundance
WELTE 1	Acrididae	4
	Asilidae	1
	Cercopidae	1
	Chironomidae	2
	Cicadellidae	3
	Mantidae	4
	Meloidae	2
	Muscidae	6
	Reduviidae	20
		43
WELTE 2	Chironomidae	4
	Coenagrionidae	2
	Curculionidae	4
	Formicidae	3
	Meloidae	1
	Reduviidae	10
	Tenebrionidae	1
		25
WELTE 3	Acrididae	1
	Chironomidae	3
	Curculionidae	5
	Elateridae	1
	Formicidae	1
	Meloidae	1
	Muscidae	6
	Reduviidae	5
	Sepsidae	2
	Tenebrionidae	4
	Tipulidae	2
		31
WELTE 4	Chironomidae	4
	Chrysomelidae	8
	Coccinellidae	1
	Coenagrionidae	1
	Curculionidae	4
	Muscidae	1
	Reduviidae	11
	Scarabaeidae	1
	Staphylinidae	2
	Tenebrionidae	3
		36
WELTE 5	Acrididae	1
	Alydidae	1
	Chironomidae	1

Site Name	Family	Abundance
	Chrysomelidae	3
	Coenagrionidae	1
	Curculionidae	1
	Formicidae	2
	Muscidae	2
	Pentatomidae	1
	Reduviidae	13
	Sepsidae	1
	Tenebrionidae	3
	Tipulidae	4
		34
WELTE 6	Acrididae	2
	Aradidae	2
	Asilidae	1
	Chironomidae	1
	Chrysomelidae	2
	Coenagrionidae	1
	Dictyopharidae	4
	Formicidae	4
	Muscidae	12
	Reduviidae	7
	Sepsidae	3
	Staphylinidae	2
	Tenebrionidae	2
	Tipulidae	8
		51
WELTE 7	Alydidae	2
	Carabidae	1
	Chrysomelidae	5
	Curculionidae	6
	Formicidae	2
	Meloidae	1
	Muscidae	5
	Reduviidae	7
	Sepsidae	2
	Sphecidae	1
	Tenebrionidae	2
		34
WELTE 8	Acrididae	1
	Aradidae	2
	Chrysomelidae	2
	Curculionidae	15
	Muscidae	1
	Pentatomidae	1
	Pompilidae	1
	Reduviidae	4
	Scarabaeidae	3

Site Name	Family	Abundance
	Tenebrionidae	1
		31
WELTE 9	Acrididae	3
	Chironomidae	1
	Coccinellidae	1
	Coenagrionidae	1
	Curculionidae	7
	Formicidae	2
	Meloidae	2
	Muscidae	2
	Pentatomidae	1
	Reduviidae	23
	Scarabaeidae	1
		44
WELTE 10	Alydidae	1
	Asilidae	1
	Carabidae	1
	Chironomidae	1
	Cicadellidae	1
	Coccinellidae	3
	Curculionidae	1
	Languriidae	1
	Meloidae	10
	Muscidae	4
	Pentatomidae	1
	Tenebrionidae	2
	Tipulidae	2
		29
WELTE 11	Asilidae	1
	Chironomidae	1
	Coccinellidae	1
	Coenagrionidae	1
	Muscidae	8
	Reduviidae	51
	Sphecidae	1
		64

Appendix 10. Map representing all five major plant communities found in Weltevreden during the dry and wet season
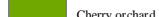
Plan 1
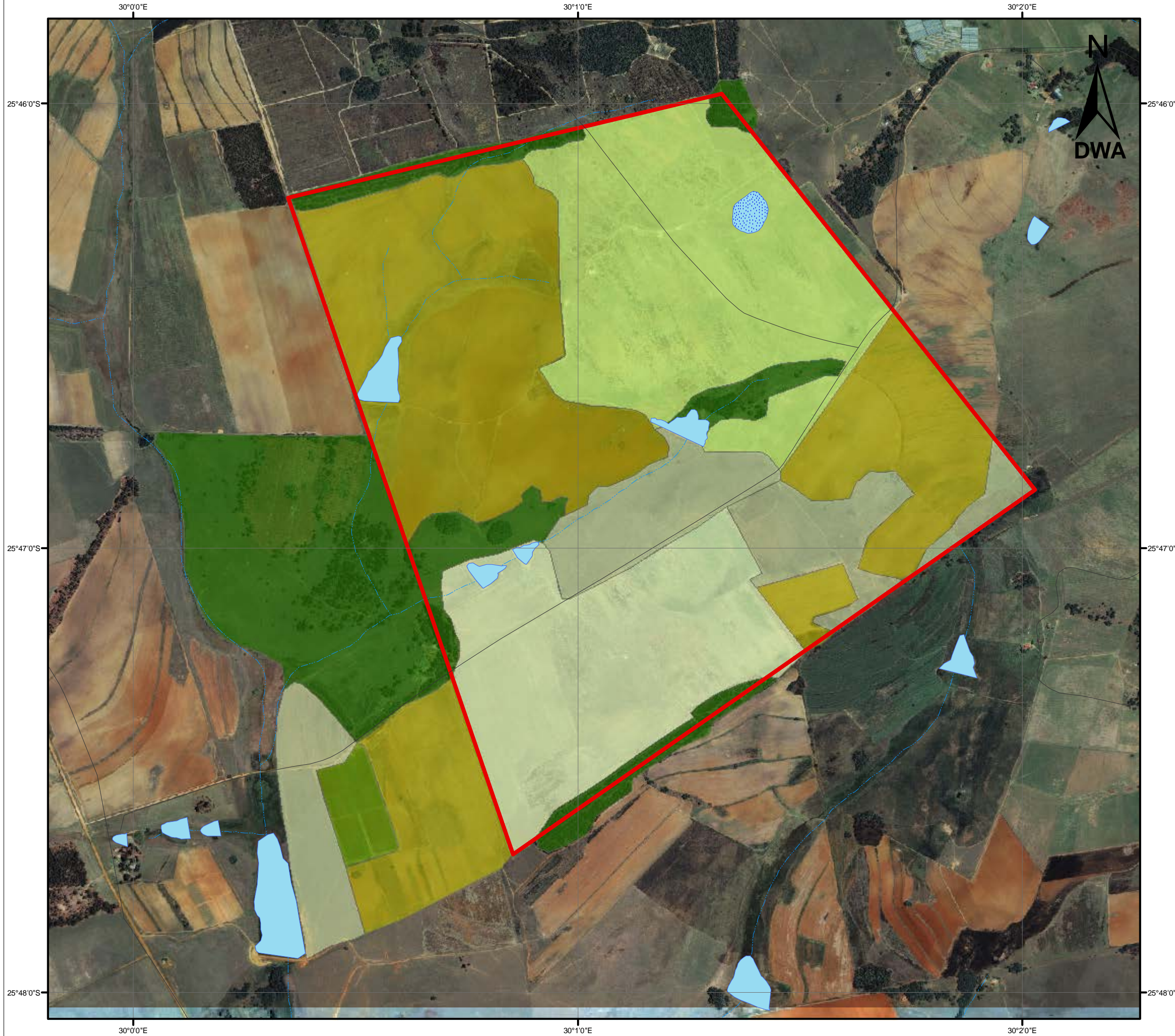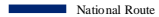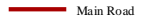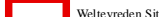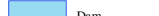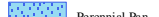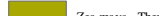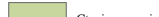
Northern Coal
Weltevreden
Plant Communities

Legend

▬▬	National Route
▬▬	Main Road
▬▬	Minor Road
▬▬	Perennial Stream
·-·-·	Non-Perennial Stream
▭	Weltevreden Site
▨	Dam
▨	Perennial Pan
▨	Non-Perennial Pan

Plant Communities

▨	Cherry orchard
▨	Pinus patula - Eucalyptus camaldulensis woodland
▨	Zea mays - Themeda triandra mielie fields
▨	Ctenium concinnum - Andropogon eucomis grassland
▨	Setaria sphacelata var sphacelata - Hyparrhenis hirta grassland
▨	Bidens pilosa - Hypairhenia hirta and Tristachya leucothrix - Monocymbium ceresiiforme grassland

(2002 Ikonos Satellite Imagery)

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Projection: Transverse Mercator
Central Meridian: Lo31
Datum: WGS84

1:15,000

0   0.125 0.25   0.5   0.75   1
Kilometres

Ref:/glo.NOR335.200906.0018