

# Ecological assessment for the proposed development of a 50MW Solar Farm on Portions 26, 27 and 28 of the Farm Schietfontein 437-JQ, Madibeng Local Municipality, North West Province



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**PHAKANANI ENVIRONMENTAL**

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To Phakanani Environmental

ECOLOGICAL ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF A 50MW SOLAR FARM  
ON PORTIONS 26, 27 AND 28 OF THE FARM SCHIETFFONTEIN 437-JQ, MADIBENG  
MUNICIPALITY, NORTH WEST PROVINCE

We have the pleasure in submitting herewith our report as requested and as per your correspondence and appointment on the 26<sup>th</sup> of October 2015. This study has been carried out in accordance with regulations stated in *DEAT (2005) Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.*

The aim of this report was to provide:

1. the client with a description of the potential status of threatened species and habitat that could be potentially suitable for their presence in the proposed development area.
2. an overall description of the biological diversity on the survey area.
3. a detailed description of the ecological status of the survey area.
4. recommendations for the long term management of the survey area.

The entire survey area is comprised of relatively natural Marikana Thornveld that has been slightly degraded by livestock farming, irregular fire regimes and the excavation of a large gravel pit. The survey confirmed the presence or possible presence of 13 species of conservation concern as indicated below:

	<b>Critically endangered</b>	<b>Endangered</b>	<b>Vulnerable</b>	<b>Near threatened</b>	<b>Nationally protected</b>
Plantae					2 (present)
Aves			3 (possible)	2 (possible)	
Mammalia				5 (possible)	
Arachnida					1 (present)

Marikana Thornveld is classified as endangered and the entire survey area is located within a Critical Biodiversity Area 1 (CBA 1) as well as an Important Birding Area (IBA). The NWPG considers CBA 1's to be irreplaceable and necessary to meet conservation targets. The survey area is completely surrounded by two large public roads (N4 & R566) however there is limited connectivity with more Marikana Thornveld to the west of the survey area. A decision on whether the proposed development should be approved will depend on NWPG priorities. The question at hand will be whether the demand for clean energy should be prioritised over the necessity to protect endangered habitat types that are known to harbour species of conservation concern.

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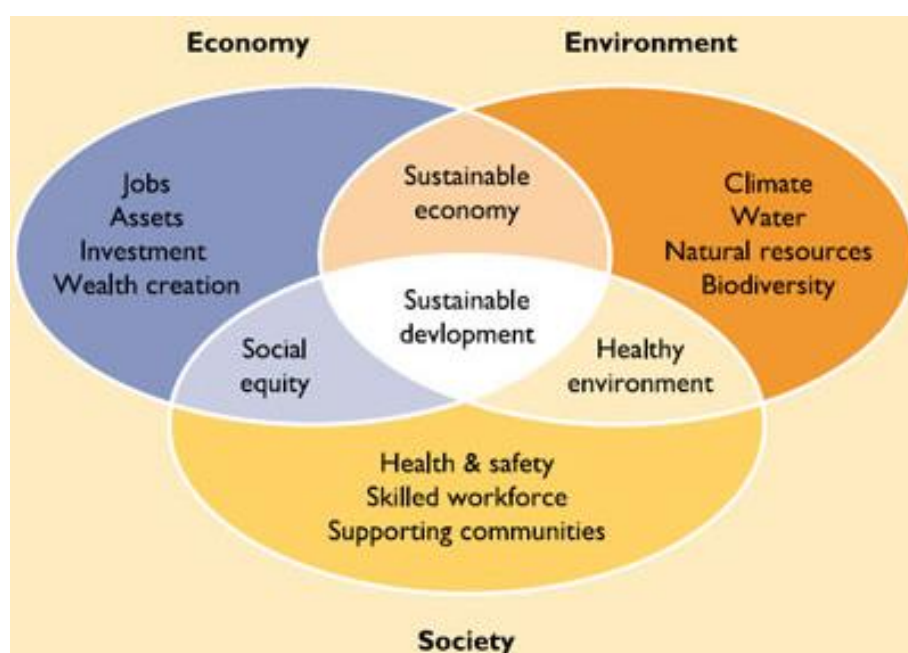
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## BIODIVERSITY AND SUSTAINABLE DEVELOPMENT

Biodiversity is the variability among living organisms on earth, including the variability within and between species and within and between ecosystems. The biodiversity of North West province is under constant threat from human settlement and societal development. Natural land is being degraded and transformed by the rapid expansion of human settlements as well as the establishment of mines, manufacturing plants, storage dams, transport and agricultural infrastructure. The loss, fragmentation and degradation of natural habitat through urbanisation and exponential human population growth, represent the greatest threats to biodiversity in North West province.

Sustainable development is an evolving concept, which is continually being redefined and reinterpreted and should form the basis of the planning processes of new developments. Reducing the burden of environmental impacts is necessary if development is to become sustainable. The process of planning new developments should be based on scientific, ecological principles and used as a planning tool to promote sustainable development by integrating environmental considerations into a wide range of proposed actions. Development proposals should not undermine critical resource and ecological functions. These proposals should improve the way environmental resources are utilised as well as the well-being, lifestyle and livelihood of the communities who depend on them.

According to NWDCE (2008) sustainable development refers to “the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations”. It rests on three namely economic viability, social equity and ecological integrity (Figure 4.). To ensure that sustainable development is achieved it is critical that government has strategies and policies in place that dictate the rate of consumption of non-renewable and renewable resources, thereby ensuring ecosystem integrity whilst still providing the necessary services to humans.



**Figure 1.** The three pillars on which sustainable utilisation and therefore economic viability rests.

Any strategy aimed at ensuring sustainable development must, according to the European Commission (1993), focus on maintaining overall quality of life (for all living organisms), guarantee continued access to these natural resources and avoid permanent damage to ecosystems. The European commission further stresses three important elements of such programmes:

1. Preventative action should be preferable to remedial measures;
2. Environmental damage should be restored at the source and;
3. The transgressor should pay the cost of corrective measures taken to protect/restore the environment.

Although the Department of Environmental Affairs and Tourism (DEAT) has developed a national Framework to improve communication between organs of state and the public and to provide sufficient information for decision-making for development, it is important that each province define their own set of priorities to ensure sustainable development and utilisation of its natural resources. From a national perspective, Section 24 of the constitution of RSA enshrines the right to - The Environment. Everyone has the right:

1. to an environment that is not harmful to their health or well-being; and
2. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
  - a) prevent pollution and ecological degradation;
  - b) promote conservation; and
  - c) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.
3. Sustainable development requires the consideration of all relevant factors including the following:
  - a) that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
  - b) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
  - c) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimized and remedied;
  - d) that waste is avoided, or where it cannot be altogether avoided, minimized and reused or recycled where possible and otherwise disposed of in a responsible manner;
  - e) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
  - f) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardized;
  - g) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
  - h) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimized and remedied.

## PROJECT BACKGROUND AND STUDY AREA

Phakanani Environmental Planning was appointed to undertake an environmental impact assessment (EIA) for the proposed development of a 50MW Solar Farm on Portions 27 and 28 of the Farm Schietfontein 437-JQ, Madibeng Municipality, North West Province.

On the 1<sup>st</sup> of November 2015 Phakanani Environmental requested an ecological survey of the area identified for the abovementioned development. This ecological survey forms part of other surveys aimed at assessing the conservation significance and heritage value of the 181ha development area.

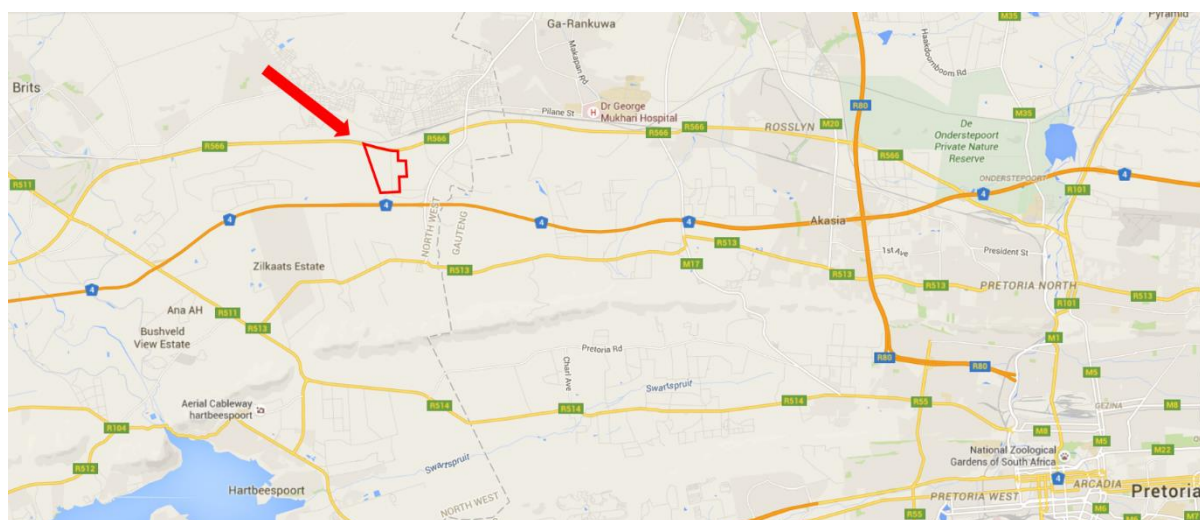
This ecological survey has been carried out with a special focus on:

1. providing the client with a detailed description of the ecological status of the survey area;
2. identifying potential species of conservation concern and habitat that could be potentially suitable for their presence in the proposed development area.

This will include:

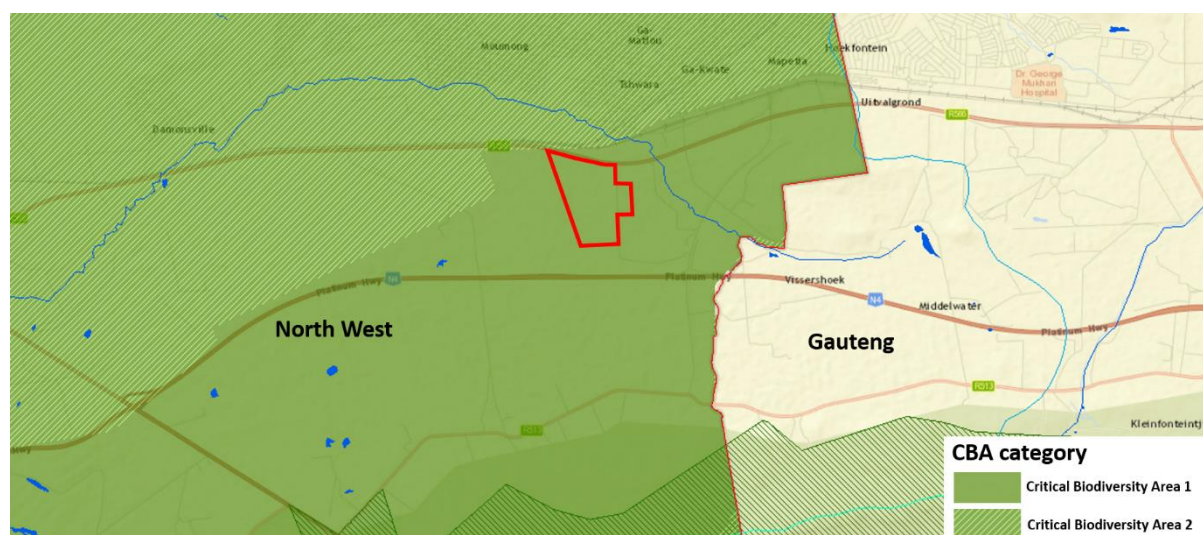
1. a vegetation assessment
2. preparation of a plant species list
3. preparation of faunal species list for species observed & those likely to occur in the study area
4. an environmental sensitivity map
5. a description of potential impacts on fauna and flora
6. recommendations for long-term management of natural areas.

**Location of the study area:** The proposed development is located on 181ha of land located directly between the R566 (Ga-Rankuwa - Brits) and the N4 (Pretoria to Rustenburg). The R566 forms the northern border whilst the southern border is located just 530 metres from the N4. Brits is located 14km from to the west of the survey area whilst Hartbeespoort Dam is located 12.4 km to the south west. Dr George Mukhari Hospital is located 7.6km to the east of the site. The entire development area is located within the Madibeng Local Municipality (North West Province) and within a Critical Biodiversity Area 1 (CBA 1) as per the North West Conservation Plan (Figure 3).



**Figure 2.** Location of the proposed development area.





**Figure 3.** Location of the proposed development area within the North West Conservation Plan.

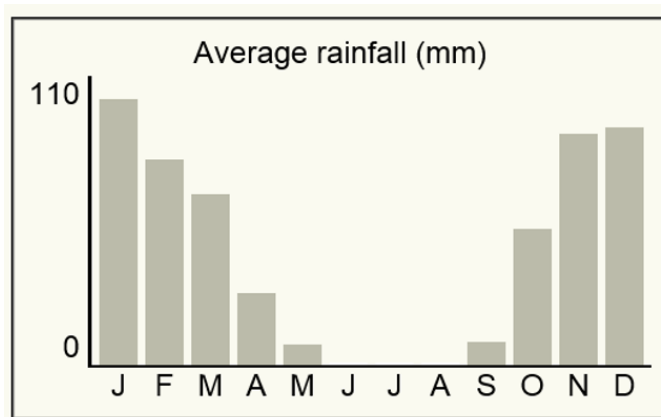
**Duration of survey:** The initial site visit was carried out on the 5<sup>th</sup> of November in early Summer. Follow up site visits took place on the 6<sup>th</sup> and 7<sup>th</sup> of November. All site visits were conducted by Vincent van der Merwe. The purpose of these site visit was to become acquainted with the development area, to document faunal and plant diversity and to investigate the possibility of species of conservation concern occurring on the site. The fact that sampling took place in early summer following the first spring rains enabled the specialist to document most of the faunal and botanical biodiversity present in the area.

**Conditions during survey:** Conditions for an ecological survey were good despite that fact that the area had received lower rainfall compared to previous years. Temperatures exceeded 25°C during all three site visits. It was sunny with low to medium cloud cover during all sampling days. Invertebrate activity was high. A large proportion of plant species were flowering allowing for easy identification.

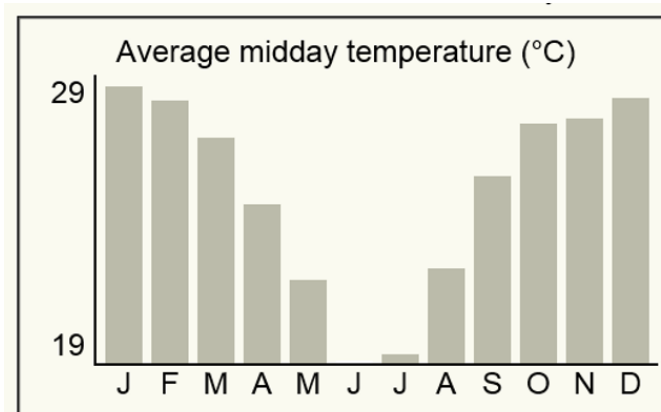
**Topography and land use:** The survey area is flat in nature ranging from 1216m above sea level in the north western corner of the site to 1250m in the south eastern corner of the survey area. A drainage line enters the site close to the north western corner, runs parallel to the western boundary and leaves the site close to the south western boundary. Water flows down the drainage line only during periods of heavy rainfall. The drainage line washes storm water into a large gravel pit located in the north western corner of the site. This gravel pit effectively traps storm water and preventing it from entering the Crocodile River catchment. The gravel pit does holds water during periods of heavy rainfall but was completely dry during the survey period. The entire survey area is currently utilised for cattle grazing. The site displayed a generally low level of invasion by exotic vegetation. Most exotics and invasives were observed in and around the large gravel pit where soil layers have been disturbed and severe dumping of litter, garden refuse and building rubble was observed. Apart from the gravel pit, the entire site was comprised of open *Acacia karroo* - *Rhus lancea* woodland. The shrub and tree layer is more developed along the drainage line and on termitaria where is it protected from fire. There are no human settlements and no permanent river systems present in the survey area. The site has been subject to moderate levels of grazing.

**Geology and soils:** The area is underlain by mafic intrusive rocks of the Rustenburg Layered Suite of the Bushveld Igneous Complex. Rocks include gabbro, norite, pyroxenite and anorthosite. The shales and quartzite's of the Pretoria Group (Transvaal Supergroup) also contribute. Soils are mainly vertic melanic clays with some dystrophic or mesotrophic plinthic catenas. There are also some freely drained, deep soils. Land types are mainly Ea, Ba and Ae (Mucina & Rutherford 2006).

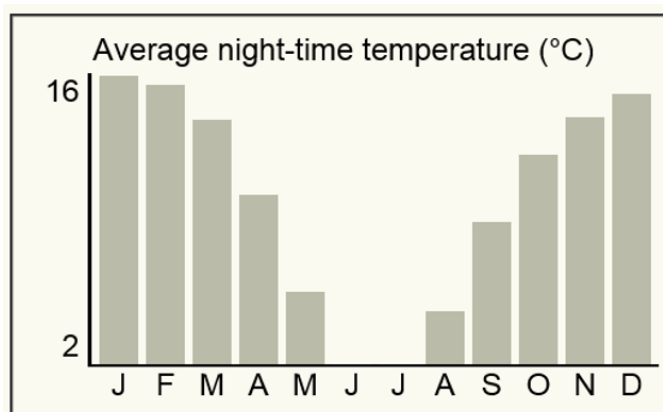
**Climate:** Summer rainfall with very dry winters. MAP between 600 and 700mm. Frost is fairly frequent in winter. Mean monthly maximum and minimum temperatures for the area are 35.3°C and -3.3°C for January and June, respectively (Mucina & Rutherford 2006). Catherine's



**Figure 4.** Average monthly rainfall values for the survey area.



**Figure 5.** Average midday temperatures per month for the survey area.



**Figure 6.** Average night-time temperatures per month for the survey area.



## VEGETATION OF THE SURVEY AREA

This chapter provides a holistic overview of the vegetation observed in the survey area with reference to the different plant communities present, their species composition and their diversity. Information for this chapter was obtained from available literature and was heavily supplemented by data collected during site visits.

**Vegetation types:** Vegetation is the most physical representation of the environment. Each plant community possesses its own specific plant species composition and structure, which is the result of the environmental conditions of its habitat (climate, geology, topography, soil, drainage, water regime, etc.). This total physical environment of an area is therefore manifested in the plant species composition, named the vegetation or plant community of the area. These plant communities may, however, also be influenced by the utilisation history and management of the area. The specific potential of each plant community, with regards to habitat type for animals, carrying capacity, resilience to utilisation and drought is a direct result of the combined influence of environmental factors and past management practices. The habitat and environmental conditions control the successional development, species composition, distribution and potential of the plant communities. Each plant community (ecosystem) also has its own specific conservation potential, need and status. A thorough inventory of the plant communities and their associated habitats will therefore provide information on the conservation status of an area.

**Methodology:** The Braun-Blanquet survey technique to describe plant communities as ecological units was used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area. The study area was delineated into different vegetation units using an aerial photograph and then surveyed on foot. Sampling plots were placed out on a stratified random basis to represent all the different vegetation units. Within each plot all the species present were identified and listed and their canopy cover estimated. Environmental data such as rockiness, slope and aspect were also listed.

**Data recorded:** A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence.

**Data processing:** Vegetation data was classified to identify, describe and map vegetation types. Descriptions of the plant communities include the tree, shrub and herbaceous layers. The conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the De Wildt area and Savanna vegetation in South Africa.

The following four conservation priority categories were considered for the single vegetation unit / plant community in the survey area:

- High:** Area with high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.
- Medium-high:** An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity; between 5-20% pioneer/alien plant species present; that would need moderate to low financial input to rehabilitate to an improved condition; and where low density development could be considered under exceptional conditions with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation are maintained.
- Medium:** Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-50% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.
- Low:** A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >50% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

The following **Agricultural Potential** categories were utilised:

- High:** The deep loamy soil has a high potential for cultivation of crops.
- Medium:** The shallow soil has a medium potential for cultivation of crops.
- Low:** The shallow, rocky soil has little or no potential for cultivation of crops, and can be used for grazing only.

The survey area is located within the Savanna Biome of southern Africa and specifically within the Central Bushveld bioregion (SVI) (Mucina & Rutherford 2006). A bioregion is a composite terrestrial unit that is defined on the basis of broadly similar biotic and physical features. The vegetation of the proposed development area was most recently classified as belonging to a single vegetation type namely Marikana Thornveld (SVcb 6). The unit was previously classified as Sourish Mixed Bushveld VT 19 by Acocks (1953) and Clay Thorn Bushveld LR 14 by Low & Rebelo (1996).

Marikana Thornveld is currently listed as Endangered with less than 1% statutorily conserved in the Magaliesberg Nature Area and Onderstepoort Nature Reserves. More than 48% of this unit has been transformed by cultivation and built-up areas. Erosion is often low to moderate. Alien plants tend to be localised in high densities, especially along drainage lines and areas that has been subject to

anthropogenic disturbance. The entire 181 ha area identified for the proposed development is comprised of three vegetation units, namely:

1. Marikana Thornveld
2. Drainage line
3. Transformed area - Gravel pit

### 1. Marikana Thornveld



<b>Mapping unit</b>	1	<b>Tree cover</b>	±10%
<b>Soil</b>	Vertic melanic clays	<b>Shrub cover</b>	±10%
<b>Rock cover</b>	< 5%	<b>Herb cover</b>	±5%
<b>Topography</b>	Level: 34m difference in altitude with no rocky outcrops	<b>Grass cover</b>	±75%
<b>Status:</b>	Natural thornveld that has been impacted by irregular fire regimes, years of livestock farming as well as gravel excavations.		
<b>Ground cover of site:</b>	85%		
<b>Need for rehabilitation:</b>	Restore natural fire regimes, regulate grazing pressure, fill gravel pit, remove invasive vegetation and reintroduce native mammal fauna.		
<b>Agricultural potential:</b>	Low		
<b>Conservation priority:</b>	High		

This vegetation unit dominates the survey area and is comprised of open *Acacia karroo* - *Sersia lancea* woodland that is permeated by a drainage line and a few gravel roads. The harsh hot and dry environment has limited the level of invasion by exotic species. The unit has been extensively utilised for cattle grazing for a number of years. *Aloe greatheadii*, an indicator of overgrazing, was observed in high densities throughout the unit. Numerous footpaths bisect the unit and cattle herders have regularly subjected the area to burning. These irregular fire regimes have contributed to the slightly degraded state of this unit. Despite these anthropogenic influences, the unit remains in a relatively natural condition and remains dominated by plants species indigenous to the area. Prominent tree species include *Acacia karroo*, *Sersia lancea*, *Zuziphus mucronata*, *Acacia caffra*, *Acacia robusta*, *Acacia gerrardii*, *Peltophorum africanum* *Acacia tortilis* and *Combretum zeyheri*. Prominent shrubs include

*Dichrostachys cinerea*, *Euclea crispa*, *Grewia flava*, *Olea europaea* and *Sersia pyroides*. Dominant graminoids include *Themeda triandra*, *Urochloa mossambicensis* and *Hypparrhenia hirta*. Two plant species of conservation concern were observed in this unit.

Table 1. Plant species of conservation concern observed in unit 1.

Plant name	Conservation status	Remarks
<i>Sclerocarya birrea</i>	Nationally protected	Observed in low densities throughout this unit
<i>Berchemia zeyheri</i>	Nationally protected	Observed in very low densities throughout this unit.

Table 2. Plant species identified in unit 1 during the survey (invasive species bolded).

Trees	Shrubs	Graminoids	Climbers	Herbs
<i>Sclerocarya birrea</i>	<i>Dichrostachys cinerea</i>	<i>Themeda triandra</i>	<i>Clematis brachiata</i>	<i>Osteospermum scariosum</i>
<i>Sersia lancea</i>	<i>Olea europaea</i>	<i>Eragrostis rigidior</i>	<i>Pentarrhinum insipidum</i>	<i>Gnidia capitata</i>
<i>Acacia karroo</i>	<i>Aloe greatheadii</i>	<i>Digitaria eriantha</i>		<i>Asparagus suaveolens</i>
<i>Peltophorum africanum</i>	<i>Euclea crispa</i>	<i>Panicum coloratum</i>		<i>Asparagus laricinus</i>
<i>Acacia tortilis</i>	<i>Grewia flava</i>	<i>Andropogon chinensis</i>		<i>Heliotropium steudneri</i>
<i>Acacia nilotica</i>	<i>Rhus pyroides</i>	<i>Eragrostis chloromelas</i>		<i>Erodium cicutarium</i>
<i>Acacia gerrardii</i>	<i>Diospyros lycioides</i>	<i>Panicum maximum</i>		<i>Ledebouria ovatifolia</i>
<i>Cussonia spicata</i>	<i>Asparagus cooperi</i>	<i>Paspalum dilatatum</i>		<i>Aptosimum elongatum</i>
<i>Zuziphus mucronata</i>	<i>Justica flava</i>	<i>Setaria incrassata</i>		<i>Hermannia depressa</i>
<i>Diospyros lycioides</i>	<i>Indigofera zeyheri</i>	<i>Heteropogon contortus</i>		<i>Vernonia oligocaphala</i>
<i>Acacia caffra</i>	<b><i>Tecoma stans</i></b>	<i>Melinis nervigulumis</i>		<i>Ipomoea oblongata</i>
<i>Euphorbia ingens</i>	<b><i>Ricinus communis</i></b>	<i>Hyperthelia dissoluta</i>		<i>Ipomoea obscura</i>
<i>Ormocarpum kirkii</i>		<i>Aristida transvaalensis</i>		<i>Ledeboria revoluta</i>
<i>Combretum zeyheri</i>		<i>Aristida congesta</i>		<i>Ornithogalum tenuifolium</i>
<i>Sersia leptodictya</i>		<i>Aristida canescens</i>		<i>Barleria macrostegia</i>
<i>Berchemia zeyheri</i>		<i>Aristida scabrivalvis</i>		<b><i>Tagetes minuta</i></b>
<i>Celtis africana</i>		<i>Eragrostis lehmanniana</i>		<b><i>Bidens pilosa</i></b>
<i>Dombeya rotundifolia</i>		<i>Pogonarthria squarrosa</i>		<b><i>Datura stramonium</i></b>
<i>Gymnosporia buxifolia</i>		<i>Hyperthelia dissoluta</i>		
<i>Zanthoxylum capense</i>		<i>Eragrostis superba</i>		
<i>Ehretia rigida</i>		<b><i>Urochloa mossambicensis</i></b>		
<b><i>Melia azedarach</i></b>		<b><i>Hypparrhenia hirta</i></b>		
<b><i>Agave sisalana</i></b>		<b><i>Melinis repens</i></b>		
<b><i>Opuntia ficus-indica</i></b>				

### Conclusion:

- This vegetation unit has a medium species richness and remains in a relatively natural condition.
- This vegetation type is classified as Endangered with less than 1% statutorily conserved.
- The unit is surrounded by two public roads there is limited connectivity with other portions of relatively natural Marikana Thornveld to the west of the survey area.
- Few exotic plant species have established themselves in the unit.
- Years of cattle grazing and irregular fire regimes have resulted in the slightly degraded condition of this unit.
- Two nationally protected tree species were observed in this unit.
- Unit one can be regarded as having **high conservation value**.

## 2. Drainage line



<b>Mapping unit</b>	2	<b>Tree cover</b>	±30%
<b>Soil</b>	Freely drained deep soils	<b>Shrub cover</b>	±20%
<b>Rock cover</b>	< 5%	<b>Herb cover</b>	±5%
<b>Topography</b>	Drainage line with 25m difference in altitude from S to N	<b>Grass cover</b>	±45%
<b>Status:</b>	Drainage line that has effectively been blocked by the development of a gravel pit to the north of the site. Vegetation remains in a natural condition.		
<b>Ground cover of site:</b>	12%		
<b>Need for rehabilitation:</b>	The gravel pit needs to be filled and rehabilitated to restore the natural flow of storm water. Invasive vegetation needs to be removed.		
<b>Agricultural potential:</b>	Low		
<b>Conservation priority:</b>	High		

This vegetation unit is a drainage line that bisects unit one. It has similar vegetation to unit one however tree and shrub cover is considerably higher due to this unit being more protected from fires. The drainage line plays an important ecological role in the channelling of water however a large gravel pit excavated close to where the drainage line exits the site effectively blocks storm water from entering the Crocodile River catchment area. Ideally the pit should be refilled and rehabilitated. As in unit one, the drainage line is dominated by *Acacia karroo* - *Sersia lancea* woodland, however has higher density tree and shrub cover due to improved access to water. The level of invasion by exotic species was low however slightly higher than observed in unit one. This is also due to improved access to water. The unit remains in a relatively natural condition. Prominent tree species include *Sersia lancea*, *Zuziphus mucronata*, *Acacia karroo*, *Acacia caffra*, *Peltophorum africanum*, *Ehretia rigida* and *Combretum zeyheri*. Prominent shrubs include *Acacia ataxacantha*, *Euclea crispa*, *Grewia flava*, *Olea europaea* and *Sersia pyroides*. Dominant graminoids include *Themeda triandra*, *Digitaria eriantha*, *Hyperthelia dissoluta* and *Hypparrhenia hirta*. No plant species of conservation concern were observed in the survey area.

Table 3. Plant species identified in unit 2 during the survey (invasive species bolded).

Trees	Shrubs	Graminoids	Climbers	Herbs
<i>Ehretia rigida</i>	<i>Diospyros lycioides</i>	<i>Themeda triandra</i>	<i>Clematis brachiata</i>	<i>Hermannia depressa</i>
<i>Sersia lancea</i>	<i>Olea europaea</i>	<i>Hyperthelia dissoluta</i>		<i>Vernonia oligocaphala</i>
<i>Acacia karroo</i>	<i>Aloe greatheadii</i>	<i>Digitaria eriantha</i>		<i>Asparagus suaveolens</i>
<i>Peltophorum africanum</i>	<i>Euclea crispa</i>	<i>Panicum coloratum</i>		<i>Asparagus laricinus</i>
<i>Combretum zeyheri</i>	<i>Grewia flava</i>	<i>Eragrostis superba</i>		<i>Erodium cicutarium</i>
<i>Acacia nilotica</i>	<i>Rhus pyroides</i>	<b><i>Hypparrhenia hirta</i></b>		<i>Ledebouria ovatifolia</i>
<i>Cussonia spicata</i>	<i>Asparagus cooperi</i>			<i>Ipomoea obscura</i>
<i>Zuziphus mucronata</i>	<b><i>Ricinus communis</i></b>			<i>Ledebouria revoluta</i>
<i>Diospyros lycioides</i>				<b><i>Tagetes minuta</i></b>
<i>Celtis africana</i>				<b><i>Bidens pilosa</i></b>
<i>Acacia caffra</i>				<b><i>Datura stramonium</i></b>
<i>Sersia leptodictya</i>				
<i>Gymnosporia buxifolia</i>				
<b><i>Opuntia ficus-indica</i></b>				
<b><i>Melia azedarach</i></b>				

**Conclusion:**

- This unit plays an important ecological role in the channelling of water.
- This vegetation unit has a medium species richness and remains in a relatively natural condition.
- This vegetation type is classified as Endangered with less than 1% statutorily conserved.
- Few exotic plant species have established themselves in the unit.
- A large gravel pit excavated close to where the drainage line exits the site effectively blocks storm water from entering the Crocodile River catchment area. Ideally the pit should be refilled and rehabilitated.
- Unit two can be regarded as having **high conservation value**.



### 3. Transformed area



<b>Mapping unit</b>	3	<b>Tree cover</b>	<5%
<b>Soil</b>	Soil layer has been removed	<b>Shrub cover</b>	<5%
<b>Rock cover</b>	< 5%	<b>Herb cover</b>	±10%
<b>Topography</b>	Drainage line with 25m difference in altitude from S to N	<b>Grass cover</b>	±15%
<b>Status:</b>	Completely transformed through the excavation of a gravel pit		
<b>Ground cover of site:</b>	3%		
<b>Need for rehabilitation:</b>	The gravel pit needs to be filled and rehabilitated to restore the natural flow of storm water into the Crocodile River catchment. Invasive vegetation needs to be removed and native species planted.		
<b>Agricultural potential:</b>	Low		
<b>Conservation priority:</b>	Low		

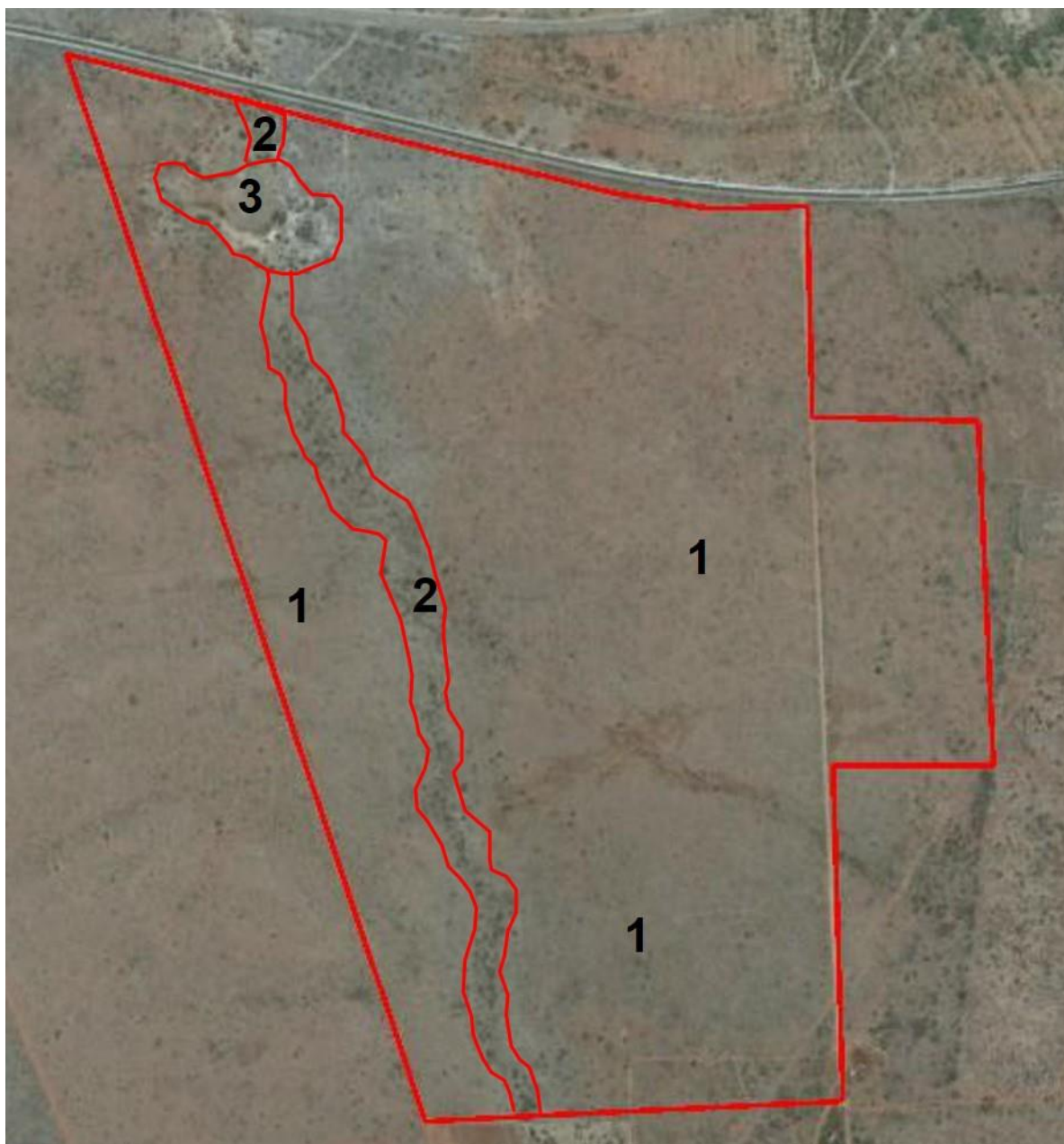
This vegetation unit is completely transformed through the excavation of a gravel pit. The topsoil layer has been removed and the ecology of the unit has been severely compromised. There was evidence of large scale dumping of building rubble, garden refuse, animal carcasses and litter into and on the edges of the gravel pit. There is low grass cover and few trees and shrubs have managed to establish themselves. Little natural vegetation remains and the area urgently needs to be rehabilitated. This will restore the flow of storm water into the Crocodile River Catchment instead of trapping it inside the gravel pit. Invasive plant species have proliferated in this unit and prominent species include *Melia azedarach*, *Tagetes minuta*, *Bidens pilosa*, *Xanthium strumarium*, *Ricinus communis*, *Opuntia ficus-indica* and *Tecoma stans*. No plant species of conservation concern were observed in unit 3.

Table 4. Plant species identified in unit 3 during the survey (invasive species bolded).

Trees	Shrubs	Graminoids	Climbers	Herbs
<i>Acacia karroo</i>	<b><i>Ricinus communis</i></b>	<i>Hyparrhenia hirta</i>		<i>Datura stramonium</i>
<i>Sersia lancea</i>	<b><i>Tecoma stans</i></b>	<i>Cyperus esculentus</i>		<i>Xanthium strumarium</i>
<i>Zuziphus mucronata</i>		<i>Brachiaria eruciformis</i>		<i>Bidens pilosa</i>
<i>Acacia nilotica</i>		<i>Chloris virgata</i>		<i>Amaranthus hybridus</i>
<i>Robinia pseudoacacia</i>		<i>Cynodon dactylon</i>		<i>Cirsium vulgare</i>
<b><i>Melia azedarach</i></b>		<i>Echinochloa colona</i>		<i>Conyza bonariensis</i>
<b><i>Opuntia ficus-indica</i></b>		<i>Eleusine coracana</i>		<i>Senecio consanguineus</i>

**Conclusion:**

- This unit is completely transformed and has no conservation value.
- This vegetation unit has a low species richness and most species present are pioneers and exotic plants.
- The gravel pit effectively blocks storm water from entering the Crocodile River catchment area.
- The gravel pit should be refilled to restore the functioning of the drainage line. If this is not possible then top soil need to be re-established so that naturally occurring trees, shrubs and graminoids can proliferate. These aesthetic and ecological mitigation measures will turn this degraded area into functional habitat.



**Figure 7.** Vegetation unit in the proposed development area include: (1) Marikana Thornveld, (2) Drainage line and (3) Transformed area - Gravel Pit.

## MAMMALS OF THE SURVEY AREA

**Small mammals:** Most small mammals are primary consumers and represent the primary prey items of many carnivores, including raptors and medium-sized mammals. They are abundant in many ecosystems and serve many important ecological roles in terms of influencing their prey and their predators. Sherman live trapping was the core survey method utilised. Pitfall trapping was also undertaken to increase the number of species detected.

Sherman traps were deployed along selected transects and arrayed in a hexagonal pattern, centred on a monitoring point or placed at regular intervals. Traps were placed near to features such as logs, burrows, rock piles, termite mounds, the base of trees, runways around burrows and almost always in an area that provided cover from weather (e.g. under shrubs, in tall grass). Traps were permanently marked or recorded with a GPS so that they could be relocated with ease. Traps were opened for two nights and checked daily. Bait was comprised of dry oats mixed with peanut butter and golden syrup. Captured animals were identified and released in suitable habitat away from the trapping area.

Pitfall traps were found to be more efficient than Sherman traps. Pitfalls captured 4 species, three of which were captured exclusively using this method. Sherman traps captured just 1 species not captured with pitfall traps. The low number of species captured was probably a consequence of the limited number of trap nights.

No nocturnal bat survey was carried out for personal safety reasons. The bat species listed in tables 6 and 7 may use the site for occasional foraging. There are no major rocky outcrops or caves/mines in the survey area that are suitable for roosting activities.

**Medium and large mammals:** For larger mammals' visual encounters of the actual animal as well as spoor or tracks, scat, foraging marks were noted and used for species identification.

Table 5. Mammal species occurring/or likely on the proposed development area.

Family	Genus	Species	Common name	Conservation status
Muridae	<i>Lemniscomys</i>	<i>rosalia</i>	Single-Striped Lemniscomys	Data Deficient
Muridae	<i>Rhabdomys</i>	<i>pumilio</i>	Xeric Four-striped Grass Rat	Least Concern
Mustelidae	<i>Mellivora</i>	<i>capensis</i>	Honey Badger	Near Threatened
Procaviidae	<i>Procavia</i>	<i>capensis</i>	Rock Hyrax	Least Concern
Sciuridae	<i>Paraxerus</i>	<i>cepapi</i>	Smith's Bush Squirrel	Least Concern
Suidae	<i>Phacochoerus</i>	<i>africanus</i>	Common Wart-hog	Least Concern
Suidae	<i>Potamochoerus</i>	<i>porcus</i>	Red River Hog	Not listed
Hystricidae	<i>Hystrix</i>	<i>africae australis</i>	Cape Porcupine	Least Concern
Leporidae	<i>Lepus</i>	<i>saxatilis</i>	Scrub Hare	Least Concern
Leporidae	<i>Pronolagus</i>		Rock-hares	Not listed
Leporidae	<i>Pronolagus</i>	<i>randensis</i>	Jameson's Red Rock Hare	Least Concern
Macroscelididae	<i>Elephantulus</i>	<i>myurus</i>	Eastern Rock Elephant Shrew	Least Concern
Muridae	<i>Aethomys</i>	<i>ineptus</i>	Tete Veld Aethomys	Least Concern
Muridae	<i>Aethomys</i>	<i>namaquensis</i>	Namaqua Rock Mouse	Least Concern
Felidae	<i>Caracal</i>	<i>caracal</i>	Caracal	Least Concern

Felidae	<i>Leptailurus</i>	<i>serval</i>	Serval	Near Threatened
Herpestidae	<i>Herpestes</i>	<i>sanguineus</i>	Slender Mongoose	Least Concern
Hyaenidae	<i>Hyaena</i>	<i>brunnea</i>	Brown Hyena	Near Threatened
Orycteropodidae	<i>Orycteropus</i>	<i>afer</i>	Aardvark	Least Concern
Bovidae	<i>Sylvicapra</i>	<i>grimmia</i>	Bush Duiker	Least Concern
Canidae	<i>Canis</i>	<i>mesomelas</i>	Black-backed Jackal	Least Concern
Cercopithecidae	<i>Cercopithecus</i>	<i>pygerythrus</i>	Vervet Monkey	Least Concern
Cercopithecidae	<i>Papio</i>	<i>ursinus</i>	Chacma Baboon	Least Concern
Rhinolophidae	<i>Rhinolophus</i>	<i>clivosus</i>	Geoffroy's Horseshoe Bat	Near threatened
Vespertilionidae	<i>Neoromicia</i>	<i>capensis</i>	Cape Serotine	Least concern
Vespertilionidae	<i>Miniopterus</i>	<i>schreibersii</i>	Schreibers's Long-fingered Bat	Near threatened
Vespertilionidae	<i>Miniopterus</i>	<i>natalensis</i>	Natal Long-fingered Bat	Not listed
Nycteridae	<i>Nycteris</i>	<i>thebaica</i>	Egyptian Slit-faced Bat	Least concern

Table 6. Red listed mammal species likely to use the survey area for occasional foraging.

Family	Genus	Species	Common name	Conservation status
Mustelidae	<i>Mellivora</i>	<i>capensis</i>	Honey Badger	Near Threatened
Hyaenidae	<i>Hyaena</i>	<i>brunnea</i>	Brown Hyena	Near Threatened
Felidae	<i>Leptailurus</i>	<i>serval</i>	Serval	Near Threatened
Rhinolophidae	<i>Rhinolophus</i>	<i>clivosus</i>	Geoffroy's Horseshoe Bat	Near threatened
Vespertilionidae	<i>Miniopterus</i>	<i>schreibersii</i>	Schreibers's Long-fingered Bat	Near threatened

## REPTILES OF THE SURVEY AREA

**Introduction:** Most current knowledge of the reptiles of North West is based on a survey performed by N.H.G Jacobsen (1989) providing a detailed account of all reptiles in the then Transvaal province. This survey resulted in descriptions of life histories, habitat requirements, the conservation status and maps of known distributions. Jacobsen's (1989) survey revealed that more than 50% of reptiles occurring in North West Province are threatened mainly due to habitat destruction and habitat fragmentation. This survey focused on species that are largely restricted to North West province. Reptile lists require intensive surveys conducted over several years. Reptiles are extremely secretive and are difficult to observe even during intensive field surveys conducted over several seasons.

### Methods

**Visual encounter surveys:** This method entails actively searching suitable habitat components including turning over logs and loosely embedded rocks, searching crevices in rocks and bark and replacing all surface objects after examining the ground beneath. Logs, termite mounds and other substrates are not torn apart to minimize disturbance to important habitat elements in the sample unit. Observers note only presence of individuals or signs, and identify the detection to the most specific taxonomic level possible. Specimens are only captured when necessary to confirm identification. The detection of rare species should be documented by taking a picture of the individual, being careful to display diagnostic characters of the species. Voucher specimens may be required to confirm identification of rare species that are difficult to identify. No spotlight surveys could be undertaken during nocturnal hours for security reasons.

**Pitfall and funnel traps:** Pitfall traps are commonly used sampling techniques that are highly effective at surveying herpetofaunal communities. The use of pitfall traps is likely to substantially increase to number of amphibian, invertebrate and reptile species detected. They can be successfully used to detect a broad array of species although arboreal species and species with good climbing/jumping ability are often missed. Many different configurations of pitfall arrays have been used in reptile studies; the pitfall array described here is suitable for most sites.

Each pitfall trap array consisted of six pitfall traps and six funnel traps set in a triangular pattern and connected by 5m long drift fences. Drift fences are effective at increasing capture rates in pitfall traps however these were not employed due to logistical constraints. Two arrays were established in vegetation units 1 and 2 the survey area. These arrays were set up in randomly selected areas that were considered representative of the unit and easily accessible for monitoring:

1. On the central western boundary of unit 1.
2. Close to the south eastern corner of the site, where the drainage line enters the survey area.

Funnel traps were used in conjunction with pitfall traps to increase snake and lizard species detections. Daily pitfall checks were undertaken to reduce mortalities and potential biases associated with predation in the traps.

Table 7. Reptile species occurring/likely to occur on the proposed development area.

Family	Genus	Species	Common name	Conservation status
Agamidae	<i>Acanthocercus</i>	<i>atricollis</i>	Southern Tree Agama	Least Concern (SARCA 2014)
Scincidae	<i>Trachylepis</i>	<i>capensis</i>	Cape Skink	Least Concern (SARCA 2014)
Scincidae	<i>Trachylepis</i>	<i>punctatissima</i>	Speckled Rock Skink	Least Concern (SARCA 2014)
Lamprophiidae	<i>Psammophis</i>	<i>brevirostris</i>	Short-snouted Grass Snake	Least Concern (SARCA 2014)
Scincidae	<i>Afroablepharus</i>	<i>wahlbergii</i>	Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)
Scincidae	<i>Trachylepis</i>	<i>varia</i>	Variable Skink	Least Concern (SARCA 2014)
Testudinidae	<i>Kinixys</i>	<i>lobatsiana</i>	Lobatse Hinged Tortoise	Least Concern (SARCA 2014)
Gekkonidae	<i>Pachydactylus</i>	<i>affinis</i>	Transvaal Gecko	Least Concern (SARCA 2014)
Gerrhosauridae	<i>Gerrhosaurus</i>	<i>flavigularis</i>	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)
Colubridae	<i>Crotaphopeltis</i>	<i>hotamboeia</i>	Red-lipped Snake	Least Concern (SARCA 2014)
Colubridae	<i>Philothamnus</i>	<i>natalensis</i>	Western Natal Green Snake	Least Concern (SARCA 2014)
Cordylidae	<i>Cordylus</i>	<i>vittifer</i>	Common Girdled Lizard	Least Concern (SARCA 2014)
Gekkonidae	<i>Lygodactylus</i>	<i>capensis</i>	Common Dwarf Gecko	Least Concern (SARCA 2014)



## AMPHIBIANS OF THE SURVEY AREA

**Introduction:** Global amphibian diversity has declined dramatically in recent decades. Amphibians are considerably more threatened than both mammals and birds, although comparisons with other taxa are confounded by a shortage of reliable data. Although habitat loss has played a significant role in this decline, recent research has focused on the effects of environmental contaminants, UV-B irradiation, emerging diseases, introduction of alien species, direct exploitation and climate change.

Evidence for a countrywide decline in frog populations in South Africa is lacking. Among the threats faced by amphibians in southern Africa, the most frequently implicated is habitat destruction resulting from wetland drainage, afforestation, crop farming invasive alien vegetation and urbanisation. Like other animals, amphibians are also susceptible to viruses, fungi as well as parasitic infections by protozoan's and various helminths. Most frogs are intimately associated with wetlands. One artificially created wetland is present in the study area however it was completely dry during the time of sampling. This wetland is located in unit 3. With a burgeoning human population and its consequent demands for limited water resources, more than one-third of South Africa's wetlands have been destroyed. Those that remain are increasingly threatened by water abstraction and pollution. Amphibians are an important component of South Africa's exceptional biodiversity and are worthy of both research and conservation effort. The fact that most amphibians have a semi-permeable skin makes them particularly vulnerable to pollutants and other environmental stresses. Frogs especially are useful environmental bio-monitors and act as an early warning system for the quality of the environment.

**Methods:** Two survey methods were used during this survey to obtain the amphibian species inventory (Table 9.). These included visual encounter surveys (VES) of the terrestrial habitats (temporary aquatic habitats were present on the site) and diurnal road surveys for live and road-killed specimens. No anuran call surveys were performed because the drainage line and artificial wetland were completely dry during the survey period. Dip-netting for tadpoles could therefore also not be attempted. It is preferable to carry out amphibian surveys after a rainfall event. All site visits took place in after the first summer rains although no rainfall had been recorded for the site one week prior to the first site visit. The only species of conservation concern known to occur in relatively close proximity to the proposed development area is *Pyxicephalus adspersus*. No specimens were observed.

Table 8. Frog species likely to occur in the proposed development area.

Common name	Genus	Species	Common name	Conservation status
Bufonidae	<i>Amietophrynus</i>	<i>gutturalis</i>	Guttural Toad	Least Concern
Bufonidae	<i>Amietophrynus</i>	<i>poweri</i>	Power's Toad	Least Concern
Bufonidae	<i>Amietophrynus</i>	<i>rangeri</i>	Raucous Toad	Least Concern
Bufonidae	<i>Poyntonophrynus</i>	<i>fenoulheti</i>	Northern Pygmy Toad	Least Concern
Bufonidae	<i>Schismaderma</i>	<i>carens</i>	Red Toad	Least Concern
Hyperoliidae	<i>Kassina</i>	<i>senegalensis</i>	Bubbling Kassina	Least Concern
Phrynobatrachidae	<i>Phrynobatrachus</i>	<i>natalensis</i>	Snoring Puddle Frog	Least Concern
Pipidae	<i>Xenopus</i>	<i>laevis</i>	Common Platanna	Least Concern
Pyxicephalidae	<i>Amietia</i>	<i>quecketti</i>	Queckett's River Frog	Least Concern
Pyxicephalidae	<i>Cacosternum</i>	<i>boettgeri</i>	Common Caco	Least Concern
Pyxicephalidae	<i>Tomopterna</i>	<i>cryptotis</i>	Tremelo Sand Frog	Least Concern
Pyxicephalidae	<i>Tomopterna</i>	<i>natalensis</i>	Natal Sand Frog	Least Concern

## AVIFAUNA OF THE SURVEY AREA

**Introduction:** It is widely accepted that vegetation structure, rather than actual plant species, influences bird species distribution and abundance. The survey area is located within the Magaliesberg Important Birding area (IBA) which contains the Magaliesberg and Witwatersberg Mountain Ranges and the several large rivers that have their headwaters in these mountains. No major riverine or mountainous features were present on the site however several birds species that reside in these features will utilise the site for occasional foraging. This bird survey was based on observations and literature. The survey took place in early summer, allowing a considerable portion of the survey area's bird diversity to be documented.

**Methods:** Birds were identified using a pair of 10\*50 Bushnell Legend binoculars as well as from species specific calls, nests and feathers. Incidental observations were also made during the amphibian, reptile and mammal surveys. Where necessary identifications were verified from Sasol Birds of Southern Africa (Sinclair et al., 2005) and Southern African Bird Sounds (Gibbon, 1991). No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. The property was surveyed both in a vehicle and on foot and in the process sighting were recorded through random transect walks. At suitable situations the vehicle was stopped and local inspections were made on foot. Three criteria were used to assess the probability of occurrence of Red Data and other bird species in the survey area:

- known distribution range
- habitat preference
- presence of suitable habitat on site as well as availability of food.

**Results:** Five red data bird species are likely to occur in the survey area. Habitat is suitable for the presence of the Corn Crake (*Crex crex*) and the African Grass Owl (*Tyto capensis*). Species such as the Cape Vulture (*Gyps coprotheres*), the Lanner Falcon (*Falco biarmicus*) and the Peregrine Falcon (*Falco peregrinus*) are likely to utilise the area for occasional foraging.

Red data species that are known to occur in the vicinity of the survey area but that are unlikely to occur on the site include the Blue Crane (*Anthropoides paradiseus*), the Grey Crowned Crane (*Balearica regulo*), the African Finfoot (*Podica senegalensis*), the Greater Flamingo (*Phoenicopterus ruber*), the Lesser Flamingo (*Phoenicopterus minor*), the African Pygmy Goose (*Nettapus auritus*), the Ayres's Hawk-Eagle (*Aquila ayresii*), the Lesser Jacana (*Microparra capensis*), the White-bellied Korhaan (*Eupodotis senegalensis*), the African Marsh-Harrier (*Circus ranivorus*), White-backed Night-Heron (*Gorsachius leuconotus*), the Great White Pelican (*Pelecanus onocrotalus*), the Yellow-throated Sandgrouse (*Pterocles gutturalis*), the Secretarybird (*Sagittarius serpentarius*), the Black Stork (*Ciconia nigra*), the Yellow-billed Stork (*Mycteria ibis*), the Caspian Tern (*Sterna caspia*), the Lappet-faced Vulture (*Torgos tracheliotus*) and the White-backed Vulture (*Gyps africanus*). Either habitat in the survey area is not suitable for their presence or they have not been recorded to occur in the De Wildt and Ga-Rankuwa area.

The artificial wetland in unit 3 was dry during the survey period. This severely impacted the ability of the specialist to gauge wetland bird diversity for the survey area. The wetland had no surrounding vegetative that would allow many wetland residents to take cover. No reed beds were present and the grass and sedge community was poorly developed due to the lack of sufficient top soil in the gravel pit.

Table 9. Bird species occurring/likely to occur in the proposed development area.

Scientific Name	Common English Name	Conservation Status (IUCN)
<i>Apalis thoracica</i>	Apalis, Bar-throated	Least concern
<i>Recurvirostra avosetta</i>	Avocet, Pied	Least concern
<i>Turdoides jardineii</i>	Babbler, Arrow-marked	Least concern
<i>Tricholaema leucomelas</i>	Barbet, Acacia Pied	Least concern
<i>Lybius torquatus</i>	Barbet, Black-collared	Least concern
<i>Trachyphonus vaillantii</i>	Barbet, Crested	Least concern
<i>Merops apiast</i>	Bee-eater, European	Least concern
<i>Merops pusillus</i>	Bee-eater, Little	Least concern
<i>Merops hirundineus</i>	Bee-eater, White-fronted	Least concern
<i>Merops bullockoides</i>	Bee-eater, Swallow-tailed	Least concern
<i>Ixobrychus sturmii</i>	Bittern, Dwarf	Least concern
<i>Ixobrychus minutus</i>	Bittern, Little	Least concern
<i>Telophorus zeylonus</i>	Bokmakierie	Least concern
<i>Laniarius ferrugineus</i>	Boubou, Southern	Least concern
<i>Nilaus afer</i>	Brubru	Least concern
<i>Pycnonotus tricolor</i>	Bulbul, Dark-capped	Least concern
<i>Emberiza capensis</i>	Bunting, Cape	Least concern
<i>Emberiza tahapisi</i>	Bunting, Cinnamon-breasted	Least concern
<i>Emberiza flaviventris</i>	Bunting, Golden-breasted	Least concern
<i>Malaconotus blanchoti</i>	Bush-Shrike, Grey-headed	Least concern
<i>Telophorus sulfureopectus</i>	Bush-Shrike, Orange-breasted	Least concern
<i>Turnix sylvaticus</i>	Buttonquail, Kurrichane	Least concern
<i>Buteo rufofuscus</i>	Buzzard, Jackal	Least concern
<i>Buteo vulpinus</i>	Buzzard, Steppe	Least concern
<i>Camaroptera brevicaudata</i>	Camaroptera, Grey-backed	Least concern
<i>Crithagra atrogularis</i>	Canary, Black-throated	Least concern
<i>Crithagra mozambicus</i>	Canary, Yellow-fronted	Least concern
<i>Cercomela familiaris</i>	Chat, Familiar	Least concern
<i>Cisticola textrix</i>	Cisticola, Cloud	Least concern
<i>Cisticola aridulus</i>	Cisticola, Desert	Least concern
<i>Cisticola aberrans</i>	Cisticola, Lazy	Least concern
<i>Cisticola tinniens+</i>	Cisticola, Levaillant's	Least concern
<i>Cisticola chiniana</i>	Cisticola, Rattling	Least concern
<i>Cisticola lais</i>	Cisticola, Wailing	Least concern
<i>Cisticola ayresii</i>	Cisticola, Wing-snapping	Least concern
<i>Cisticola juncidis</i>	Cisticola, Zitting	Least concern
<i>Centropus burchellii</i>	Coucal, Burchell's	Least concern
<i>Cursorius temminckii</i>	Cursorer, Temminck's	Least concern
<i>Crex crex</i>	Crake, Corn	Vulnerable
<i>Sylvietta rufescens</i>	Crombec, Long-billed	Least concern
<i>Corvus albus</i>	Crow, Pied	Least concern

<i>Cuculus clamosus</i>	Cuckoo, Black	Least concern
<i>Chrysococcyx caprius</i>	Cuckoo, Diderick	Least concern
<i>Clamator glandarius</i>	Cuckoo, Great Spotted	Least concern
<i>Clamator jacobinus</i>	Cuckoo, Jacobin	Least concern
<i>Chrysococcyx klaas</i>	Cuckoo, Klaas's	Least concern
<i>Clamator levaillantii</i>	Cuckoo, Levaillant's	Least concern
<i>Cuculus solitarius</i>	Cuckoo, Red-chested	Least concern
<i>Campephaga flava</i>	Cuckooshrike, Black	Least concern
<i>Streptopelia senegalensis</i>	Dove, Laughing	Least concern
<i>Oena capensis</i>	Dove, Namaqua	Least concern
<i>Streptopelia semitorquat</i>	Dove, Red-eyed	Least concern
<i>Dicrurus adsimilis</i>	Drongo, Fork-tailed	Least concern
<i>Aquila pennatus</i>	Eagle, Booted	Least concern
<i>Aquila wahlbergi</i>	Eagle, Wahlberg's	Least concern
<i>Bubo africanus</i>	Eagle-Owl, Spotted	Least concern
<i>Bubulcus ibis</i>	Egret, Cattle	Least concern
<i>Eremomela usticollis</i>	Eremomela, Burnt-necked	Least concern
<i>Eremomela icteropygialis</i>	Eremomela, Yellow-bellied	Least concern
<i>Falco amurensis</i>	Falcon, Amur	Least concern
<i>Falco biarmicus</i>	Falcon, Lanner	Near threatened
<i>Falco peregrinus</i>	Falcon, Peregrine	Near threatened
<i>Amadina fasciata</i>	Finch, Cut-throat	Least concern
<i>Amadina erythrocephala</i>	Finch, Red-headed	Least concern
<i>Sporopipes squamifrons</i>	Finch, Scaly-feathered	Least concern
<i>Lagonosticta rubricata</i>	Firefinch, African	Least concern
<i>Lagonosticta rhodopareia</i>	Firefinch, Jameson's	Least concern
<i>Lagonosticta senegala</i>	Firefinch, Red-billed	Least concern
<i>Lanius collaris</i>	Fiscal, Common	Least concern
<i>Sarothrura rufa</i>	Flufftail, Red-chested	Least concern
<i>Stenostira scita</i>	Flycatcher, Fairy	Least concern
<i>Sigelus silens</i>	Flycatcher, Fiscal	Least concern
<i>Melaenornis pammelaina</i>	Flycatcher, Southern Black	Least concern
<i>Muscicapa striata</i>	Flycatcher, Spotted	Least concern
<i>Peliperdix coqui</i>	Francolin, Coqui	Least concern
<i>Dendroperdix sephaena</i>	Francolin, Crested	Least concern
<i>Scleroptila levaillantoides</i>	Francolin, Orange River	Least concern
<i>Scleroptila levaillantii</i>	Francolin, Red-winged	Least concern
<i>Scleroptila shelleyi</i>	Francolin, Shelley's	Least concern
<i>Corythaixoides concolor</i>	Go-away-bird, Grey	Least concern
<i>Melierax gabar</i>	Goshawk, Gabar	Least concern
<i>Sphenoeacus afer</i>	Grassbird, Cape	Least concern
<i>Chlorocichla flaviventris</i>	Greenbul, Yellow-bellied	Least concern
<i>Treron calvus</i>	Green-Pigeon, African	Least concern
<i>Tringa nebularia</i>	Greenshank, Common	Least concern
<i>Numida meleagris</i>	Guineafowl, Helmeted	Least concern
<i>Larus cirrocephalus</i>	Gull, Grey-headed	Least concern
<i>Polyboroides typus</i>	Harrier-Hawk, African	Least concern
<i>Aviceda cuculoides</i>	Hawk, African Cuckoo	Least concern
<i>Prionops plumatus</i>	Helmet-Shrike, White-crested	Least concern

<i>Ardea cinerea</i>	Heron, Grey	Least concern
<i>Prodotiscus regulus</i>	Honeybird, Brown-backed	Least concern
<i>Pernis apivorus</i>	Honey-Buzzard, European	Least concern
<i>Indicator indicator</i>	Honeyguide, Greater	Least concern
<i>Indicator minor</i>	Honeyguide, Lesser	Least concern
<i>Upupa africana</i>	Hoopoe, African	Least concern
<i>Tockus nasutus</i>	Hornbill, African Grey	Least concern
<i>Tockus erythrorhynchus</i>	Hornbill, Red-billed	Least concern
<i>Tockus leucomelas</i>	Hornbill, Southern Yellow-billed	Least concern
<i>Delichon urbicum</i>	House-Martin, Common	Least concern
<i>Bostrychia hagedash</i>	Ibis, Hadedda	Least concern
<i>Vidua funerea</i>	Indigobird, Dusky	Least concern
<i>Vidua purpurascens</i>	Indigobird, Purple	Least concern
<i>Vidua chalybeata</i>	Indigobird, Village	Least concern
<i>Falco rupicoloides</i>	Kestrel, Greater	Least concern
<i>Falco naumanni</i>	Kestrel, Lesser	Least concern
<i>Ispidina picta</i>	Kingfisher, African Pygmy	Least concern
<i>Halcyon albiventris</i>	Kingfisher, Brown-hooded	Least concern
<i>Alcedo semitorquata</i>	Kingfisher, Half-collared	Least concern
<i>Alcedo cristata</i>	Kingfisher, Malachite	Least concern
<i>Ceryle rudis</i>	Kingfisher, Pied	Least concern
<i>Halcyon chelicuti</i>	Kingfisher, Striped	Least concern
<i>Halcyon senegalensis</i>	Kingfisher, Woodland	Least concern
<i>Milvus migrans</i>	Kite, Black	Least concern
<i>Elanus caeruleus</i>	Kite, Black-shouldered	Least concern
<i>Milvus aegyptius</i>	Kite, Yellow-billed	Least concern
<i>Afrotis afraoides</i>	Korhaan, Northern Black	Least concern
<i>Vanellus senegallus</i>	Lapwing, African Wattled	Least concern
<i>Vanellus armatus</i>	Lapwing, Blacksmith	Least concern
<i>Vanellus coronatus</i>	Lapwing, Crowned	Least concern
<i>Certhilauda semitorquata</i>	Lark, Eastern Long-billed	Least concern
<i>Mirafra rufocinnamomea</i>	Lark, Flappet	Least concern
<i>Mirafra africana</i>	Lark, Rufous-naped	Least concern
<i>Calendulauda sabota</i>	Lark, Sabota	Least concern
<i>Macronyx capensis</i>	Longclaw, Cape	Least concern
<i>Spermestes cucullatus</i>	Mannikin, Bronze	Least concern
<i>Riparia paludicola</i>	Martin, Brown-throated	Least concern
<i>Ploceus intermedius</i>	Masked-Weaver, Lesser	Least concern
<i>Ploceus velatus</i>	Masked-Weaver, Southern	Least concern
<i>Urocolius indicus</i>	Mousebird, Red-faced	Least concern
<i>Colius striatus</i>	Mousebird, Speckled	Least concern
<i>Colius colius</i>	Mousebird, White-backed	Least concern
<i>Acridotheres tristis</i>	Myna, Common	Least concern
<i>Cisticola fulvicapilla</i>	Neddicky, Neddicky	Least concern
<i>Nycticorax nycticorax</i>	Night-Heron, Black-crowned	Least concern
<i>Caprimulgus pectoralis</i>	Nightjar, Fiery-necked	Least concern
<i>Caprimulgus tristigma</i>	Nightjar, Freckled	Least concern
<i>Caprimulgus rufigena</i>	Nightjar, Rufous-cheeked	Least concern
<i>Columba arquatrix</i>	Olive-Pigeon, African	Least concern

<i>Oriolus larvatus</i>	Oriole, Black-headed	Least concern
<i>Tyto capensis</i>	Owl, African Grass	Vulnerable
<i>Tyto alba</i>	Owl, Barn	Least concern
<i>Glaucidium perlatum</i>	Owlet, Pearl-spotted	Least concern
<i>Buphagus erythrorhynchus</i>	Oxpecker, Red-billed	Least concern
<i>Cypsiurus parvus</i>	Palm-Swift, African	Least concern
<i>Terpsiphone viridis</i>	Paradise-Flycatcher, African	Least concern
<i>Vidua paradisaea</i>	Paradise-Whydah, Long-tailed	Least concern
<i>Petronia supercilii</i>	Petronia, Yellow-throated	Least concern
<i>Columba guinea</i>	Pigeon, Speckled	Least concern
<i>Anthus cinnamomeus</i>	Pipit, African	Least concern
<i>Anthus vaalensis</i>	Pipit, Buffy	Least concern
<i>Anthus caffer</i>	Pipit, Bushveld	Least concern
<i>Anthus similis</i>	Pipit, Long-billed	Least concern
<i>Anthus leucophrys</i>	Pipit, Plain-backed	Least concern
<i>Anthus lineiventris</i>	Pipit, Striped	Least concern
<i>Charadrius tricollaris</i>	Plover, Three-banded	Least concern
<i>Prinia flavicans</i>	Prinia, Black-chested	Least concern
<i>Prinia subflava</i>	Prinia, Tawny-flanked	Least concern
<i>Dryoscopus cubla</i>	Puffback, Black-backed	Least concern
<i>Pytilia melba</i>	Pytilia, Green-winged	Least concern
<i>Coturnix coturnix</i>	Quail, Common	Least concern
<i>Ortygospiza atricollis</i>	Quailfinch, African	Least concern
<i>Quelea quelea</i>	Quelea, Red-billed	Least concern
<i>Cossypha caffra</i>	Robin-Chat, Cape	Least concern
<i>Cossypha humeralis</i>	Robin-Chat, White-throated	Least concern
<i>Coracias caudatus</i>	Roller, Lilac-breasted	Least concern
<i>Bradypterus baboecala</i>	Rush-Warbler, Little	Least concern
<i>Rhinopomastus cyanomelas</i>	Scimitarbill, Common	Least concern
<i>Otus senegalensis</i>	Scops-Owl, African	Least concern
<i>Ptilopus granti</i>	Scops-Owl, Southern White-faced	Least concern
<i>Cercotrichas paena</i>	Scrub-Robin, Kalahari	Least concern
<i>Cercotrichas leucophrys</i>	Scrub-Robin, White-browed	Least concern
<i>Crithagra gularis</i>	Seedeater, Streaky-headed	Least concern
<i>Accipiter badius</i>	Shikra, Shikra	Least concern
<i>Laniarius atrococcineus</i>	Shrike, Crimson-breasted	Least concern
<i>Lanius minor</i>	Shrike, Lesser Grey	Least concern
<i>Corvinella melanoleuca</i>	Shrike, Magpie	Least concern
<i>Lanius collurio</i>	Shrike, Red-backed	Least concern
<i>Circaetus pectorali</i>	Snake-Eagle, Black-chested	Least concern
<i>Circaetus cinereus</i>	Snake-Eagle, Brown	Least concern
<i>Passer melanurus</i>	Sparrow, Cape	Least concern
<i>Passer motitensis</i>	Sparrow, Great	Least concern
<i>Passer domesticus</i>	Sparrow, House	Least concern
<i>Passer diffusus</i>	Sparrow, Southern Grey-headed	Least concern
<i>Accipiter melanoleucus</i>	Sparrowhawk, Black	Least concern
<i>Accipiter minullus</i>	Sparrowhawk, Little	Least concern
<i>Accipiter ovampensis</i>	Sparrowhawk, Ovambo	Least concern
<i>Plocepasser mahali</i>	Sparrow-Weaver, White-browed	Least concern
<i>Pternistis natalensis</i>	Spurfowl, Natal	Least concern



<i>Pternistis swainsonii</i>	Spurfowl, Swainson's	Least concern
<i>Lamprotornis nitens</i>	Starling, Cape Glossy	Least concern
<i>Onychognathus morio</i>	Starling, Red-winged	Least concern
<i>Cinnyricinclus leucogaster</i>	Starling, Violet-backed	Least concern
<i>Creatophora cinerea</i>	Starling, Wattled	Least concern
<i>Saxicola torquatus</i>	Stonechat, African	Least concern
<i>Chalcomitra amethystina</i>	Sunbird, Amethyst	Least concern
<i>Cinnyris mariquensis</i>	Sunbird, Marico	Least concern
<i>Cinnyris talatala</i>	Sunbird, White-bellied	Least concern
<i>Hirundo rustica</i>	Swallow, Barn	Least concern
<i>Hirundo cucullata</i>	Swallow, Greater Striped	Least concern
<i>Hirundo abyssinica</i>	Swallow, Lesser Striped	Least concern
<i>Hirundo dimidiata</i>	Swallow, Pearl-breasted	Least concern
<i>Hirundo semirufa</i>	Swallow, Red-breasted	Least concern
<i>Hirundo albigularis</i>	Swallow, White-throated	Least concern
<i>Apus barbatus</i>	Swift, African Black	Least concern
<i>Tachymarptis melba</i>	Swift, Alpine	Least concern
<i>Apus apus</i>	Swift, Common	Least concern
<i>Apus horus</i>	Swift, Horus	Least concern
<i>Apus affinis</i>	Swift, Little	Least concern
<i>Apus caffer</i>	Swift, White-rumped	Least concern
<i>Tchagra senegalus</i>	Tchagra, Black-crowned	Least concern
<i>Tchagra australis</i>	Tchagra, Brown-crowned	Least concern
<i>Psophocichla litsipsirupa</i>	Thrush, Groundscraper	Least concern
<i>Turdus smithi</i>	Thrush, Karoo	Least concern
<i>Turdus libonyanus</i>	Thrush, Kurrichane	Least concern
<i>Pogoniulus chrysoconus</i>	Tinkerbird, Yellow-fronted	Least concern
<i>Parus cinerascens</i>	Tit, Ashy	Least concern
<i>Parus niger</i>	Tit, Southern Black	Least concern
<i>Parisoma subcaeruleum</i>	Chestnut-vented	Least concern
<i>Myioparus plumbeus</i>	Tit-Flycatcher, Grey	Least concern
<i>Streptopelia capicola</i>	Turtle-Dove, Cape	Least concern
<i>Gyps coprotheres</i>	Vulture, Cape	Vulnerable
<i>Motacilla capensis</i>	Wagtail, Cape	Least concern
<i>Sylvia borin</i>	Warbler, Garden	Least concern
<i>Acrocephalus schoenobaenus</i>	Warbler, Sedge	Least concern
<i>Phylloscopus trochilus</i>	Warbler, Willow	Least concern
<i>Uraeginthus angolensis</i>	Waxbill, Blue	Least concern
<i>Estrilda astrild</i>	Waxbill, Common	Least concern
<i>Amandava subflava</i>	Waxbill, Orange-breasted	Least concern
<i>Coccygia melanotis</i>	Waxbill, Sweet	Least concern
<i>Ploceus capensis</i>	Weaver, Cape	Least concern
<i>Amblyospiza albifrons</i>	Weaver, Thick-billed	Least concern
<i>Ploceus cucullatus</i>	Weaver, Village	Least concern
<i>Oenanthe pileata</i>	Wheatear, Capped	Least concern
<i>Oenanthe monticola</i>	Wheatear, Mountain	Least concern
<i>Zosterops virens</i>	White-eye, Cape	Least concern
<i>Vidua macroura</i>	Whydah, Pin-tailed	Least concern
<i>Euplectes ardens</i>	Widowbird, Red-collared	Least concern
<i>Euplectes albonotatus</i>	Widowbird, White-winged	Least concern

<i>Turtur chalcospilos</i>	Wood-Dove, Emerald-spotted	Least concern
<i>Phoeniculus purpureus</i>	Wood-Hoopoe, Green	Least concern
<i>Dendropicos namaquus</i>	Woodpecker, Bearded	Least concern
<i>Dendropicos fuscescens</i>	Woodpecker, Cardinal	Least concern
<i>Campethera abingoni</i>	Woodpecker, Golden-tailed	Least concern

Table 11. Red listed bird species that occur on/nearby the proposed development area.

Scientific Name	English Name	Conservation Status	Likelihood of occurrence
<i>Crex crex</i>	Crake, Corn	Vulnerable	Medium - during winter
<i>Gyps coprotheres</i>	Vulture, Cape	Vulnerable	High - occasional foraging
<i>Falco biarmicus</i>	Falcon, Lanner	Near threatened	High - occasional foraging
<i>Tyto capensis</i>	Owl, African Grass	Vulnerable	High
<i>Falco peregrinus</i>	Falcon, Peregrine	Near threatened	High – occasional foraging

## INVERTEBRATE DIVERSITY OF THE SURVEY AREA

**Introduction:** Invertebrates dominate terrestrial and freshwater ecosystems, with insects being the most speciose class, comprising more than 75% of all known species in the Animal Kingdom. Insects, myriapods and arachnids form part of the diverse and essential natural processes that sustain biological systems. The insect-plant interaction is the most common biotic interaction on Earth, and indeed, our present ecosystems would not function without these invertebrates. The worldwide Red List of Threatened Species (<http://www.iucnredlist.org/>) contains approximately 560 insects. This is a meagre 7% of the faunal list, which when one considers that insects make up over 70% of the world's fauna, is tremendously biased. In a study carried out by Black and Vaughn (2003), it was noted that of the world's insects, very few groups have been assessed on a worldwide scale. Approximately 10% of Swallowtail butterflies, for example, are considered globally threatened. Based on a mathematical model, McKinney (2003), predicted that 10% of all butterflies were threatened strongly contrasting the 1% currently listed. At National levels, figures between 10% and 34% are given for the number of threatened indigenous insect species, suggesting that the overall number of threatened insect species could be in excess of 100,000. Globally countries such as Australia, France, Spain, the United States and South Africa have among the highest numbers of threatened invertebrates. This is however, more a reflection of the effort made by these countries to assess their biodiversity and hence distinguish those that are threatened rather than a true overall indication.

Invertebrates have an enormous functional value because of the numerous individuals and the great intra- and interspecific variety. The ecological importance of this great variety of invertebrates makes them valuable to assess disturbances or environmental impacts. A sound knowledge of arthropods is crucial to the conservation and management of ecosystems because a skewed focus only on the larger organisms will misrepresent ecosystem dynamics. The lack of human appreciation of the importance of invertebrates and their general disregard and dislike, coupled to the fact that only about 7-10% of insects are scientifically described, must be overcome to realistically conserve biodiversity.

**Methodology:** Invertebrates were sampled using active and passive methods. Active methods entail collection by an individual using various kinds of equipment, while passive methods involve specialised types of traps at specific sites in the field, which are visited at given time intervals.

### Passive collection

- Pitfall traps
  - Ten pitfall traps were placed ten meters apart, in a single transect:
    1. On the eastern boundary of the survey area in unit 1.
    2. In the south western corner of the survey area where unit two enters the site.

The pitfall traps were baited with rotting fruit as well as fresh cattle dung. The plastic buckets used for traps had a 1000 mL capacity and were 11 cm in diameter and 12 cm deep. All the traps were sunk into the ground so that the buckets' rims were level with the soil surface. Buckets were filled to about one fifth their volumes with a solution of liquid soap and water to immobilise trapped invertebrates. Trap

contents were collected 24 hours after the traps had been set. Only insects and arachnids were collected from the traps. Specimens of interest were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

### **Active collection**

- Sweepnetting

Transect sweepnetting was carried out on the 6<sup>th</sup> and 7<sup>th</sup> of November 2015. *Ad hoc* sweepnetting was carried out in randomly chosen sites throughout the survey. An insect net with a diameter of 40 cm were used for collecting insects and arachnids. Transect sweepnetting was not carried out because of the dense nature of the vegetation. Where necessary, insects and arachnids from the samples were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

- Beating

This method of collecting was not employed as it was deemed unlikely to retrieve any invertebrates of conservation concern known to occur in the vicinity of the site.

- Physical searches

Physical ground and rock searches were undertaken in order to identify arachnids, scorpions and various insects which take refuge underground in burrows or under rocks. The scorpion species *Uroplectes vittatus* was located using this technique. This burrowing scorpion *Opisthophthalmus carinatus* was dug out using a spade.

- Light trapping

This method of trapping could not be employed due to security reasons.

- Data recorded and red data species

A list of all identifiable insects and arachnids caught or seen on the site was compiled and is documented below:

## **Class Insecta**

### **Dragonflies and damselflies**

#### **Suborder Anisoptera**

Family Libellulidae

*Brachythemis leucostica*

There are no Odonatan species of conservation concern recorded for North West. All members of this order are excellent flyers. All adults are day flying and predatory. The order has a strong association with water as all immature odonatan's are aquatic. One species was observed in unit 1 during the survey. Approximately 160 species occur in southern Africa.

### **Cockroaches**

#### **Order Blattodea**

Family Blattidae

*Deropeltis* sp.

Family Blaberidae

*Bantua* spp.

*Derocalymma* sp.

Family Pseudophyllodromiidae

There are no cockroach species of conservation concern recorded for North West. This order of nocturnal insects feed on a wide range of foodstuffs. All 6 known families occur in the southern Africa and members of 3 families were observed in the survey area.

### **Termites**

#### **Order Isoptera**

Family Kalotermitidae

Family Hodotermitidae

*Hodotermes mossambicus*

Family Termitidae

*Macrotermes natalensis*

There are no termite species of conservation concern recorded for North West. These social insects live in mounds where there is a division of labour amongst the four castes (morphological varieties). The King and Queen casts are the primary reproductives whilst workers can be either male or female but are sterile. Soldiers are exclusively male. A fifth caste includes flying termites which are secondary reproductives that may go on to build new termitaria and eventually become primary reproductives. Termites have significant ecological importance in that they are responsible for aeration of soils and recycling of nutrients in soil.

**Mantids****Order Mantodea**

Family Hymenopidae

*Harpagomantis tricolor*

Family Mantidae

*Tarachodes* sp.*Miomantis* sp.*Pyrgomantis rhodesica**Erioscopomantis chalybea**Popa undata*

Family Empusidae

*Empusa guttula*

There are no Mantid species of conservation concern recorded for North West. Members of this order are all vicious predators. Several colourful mimics resembling flowers were observed on the site. A number of species were recorded whilst sweepnetting. Of the approximately 1 800 described species, 185 occur in southern Africa.

**Earwigs****Order Dermaptera**

Family Forficulidae

There are no earwig species of conservation concern recorded for North West. All members of this order have terminal forceps. Females exhibit brood care by tending their eggs. Flightless earwig species were observed in leaf litter where they feeding on decaying organic matter. Of the 1 800 described species, approximately 50 occur in southern Africa.

**Crickets, Grasshoppers and Locusts****Order Orthoptera**

Family Bradyporidae

*Acanthoplus* sp.

Family Tettigoniidae

*Terpnistria* sp.*Ruspolia* sp.*Clonia* sp.

Family Gryllidae

*Acanthogryllus fortipes**Oecanthus* sp.

Family Thericleidae

*Thericles* sp.

## Family Pamphagidae

*Lamarckiana* sp.

## Family Pyrgomorphidae

*Phymateus morbillosus**Zonocerus elegans*

## Family Acrididae

*Acridida acuminata**Acrida* sp.*Truxaloides* sp.*Cyrtacanthacris* sp.*Locusta pardalina**Acanthacris ruficornis**Schistocerca gregaria**Gastrimargus* sp.*Leptacris* sp.*Cannula* sp.*Acrotylus* sp.*Tmetanota* sp.*Rhachitopsis* sp.*Catantops* sp.*Oedaleus* sp.

There are no orthopterans of conservation concern recorded for North West. This order is of major economic importance and includes many pest species, some of which were observed in the survey area. All members have legs adapted for jumping and produce sounds. Numerous species were observed whilst sweepnetting.

**Stick insects****Order Phasmatodea**

Family Heteronemiidae

Family Bacillidae

*Maransis* sp.

There are no phasmatids of conservation concern recorded for North West. All members of this order are nocturnal herbivores and rely on mimicry for protection from predators. Males are unknown in many species and reproduction is parthenogenetic (asexual). Numerous stick insect species have spectacular eggs that mimic plant seeds. All members of this order are capable of reflex autonomy whereby they can regrow legs which may have been lost. Several species were observed whilst sweepnetting.



## Bugs

### Order Hemiptera

Family Miridae

*Deroeocoris* sp.

Family Tingidae

Family Reduviidae

*Acanthaspis* sp.

*Ectrichodia crux*

*Lopodytes* spp.

*Oncocephalus* sp.

*Petalochirus* sp.

Subfamily Emesinae

Family Aradidae

Family Coreidae

*Cletus* sp.

*Homoeoceris* sp.

*Pephricus* sp.

Family Alydidae

*Mirpernus faculus*

Family Pyrrhocoridae

*Dysdercus intermedius*

*Scantius fosteri*

Family Lygaeidae

*Oncopeltus* sp.

*Spilostethus* sp.

Family Tessaratomidae

Family Pentatomidae

*Coenomorpha* sp.

*Aspongopus* sp.

*Cuara rufventris*

*Dalsira costalis*

Family Cixiidae

Family Cercopidae

*Ptyelus* sp.

*Locris* sp.

Family Cicadellidae

*Cofana spectra*

Family Aphididae

*Aphis gossypii*

Family Coccidae

*Ceroplastes* sp.

Family Dactylopiidae

There are no Hemipteran species of conservation concern recorded for North West. Hemiptera is the most important order of insects from an agricultural perspective. There are also numerous species that have medical and veterinary importance. All members of this order have piercing (sucking) mouthparts. From a behavioural and morphological perspective, there is no order that displays more diversity. Sexual dimorphism is pronounced in many species.

## **Thrips**

### **Order Thysanoptera**

There are no Thrip species of conservation concern recorded for North West. Thrips are a very large, diverse and common group, but attract little attention because of their small size. Species are difficult to distinguish from one another without the aid of a microscope. Some species are pests of cultivated plants whilst others are important pollinators. Reproduction can be sexual or parthenogenetic. Of the 4 500 known species, approximately 230 occur in southern Africa.

## **Lacewings and Antlions**

### **Order Neuroptera**

Family Hemerobiidae

Family Chrysopidae

*Chrysoperla* sp.

*Chrysemosa jeanneli*

Family Myrmeleontidae

*Centoclis* sp.

*Hagenomyia* sp.

*Myrmeleon* sp.

*Macronemurus tinctus*

*Neuroleon* sp.

Family Acalaphidae

*Neomelambrotus* sp.

There are no Neuropteran species of conservation concern recorded for North West. All larvae of this order are predators whilst adults can be predatory or herbivorous, some being important pollinators. Neuropteran biomass is thought to rival mammalian biomass in more arid areas of southern Africa such as the Kalahari. The order is well represented in southern Africa by 13 of the 16 known families, with 383 species.

## Beetles

### Order Coleoptera

Family Carabidae

*Graphipterus* sp.

*Thermophilum homoplatum*

*Craspedophorus* sp.

Subfamily Cicindelinae

*Lophyra* sp.

Subfamily Paussinae

Family Histeridae

Family Staphylinidae

Family Trogidae

*Trox* sp.

Family Scarabaeidae

Subfamily Cetoniinae

*Pachnoda sinuata*

*Cyrtothyrea marginalis*

Subfamily Rutellinae

Subfamily Melolonthinae

*Adoretus* sp.

Subfamily Dynastinae

*Cyphonistes* sp.

*Heteronychis arator*

*Oryctes boas*

Subfamily Scarabaeidae

*Onitis alexis*

*Sisyphus* sp.

*Copris* sp.

*Heliocopris* sp.

*Scarabaeus* sp.

Subfamily Aphodiinae

*Aphodius* sp.

Family Buprestidae

*Sphenoptera* sp.

*Acmaeodera* sp.

Family Elateridae

*Cardiotarsus* sp.

Family Lycidae

*Lycus* sp.

Family Bostrichidae

## Family Melyridae

*Astylus astromaculatus*

## Family Coccinellidae

## Subfamily Coccinellinae

*Micraspis* sp.*Cheilomenes lunata**Henosepilachna bifasciata*

## Subfamily Epilachninae

*Epilachna* sp.

## Family Tenebrionidae

*Lagria* sp.*Anomalipus elephas**Gonocephalum simplex*

## Family Meloidae

*Mylabris oculata*

## Family Cerambycidae

*Ceropalesis thunbergi**Macrotoma palmata*

## Family Chrysomelidae

## Subfamily Chryptocephalinae

*Cryptocephalus decemnotatus*

## Subfamily Chrysomelinae

*Chrysolina* sp.*Plagioderia* sp.

## Subfamily Galerucinae

*Monolepta* sp.*Sonchia* sp.

## Subfamily Eumolpinae

*Platycorynus* sp.

## Family Curculionidae

*Hypolixus* sp.*Protostrophus* sp.

No beetles of conservation concern were observed on the site. Beetles are the largest order of living organisms with an estimated 370 000 spp. worldwide. Beetles vary greatly in size, shape, habits and biological requirements. They have no obvious character to which their success can be attributed. Approximately 18 000 species have been described in southern Africa. Numerous species were observed in the survey area. A large number of dung beetles were observed on cattle dung in the survey area.

**Flies****Order Diptera**

Family Tipulidae

*Nephrotoma* sp.

Family Simuliidae

Family Tabanidae

*Tabanus* sp.*Haematopota* sp.

Family Asilidae

*Daspletis* sp.*Gonioscelis* sp.*Lasiocnemis* sp.

Family Bombyliidae

*Bombomyia* sp.*Exoprosopa* sp.

Family Syrphidae

Family Muscidae

*Musca domestica*

Family Calliphoridae

*Lucilia* sp.

Family Sarcophagidae

Family Tachinidae

There are no Dipteran species of conservation concern recorded for North West. From a medical point of view this is the most important insect order. Flies are also important from a veterinary and agricultural point of view. Flies are important from an ecological point of view as they responsible from 70 to 80% of carcass breakdown. Approximately 16 000 species are known in the Afrotropical region.

**Caddisflies****Order Trichoptera**

There are no Caddisfly species of conservation concern recorded for North West. Caddisflies are similar to butterflies and moths in appearance. The major difference between the orders is that Caddisflies have hairy wings whilst butterflies and moths are scale winged insects. All members of the order are aquatic and larvae have gills. Adults do not feed whilst larvae have a diverse array of feeding habits ranging from shredders, collectors, scrapers, piercers to predators. They display many convergent similarities to the more primitive order Ephemeroptera and are also important environmental indicators. This is due to their dependence on consistent water pH and O<sub>2</sub> content.

**Moths and Butterflies****Order Lepidoptera**

Family Hepialidae

Family Scythiridae

Family Psychidae

Family Xyloryctidae

Family Crambidae

Subfamily Spilomelinae

*Palpita unionalis*

Subfamily Crambinae

Subfamily Phycitinae

Family Pterophoridae

Family Alucitidae

Family Geometridae

Family Saturniidae

Family Noctuidae

*Cyligramma latona*

Family Nymphalidae

Subfamily Danainae

*Danaus chrysippus*

Subfamily Satyrinae

*Strygionympha wichgrafi**Ypthima impura*

Subfamily Heliconiinae

*Acraea anemosa**Acraea axina**Acraea horta*

Subfamily Charaxinae

*Charaxes jasius**Charaxes jahlusa*

Subfamily Limentinae

*Hamanumida daedalus*

Subfamily Biblidinae

*Byblia ilithyia*

Subfamily Nymphalinae

*Hypolimnas misippus**Junonia hierta cebrene**Junonia oenone oenone**Junonia orithya**Vanessa cardui*

Family Lycaenidae

Subfamily Lycaenidae

*Axiocerses tjoane*  
*Axiocerses amanga*  
*Aloeides taikosama*  
*Aloeides aranda*  
*Anthene amarah*  
*Anthene definita*  
*Leptotes pirithous*  
*Leptotes babaulti*  
*Leptotes brevidentatus*  
*Lampides boeticus*  
*Tarucus sybaris*  
*Lepidochrysops patricia*  
*Cupidopsis cissus*  
*Cupidopsis jobates*  
*Azanas jesous*  
*Azanas moriqua*  
*Azanas natalensis*

Family Pieridae

Subfamily Pierinae

*Pinacopteryx eriphia*  
*Colotis evenia*  
*Colotis elagore*  
*Colotis antevippe*  
*Colotis euipe*  
*Belenois aurota*  
*Belenois creona*  
*Belenois zochalia*  
*Pontia helice*  
*Mylothris agathina*

Subfamily Coliadinae

*Colias electo*  
*Catopsilia florella*  
*Eurema brigitta*

Family Papilionidae

*Papilio demodocus*  
*Graphium antheus*

Family Hesperidae

*Caprona pillaana*



*Gegenes niso*  
*Gegenes pumilio*  
*Platylesches ayresii*  
*Platylesches neba*  
*Parosmodes morantii*

No moths or butterflies of conservation concern were observed on the site. Lepidoptera is very large order that has close association with flowering plants. Lepidoptera contains the highest number of endangered species in South Africa relative to other orders. There is no simple distinction between moths and butterflies. All adult members of this order have coiled mouthparts. These are reduced in a few species where adults do not feed. Many moth species are pests on agricultural products and have economic importance. Of the 136 species recorded by the southern African butterfly conservation assessment for the survey loci, 53 were recorded during the survey. The 136 species recorded by the southern African butterfly conservation assessment for the survey loci (2427BA, 2427BB, 2427CA) are indicated in the below table.

**Table 1.** Butterfly species recorded by the southern African Butterfly conservation assessment for the combined loci 2527CD (Henning, Terblanche and Ball, 2009)

Family	Genus	species	Common name	Conservation status	Atlas region endemic
HESPERIIDAE	<i>Abantis</i>	<i>tettensis</i>	Spotted velvet skipper	Least concern	
HESPERIIDAE	<i>Caprona</i>	<i>pillaana</i>	Ragged skipper	Least concern	
HESPERIIDAE	<i>Coeliades</i>	<i>pisistratus</i>	Two-pip policeman	Least concern	
HESPERIIDAE	<i>Eretis</i>	<i>umbra</i>	Small marbled elf	Least concern	Yes
HESPERIIDAE	<i>Gegenes</i>	<i>niso</i>	Common hottentot	Least concern	
HESPERIIDAE	<i>Gegenes</i>	<i>pumilio</i>	Dark hottentot	Least concern	
HESPERIIDAE	<i>Gomalia</i>	<i>elma</i>	Green-marbled skipper	Least concern	
HESPERIIDAE	<i>Kedestes</i>	<i>barberae</i>	Barber's ranger	Least concern	
HESPERIIDAE	<i>Kedestes</i>	<i>callicles</i>	Pale ranger	Least concern	
HESPERIIDAE	<i>Kedestes</i>	<i>macomo</i>	Macomo ranger	Least concern	
HESPERIIDAE	<i>Kedestes</i>	<i>wallengrenii</i>	Wallengren's ranger	Least concern	
HESPERIIDAE	<i>Metisella</i>	<i>willemi</i>	Netted sylph	Least concern	
HESPERIIDAE	<i>Parnara</i>	<i>monasi</i>	Water watchman	Least concern	
HESPERIIDAE	<i>Parosmodes</i>	<i>morantii</i>	Morant's orange	Least concern	
HESPERIIDAE	<i>Pelopidas</i>	<i>mathias</i>	Black-banded swift	Least concern	
HESPERIIDAE	<i>Pelopidas</i>	<i>thrax</i>	White-banded swift	Least concern	
HESPERIIDAE	<i>Platylesches</i>	<i>ayresii</i>	Peppered hopper	Least concern	
HESPERIIDAE	<i>Platylesches</i>	<i>neba</i>	Flower-girl hopper	Least concern	
HESPERIIDAE	<i>Sarangesa</i>	<i>motozi</i>	Elfin skipper	Least concern	
HESPERIIDAE	<i>Sarangesa</i>	<i>seineri</i>	Dark elfin	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>asterodia</i>	Star sandman	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>depauperata</i>	Wandering sandman	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>diomus</i>	Common sandman	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>dromus</i>	Forest sandman	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>mafa</i>	Mafa sandman	Least concern	
HESPERIIDAE	<i>Spialia</i>	<i>spio</i>	Mountain sandman	Least concern	
HESPERIIDAE	<i>Tsitana</i>	<i>tsita</i>	Dismal sylph	Least concern	
LYCAENIDAE	<i>Actizera</i>	<i>lucida</i>	Rayed blue	Least concern	

LYCAENIDAE	<i>Aloeides</i>	<i>aranda</i>	Aranda copper	Least concern
LYCAENIDAE	<i>Aloeides</i>	<i>taikosama</i>	Dusky copper	Least concern
LYCAENIDAE	<i>Anthene</i>	<i>amarah</i>	Black striped hairtail	Least concern
LYCAENIDAE	<i>Anthene</i>	<i>definita</i>	Common hairtail	Least concern
LYCAENIDAE	<i>Anthene</i>	<i>livida</i>	Pale hairtail	Least concern
LYCAENIDAE	<i>Anthene</i>	<i>millari</i>	Millar's hairtail	Least concern
LYCAENIDAE	<i>Aphnaeus</i>	<i>hutchinsonii</i>	Hutchinson's highflier	Least concern
LYCAENIDAE	<i>Axiocerses</i>	<i>amanga</i>	Bush scarlet	Least concern
LYCAENIDAE	<i>Axiocerses</i>	<i>tjoane</i>	Eastern scarlet	Least concern
LYCAENIDAE	<i>Azanus</i>	<i>jesous</i>	Topaz babul blue	Least concern
LYCAENIDAE	<i>Azanus</i>	<i>moriqua</i>	Black-bordered babul blue	Least concern
LYCAENIDAE	<i>Azanus</i>	<i>natalensis</i>	Natal babul blue	Least concern
LYCAENIDAE	<i>Azanus</i>	<i>ubaldus</i>	Velvet-spotted babul blue	Least concern
LYCAENIDAE	<i>Cacyreus</i>	<i>lingeus</i>	Bush bronze	Least concern
LYCAENIDAE	<i>Cacyreus</i>	<i>marshalli</i>	Common geranium bronze	Least concern
LYCAENIDAE	<i>Cacyreus</i>	<i>virilis</i>	Mocker bronze	Least concern
LYCAENIDAE	<i>Capys</i>	<i>disjunctus</i>	Russet protea	Least concern
LYCAENIDAE	<i>Chilades</i>	<i>trochylus</i>	Grass jewel	Least concern
LYCAENIDAE	<i>Cigaritis</i>	<i>ella</i>	Ella's bar	Least concern
LYCAENIDAE	<i>Cigaritis</i>	<i>mozambica</i>	Mozambique bar	Least concern
LYCAENIDAE	<i>Cigaritis</i>	<i>natalensis</i>	Natal bar	Least concern
LYCAENIDAE	<i>Cnodontes</i>	<i>penningtoni</i>	Pennington's buff	Least concern
LYCAENIDAE	<i>Cupidopsis</i>	<i>cissus</i>	Common meadow blue	Least concern
LYCAENIDAE	<i>Cupidopsis</i>	<i>jobates</i>	Tailed meadow blue	Least concern
LYCAENIDAE	<i>Eicochrysops</i>	<i>messapus</i>	Cupreous blue	Least concern
LYCAENIDAE	<i>Euchrysops</i>	<i>dolorosa</i>	Sabie smoky blue	Least concern
LYCAENIDAE	<i>Euchrysops</i>	<i>malathana</i>	Common smoky blue	Least concern
LYCAENIDAE	<i>Hypolycaena</i>	<i>philippus</i>	Purplebrown hairstreak	Least concern
LYCAENIDAE	<i>Iolaus</i>	<i>alienus</i>	Brown-line sapphire	Least concern
LYCAENIDAE	<i>Iolaus</i>	<i>mimosae</i>	Mimosa sapphire	Least concern
LYCAENIDAE	<i>Iolaus</i>	<i>pallene</i>	Saffron sapphire	Least concern
LYCAENIDAE	<i>Iolaus</i>	<i>trimeni</i>	Trimen's sapphire	Least concern
LYCAENIDAE	<i>Lachnocnema</i>	<i>bibulus</i>	Common woolly legs	Least concern
LYCAENIDAE	<i>Lampides</i>	<i>boeticus</i>	Pea blue	Least concern
LYCAENIDAE	<i>Lepidochrysops</i>	<i>patricia</i>	Patricia blue	Least concern
LYCAENIDAE	<i>Leptomyrina</i>	<i>henningi</i>	Henning's black-eye	Least concern
LYCAENIDAE	<i>Leptotes</i>	<i>babaulti</i>	Babault's zebra blue	Least concern
LYCAENIDAE	<i>Leptotes</i>	<i>brevidentatus</i>	Short-toothed zebra blue	Least concern
LYCAENIDAE	<i>Leptotes</i>	<i>jeanneli</i>	Jeannel's zebra blue	Least concern
LYCAENIDAE	<i>Leptotes</i>	<i>pirithous</i>	Common zebra blue	Least concern
LYCAENIDAE	<i>Myrina</i>	<i>silenus</i>	Common fig tree blue	Least concern
LYCAENIDAE	<i>Pseudonacaduba</i>	<i>sichela</i>	Dusky line blue	Least concern
LYCAENIDAE	<i>Stugeta</i>	<i>bowkeri</i>	Bowker's marbled sapphire	Least concern
LYCAENIDAE	<i>Tarucus</i>	<i>sybaris</i>	Dotted blue	Least concern
LYCAENIDAE	<i>Tuxentius</i>	<i>calice</i>	White pie	Least concern
LYCAENIDAE	<i>Tuxentius</i>	<i>melaena</i>	Black pie	Least concern
LYCAENIDAE	<i>Uranothauma</i>	<i>nubifer</i>	Black heart	Least concern
LYCAENIDAE	<i>Virachola</i>	<i>antalus</i>	Brown playboy	Least concern
LYCAENIDAE	<i>Virachola</i>	<i>dinochaes</i>	Apricot playboy	Least concern
LYCAENIDAE	<i>Zintha</i>	<i>hintza</i>	Hintza pierrot	Least concern
LYCAENIDAE	<i>Zizeeria</i>	<i>knysna</i>	African grass blue	Least concern
LYCAENIDAE	<i>Zizula</i>	<i>hylax</i>	Tiny grass blue	Least concern
NYMPHALIDAE	<i>Acraea</i>	<i>anemosa</i>	Broad-bordered acraea	Least concern

NYMPHALIDAE	<i>Acraea</i>	<i>axina</i>	Little acraea	Least concern	
NYMPHALIDAE	<i>Acraea</i>	<i>caldarena</i>	Black-tipped acraea	Least concern	
NYMPHALIDAE	<i>Acraea</i>	<i>horta</i>	Garden acraea	Least concern	
NYMPHALIDAE	<i>Acraea</i>	<i>lygus</i>	Lygus acraea	Least concern	
NYMPHALIDAE	<i>Acraea</i>	<i>natalica</i>	Natal acraea	Least concern	
NYMPHALIDAE	<i>Acraea</i>	<i>neobule</i>	Wandering donkey acraea	Least concern	
NYMPHALIDAE	<i>Byblia</i>	<i>anvatara</i>	Joker	Least concern	
NYMPHALIDAE	<i>Byblia</i>	<i>ilithyia</i>	Spotted joker	Least concern	
NYMPHALIDAE	<i>Catacroptera</i>	<i>cloanthe</i>	Pirate	Least concern	
NYMPHALIDAE	<i>Charaxes</i>	<i>achaemenes</i>	Bushveld charaxes	Least concern	
NYMPHALIDAE	<i>Charaxes</i>	<i>candioppe</i>	Green-veined charaxes	Least concern	
NYMPHALIDAE	<i>Charaxes</i>	<i>jahlusa</i>	Pearl-spotted charaxes	Least concern	
NYMPHALIDAE	<i>Charaxes</i>	<i>jasius</i>	Foxy charaxes	Least concern	
NYMPHALIDAE	<i>Danaus</i>	<i>chrysippus</i>	African monarch	Least concern	
NYMPHALIDAE	<i>Eurytela</i>	<i>dryope</i>	Golden piper	Least concern	
NYMPHALIDAE	<i>Hamanumida</i>	<i>daedalus</i>	Guinea-fowl butterfly	Least concern	
NYMPHALIDAE	<i>Heteropsis</i>	<i>perspicua</i>	Eyed bush brown	Least concern	
NYMPHALIDAE	<i>Hypolimnias</i>	<i>misippus</i>	Common diadem	Least concern	
NYMPHALIDAE	<i>Junonia</i>	<i>hierta</i>	Yellow pansy	Least concern	
NYMPHALIDAE	<i>Junonia</i>	<i>oenone</i>	Blue pansy	Least concern	
NYMPHALIDAE	<i>Junonia</i>	<i>orithya</i>	Eyed pansy	Least concern	
NYMPHALIDAE	<i>Neptis</i>	<i>saclava</i>	Spotted sailer	Least concern	
NYMPHALIDAE	<i>Paternympha</i>	<i>narycia</i>	Spotted-eye brown	Least concern	Yes
NYMPHALIDAE	<i>Phalanta</i>	<i>phalantha</i>	African leopard	Least concern	
NYMPHALIDAE	<i>Precis</i>	<i>archesia</i>	Garden commodore	Least concern	
NYMPHALIDAE	<i>Precis</i>	<i>ceryne</i>	Marsh commodore	Least concern	
NYMPHALIDAE	<i>Stygionympha</i>	<i>wichgrafi</i>	Wichgraf's hillside brown	Least concern	Yes
NYMPHALIDAE	<i>Telchinia</i>	<i>anacreon</i>	Orange acraea	Least concern	
NYMPHALIDAE	<i>Telchinia</i>	<i>encedon</i>	White-barred acraea	Least concern	
NYMPHALIDAE	<i>Telchinia</i>	<i>rahira</i>	Marsh acraea	Least concern	
NYMPHALIDAE	<i>Telchinia</i>	<i>serena</i>	Dancing acraea	Least concern	
NYMPHALIDAE	<i>Vanessa</i>	<i>cardui</i>	Painted lady	Least concern	
NYMPHALIDAE	<i>Ypthima</i>	<i>asterope</i>	African ringlet	Least concern	
NYMPHALIDAE	<i>Ypthima</i>	<i>impura</i>	Impure ringlet	Least concern	
PAPILIONIDAE	<i>Graphium</i>	<i>antheus</i>	Large striped swordtail	Least concern	
PAPILIONIDAE	<i>Papilio</i>	<i>demodocus</i>	Citrus swallowtail	Least concern	
PAPILIONIDAE	<i>Papilio</i>	<i>nireus</i>	Green-banded swallowtail	Least concern	
PIERIDAE	<i>Belenois</i>	<i>aurora</i>	Brown-veined white	Least concern	
PIERIDAE	<i>Belenois</i>	<i>creona</i>	African common white	Least concern	
PIERIDAE	<i>Belenois</i>	<i>zochalia</i>	Forest white	Least concern	
PIERIDAE	<i>Catopsilia</i>	<i>florella</i>	African migrant	Least concern	
PIERIDAE	<i>Colias</i>	<i>electo</i>	African clouded yellow	Least concern	
PIERIDAE	<i>Colotis</i>	<i>antevippe</i>	Red tip	Least concern	
PIERIDAE	<i>Colotis</i>	<i>euipepe</i>	Smoky orange tip	Least concern	
PIERIDAE	<i>Colotis</i>	<i>evagore</i>	Small orange tip	Least concern	
PIERIDAE	<i>Colotis</i>	<i>evenina</i>	Orange tip	Least concern	
PIERIDAE	<i>Eurema</i>	<i>brigitta</i>	Broad-bordered yellow	Least concern	
PIERIDAE	<i>Mylothris</i>	<i>agathina</i>	Common dotted border	Least concern	
PIERIDAE	<i>Mylothris</i>	<i>rueppellii</i>	Twin dotted border	Least concern	
PIERIDAE	<i>Pinacopteryx</i>	<i>eriphia</i>	Zebra white	Least concern	
PIERIDAE	<i>Pontia</i>	<i>helice</i>	Common meadow white	Least concern	
PIERIDAE	<i>Teracolus</i>	<i>eris</i>	Banded gold tip	Least concern	

**Sawflies, Wasps, Bees & Ants****Order Hymenoptera****Suborder Apocrita**

Family Ichneumonidae

*Enicospilus* sp.*Theronia* sp.

Family Braconidae

*Archibracon servillei**Apanteles* sp.

Family Gasterupiidae

Family Chrysididae

Family Mutilidae

Family Pompilidae

*Tachypompilus* sp.*Batozonellus* sp.

Family Vespidae

*Polistes* sp.*Belonogaster* sp.

Family Apidae

*Xylocopa* sp.*Ceratina* sp.*Apis mellifera*

Family Formicidae

*Dorylus helvolus**Messor capensis**Solenopsis punctaticeps**Camponotus maculatus**Camponotus fulvopilosus**Anoplolepis* sp.

There are no Wasp, Bee or Ant species of conservation concern recorded for North West. Hymenoptera is the youngest insect order in evolutionary terms. It is also a very diverse order including solitary, social and parasitic species. Many members of this order have a well-developed sting. A common characteristic across this order is haplodiploidy where males are haploid and have half the genetic composition of females. Males inherit all their genetics from their mother. Of the 198 000 known species worldwide, over 6000 are known from southern Africa.

## Spiders and scorpions

### Class Arachnida

#### Scorpions

##### Order Scorpiones

Family Buthidae

*Uroplectes vittatus*

Family Scorpionidae

*Opisththalmus pugnax*

One TOPS registered scorpion species was observed on the site. Of the 1 500 known species, approximately 130 are known from southern Africa. On average 6 species occur in a localized area. Two species were observed in the survey area although some species may have missed during the sampling effort. Scorpion spends 92 to 97% of their time inactive. With such high levels of inertia, some species are thought to be able to live without food for more than a year. Species known to occur in the vicinity of the survey area that were not recorded include *Parabuthus mosambicensis* and *Uroplectes triangulifer*.

#### Spiders

##### Order Aranaea

Family Araneidae

Subfamily Argiopinae

Subfamily Gasteracanthinae

*Gasteracantha* sp.

Subfamily Araneinae

*Caerostris* sp.

*Larinia* sp.

Family Tetragnathidae

Subfamily Nephilinae

*Nephila* sp.

Family Uloboridae

Subfamily Uloborinae

Family Eresidae

Subfamily Eresinae

*Dresserus* sp.

*Stegodyphus* sp.

Family Agelenidae

*Olorunia* sp.

Family Pholcidae

*Pholcus* sp.  
*Smeringopus* sp.  
Family Deinopidae  
*Menneus camelus*  
Family Ammoxenus  
*Ammoxenus amphalodes*  
Family Gnaphosidae  
Family Heteropodidae  
*Palystes* sp.  
*Parapalystes* sp.  
*Olios* sp.  
Family Lycosidae  
*Geolycosa* sp.  
*Lycosa* sp.  
Family Salticidae  
*Slasticus* sp.  
*Portia* sp.  
Family Selenopidae  
*Selenops* sp.  
Family Zodariidae  
Subfamily Zodariinae  
*Dioes* spp.  
Family Thomsidae  
*Thomsius* sp.  
Family Oxyopidae  
*Peucetia* sp.  
Family Hersilidae  
*Hersilia* sp.  
Family Ctenizidae  
*Stasimopus* sp.  
Family Idiopidae  
*Gorgyrella* sp.

No spider species of conservation concern were observed on the site. Approximately 40 000 species of spider have been described to date however it is estimated that this figure represents approximately 30% of total spider diversity worldwide. With the exception of ticks (Acari) and scorpions (Scorpiones), Arachnids have been poorly studied in southern Africa. Ticks and scorpions are better known due to their medical and veterinary importance. Specimens of other arachnid orders that were observed during the survey included whip spiders (Order Amblypygi), harvestmen (Order Opiliones), pseudoscorpiones (Order Pseudoscorpiones) and solifuges (Order Solifugae).

## RECOMMENDATIONS

The following standard mitigatory measures are recommended for this site. These recommendations are important because the proposed development alignment traverses a Critical Biodiversity Area (CBA 1), an Endangered vegetation type (Marikana Thornveld), an Important Birding Area (IBA) and two vegetation units that have high conservation value. Uncontrolled development in and around these vegetation units is expected to impact significantly on their associated Red Data species, populations, assemblages or communities. The sensitive habitats include:

### Vegetation unit 1

Marikana Thornveld

**Reasoning:** Despite degradation through livestock farming practices, this vegetation unit has moderate species richness and remains in a relatively natural condition. Marikana Thornveld is an endangered vegetation type with less than 1% statutorily conserved.

**Conservation value:** High

### Vegetation unit 2

Drainage line

**Reasoning:** This unit plays an important ecological role in the channelling of water.

**Conservation value:** High

### General mitigation measures

Portions of the survey area are ecologically degraded. The landowner needs to take steps to remove all the alien invasive plant species and employ further restrictions and control, as specified by CARA Regulations. An ecological management plan must be generated by a suitably qualified specialist for implementation by the appropriate management authority. This ecological management must include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and exotic species such as *Melia azedarach*, *Tagetes minuta*, *Bidens pilosa*, *Xanthium strumarium*, *Ricinus communis*, *Opuntia ficus-indica* and *Tecoma stans*. Where removal of alien species may leave soil exposed, alternative indigenous species should be established to prevent any erosion. Plants growing naturally in the proposed development areas should, as far as possible, be retained and incorporated into landscaping. This should include specimens of *Sclerocarya birrea* and *Berchemia zeyheri* that were observed in low densities in vegetation unit 1. When additional plant species are used for landscaping, special emphasis should be focused on forage and host plants required by herbivores and pollinators present in the area and must otherwise only be limited to those indigenous to South Africa (Refer to Table 13.). The integrity of natural vegetation that falls outside developed areas should be preserved through the development of the proposed university accommodation.

Construction activities must be restricted and carefully monitored to keep disturbance to a minimum, and must be appropriately rehabilitated and managed. This entails the removal and proper disposal of



all rubble and litter from the proposed cemetery site. All scrap materials, building rubble and rubbish accumulated during construction should be relocated to official municipal dumping grounds. Dumping of any materials in undeveloped open areas should not be allowed and this must be actively managed. Construction must preferably take place during the dry season. Temporary housing, temporary ablutions and the storing of equipment should be administered in such a manner that natural habitat is subject to as little disturbance as possible during the construction phase. A concerted effort should be made to limit construction-related impacts to natural habitat.

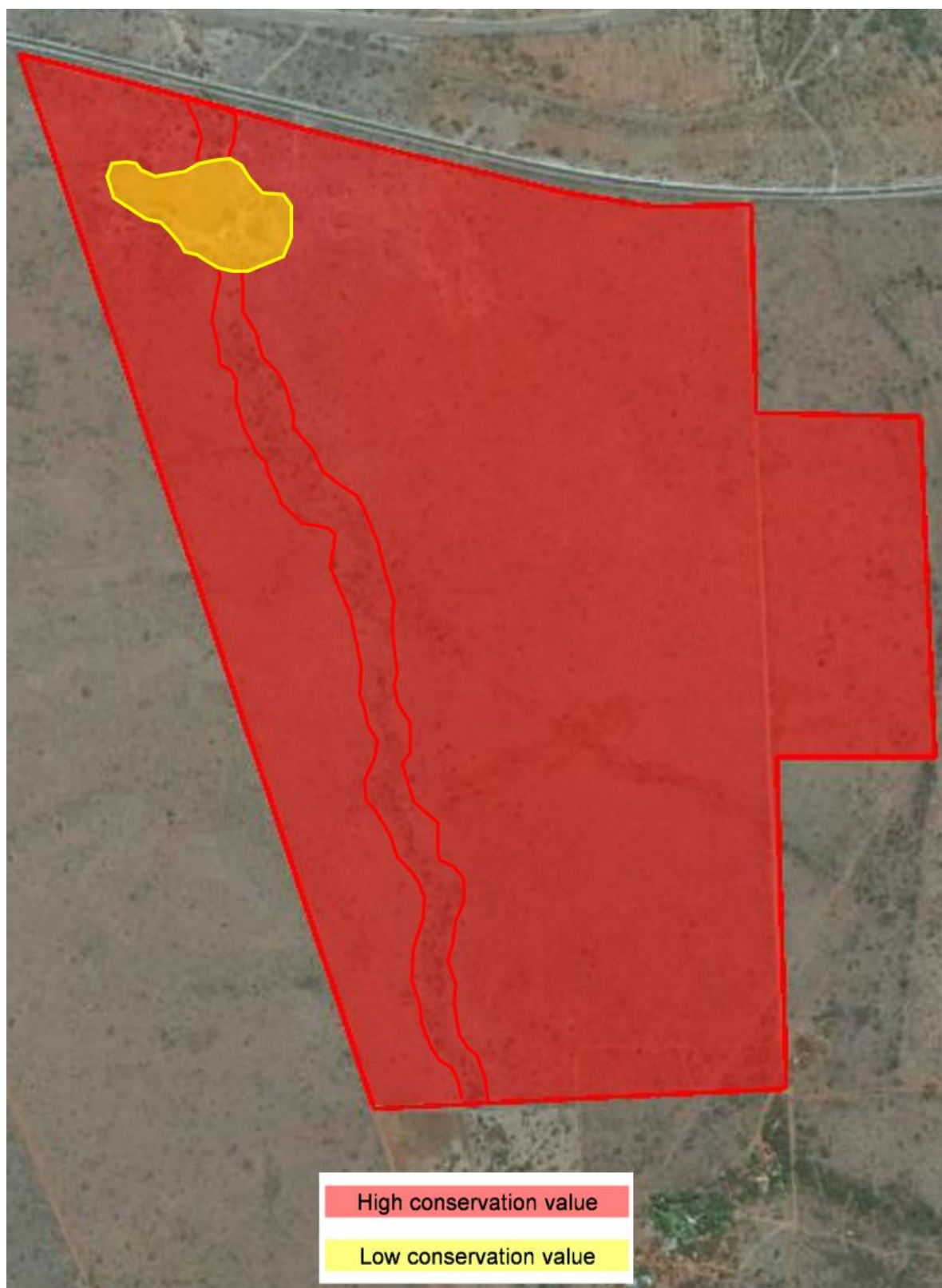
Table 13. List of plants and shrubs are recommended for butterflies (nectar plants).

<i>Pentas lanceolata</i> and <i>Pentas lanceolata</i>
<i>Buddleja salvifolia</i>
<i>Verbena</i> spp.
<i>Asclepias</i> spp.
<i>Bougainvillea</i> spp. (Varieties such as Killie Campbell)
<i>Plumbago auriculata</i>
<i>Impatiens</i> spp.
<i>Kalanchoe</i> spp.
<i>Lobelia</i> species
<i>Limonium</i> spp.
<i>Asystasia gangetica</i>

It is imperative that adequate erosion preventative mechanisms are implemented throughout the construction phase. Erosion resulting from the development should be appropriately rehabilitated preventing further habitat deterioration. Stormwater runoff must be correctly managed during all phases of the development. Special care needs to be taken during the construction phase to prevent surface stormwater containing sediments and other pollutants from the onsite drainage lines and wetland. A surface runoff and stormwater management plan must be put in place. The total sealing of walkways, pavements, drive ways and parking lots should not be permitted in the free space system. These should form part of and be contained within the areas earmarked for development. This would aid in the minimising of artificially generated surface stormwater runoff.

The use of insecticides, herbicides and other chemicals should not be permitted within 200m of an open space system. An integrated pest management programme, where the use of chemicals is considered as a last option, should be employed. However, if chemicals are used to clear invasive vegetation and weedy species or for the control of invertebrate pests, species-specific chemicals should be applied and in the recommended dosages. General spraying should be prohibited and the application of chemicals as part of a control programme should not be permitted to take place on windy days.

Outside lighting should be designed to minimize impacts, both directly on especially rare or endangered invertebrate species and indirectly by impacts on populations of prey species. All outside lighting should be directed away from sensitive areas. The drainage line (unit 2) should be subject to as little disturbance as possible. This drainage line forms part of the Crocodile River catchment but the gravel pit (unit 3) blocks the drainage line from delivering storm water into this catchment. An attempt should be made to refill unit 3 so that the ecological function of unit 2 can be restored.



**Figure 8.** Sensitivity map of the study area.

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