PRELIMINARY ECOLOGICAL SURVEY FOR THE MZINTI ABATTOIR & FEEDING LOT; MPUMALANGA PROVINCE

PREPARED for Royal HaskoningDHV BY:
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Declaration of Independence

I Clayton Lance Cook declare that I have been appointed as an independent consulting ecologist with no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2010. I have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. Remuneration for our services by the proponent is not linked to approval by any decision-making authority responsible for authorising this development.

C.L. Cook *28th of May 2015*

DETAILS OF SPECIALIST

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Appointment of specialist

Clayton Cook was commissioned by Royal HaskoningDHV to provide specialist consulting services for the Environmental Impact Assessment for the proposed Mzinti abattoir and feeding in Mpumalanga Province. The consulting services comprise a description of dominant vegetation and associated faunal component on the site and an assessment of the potential for threatened plant and animal species likely to occur on site.

Summary of expertise

Clayton Cook:

- Registered professional member of The South African Council for Natural Scientific Professions (Zoological Science), registration number 400084/04.
- Ecological and Specialist Faunal/Herpetological consultant since 1997.
- Conducted over 150 preliminary faunal surveys and over 50 specialist surveys as a faunal consultant.
- Regional Organiser for Gauteng Province for the South African Frog Atlas Project 1999-2003.
- Published a scientific paper on *Pyxicephalus adspersus*, 8 scientific conference presentations, co-wrote the species accounts for the genus *Pyxicephalus* for the Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland South African as well as W.R.C Report No. 1258/1/06 on "A Biophysical framework for The Sustainable Management Of Wetlands In Limpopo Province With Nylsvley as a Reference Model".
- Attended 5 national and international herpetological congresses & 1 expert workshop, 6 Zoological Conferences as well as 4 South African Aquatic Sciences conferences lectured zoology and botanical science at University of Limpopo (2001-2004).
- Participant and author in the State of the Rivers project for the upper reaches of the Letaba River System
- Participant in the EWT Giant Bullfrog species survival programme as well as African Grass Owl Workshops.
- Lead Researcher of a 3 year W.R.C. project on the distribution and status of frog species in the Kruger National Park (2009-2012).

Scope and purpose of report

The scope and purpose of the report are reflected in the "Terms of reference" section of this report below.

Terms of Reference

Clayton Cook was commissioned by Royal HaskoningDHV to provide specialist consulting services for the Environmental Impact Assessment for the existing Mzinti abattoir and proposed new feeding lot (henceforth called the Mzinti site). The consulting services comprise a description of dominant vegetation and associated faunal component on the site and an assessment of the potential for threatened plant and animal species likely to occur on the Mzinti site.

1. INTRODUCTION

The existing Mzinti red meat abattoir and proposed feeding lot site is situated to the east of Mzinti approximately 28 km to the south of Malelane within the eastern boundary of Mpumalanga Province (see Figure 1 Locality Map). The Mzinti abattoir and feeding lot site is bordered by the non-perennial Mnywane River and approximately 1km to the north of the Mzinti River. The proposed project involves the establishment of a feeding lot adjacent to the existing Mzinti red meat abattoir. The vegetation unit on which the Mzinti abattoir and feeding lot site is situated is **Granite Lowveld (SVI 3)** (Mucina & Rutherford 2006) previously classified as **Arid Lowveld (VT 11)** and **Lowveld** (VT 10) (Acocks 1953) and **Mixed Lowveld Bushveld** (Low & Rebelo 1996). The vegetation of the site consists mainly of mixed *Terminalia sericea*, *Combretum zeyheri* and *Combretum apiculatum* woodlands in various stages of transformation and degradation. Transformed areas include the existing abattoir site and access roads, residential property, bush encroached and cleared areas including the clearance of shrubs and trees under the Eskom servitudes. The natural hydrological pattern of the non-perennial Mnywane River has been disrupted by the existing Tonga primary access road and secondary access roads and the artificially embanking of the river above a concrete weir. The remaining open and closed mixed bushveld as well as the wooded riparian zone of the Mnywane River provide favourable habitat to several animal species (especially avifauna/birds).

It must be stressed that no comprehensive vegetation or faunal surveys of animal species occurring on the site were conducted but merely an assessment of available and specialised habitat. By surveying the site for specialised habitats, as well as the remaining vegetation and specific habitats, one can make an assumption of the possible presence or absence of threatened plant and animal species. In order to ascertain actual species lists more intensive surveys are required over several seasons. The vegetation and faunal survey was heavily supplemented by literature investigations; personal records and previous surveys conducted in similar habitats in the Malelane-Hectorspruit area as well as amphibian surveys conducted in the Kruger National Park (2009-2012).

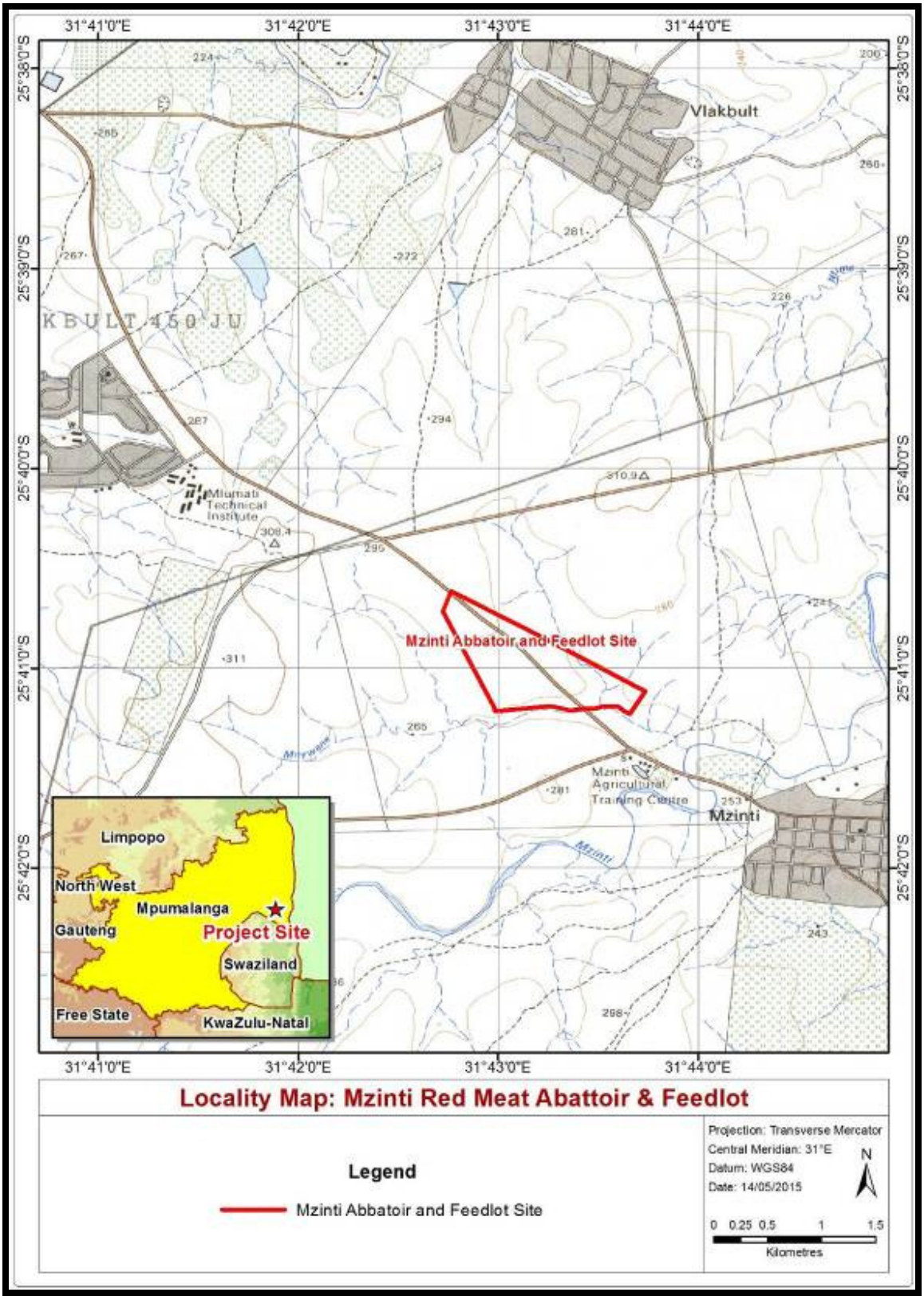

Figure1. Locality map of the Mzinti red meat abattoir and feeding lot site.

1.1 Objectives of the preliminary ecological survey/ habitat assessment

- To provide a description of the dominant vegetation and fauna occurring in the proposed Mzinti abattoir and feeding lot site.
- To provide a description of threatened plant and animal (mammals, birds, reptiles and amphibians) occurring or likely to occur on the proposed Mzinti abattoir and feeding site.
- To describe the available habitats on site including areas of important conservation value or areas most likely to form important habitat for remaining threatened plant and animal species.
- To determine potential impacts of the proposed feeding lot on the vegetation and associated fauna.
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed feeding lot site.

1.2 Scope of study

- A preliminary vegetation and faunal survey recording dominant vegetation and sightings and/or evidence of existing fauna.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened plant and animal species (Red Data Species), within the proposed site and adjacent areas.
- Literature investigations with which to augment field data were necessary.
- Identification of potential ecological impacts that could occur as a result of the feeding lot and assess the significance of these, where possible.
- Investigate feasible and practical management recommendations that should be implemented to reduce or minimize the impacts, should the project be approved.
- Documentation of the findings of the study in a report.

2. METHODOLOGY

2.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure on and around the proposed site. This was used as far as possible in order to identify potential "hot-spots" or specialised habitats e.g. Patches of undisturbed mixed bushveld vegetation, Mnywane & Mziniti Rivers, drainage lines and agricultural areas. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and current land use. Aerial photographs were utilised for the sensitivity mapping using Arcview 9.2

2.2 Literature Survey

The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009) or protected species as listed under the Mpumalanga Nature Conservation Act (MNCA) (No. 10 of 1998), National Forests Act (NFA) (No. 30 of 1998) or the National Environmental Management: Biodiversity Act 'Threatened or Protected Species' (NEMBA ToPS) (No. 10 of 2004) as well as internet using POSA (http://posa.sanbi.org accessed on the 21st March 2015). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) as well as ADU's MammalMap (http://vmus.adu.org.za/vm_sp_list.php accessed on the 21st of March 2015) for mammals. Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). 2005. *Roberts- Birds of Southern Africa VIIth ed*. And BARNES, K.N. (ed.) (2000) *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* for avifauna (birds) as well as internet SABAP2 pentad 2540_3140 (http://sabap2.adu.org.za accessed on the 21st March 2015). The *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians as well as SAFAP FrogMap (http://vmus.adu.org.za accessed on the 21st March 2015) The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) as well as SARCA (http://sarca.adu.org.za accessed on the 21st March 2015) for reptiles.

2.3 Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority faunal species likely to occur in the proposed development site .as well as potential threats was conducted. For certain species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. For other species little of this information was readily available and conservation targets remain speculative. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

Three general habitat sensitivity scans were carried out during daylight hours (09h00-17h00) between the 27th -29th of April 2015. The site visit did not entail intensive surveying or utilisation of any specific sampling methods and can rather be viewed as being an opportunity to identify sensitive faunal habitats occurring on the proposed site. A single nocturnal survey was conducted on the evening of the 29th of April 2015.

2.4 Uncertainties in predicting results

- Limitation to a single season or base-line ecological survey for only 3 day3 (20 hours) during the late summer early autumn months (April 2015). Observations of plant species flowering during the alter summer months only. It is possible that plants which flower at other times of the year are underrepresented.
- Due to rank grasslands (>2m) and heavily bush-encroached areas visibility and access was severely restricted and certain species may have been overlooked.
- The majority of threatened faunal species are seasonal only emerging after sufficient early heavy summer rainfalls between October and December. Precipitation (14mm) occurred during the site visit in April.
- The majority of threatened faunal species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years.
- Limitation of historic data and available databases. Insufficient knowledge on detailed habitat requirements (migratory, foraging and breeding) of the majority of threatened species.
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records and previous surveys conducted in similar habitats between1995-2015).

3. VEGETATION

3.1 GRANITE LOWVELD (SVI 3)

The vegetation unit of the site is **Granite Lowveld (SVI 3)** (Mucina & Rutherford 2006) previously classified as Arid Lowveld (VT 11) and Lowveld (VT 10) (Acocks 1953) and Mixed Lowveld Bushveld (Low & Rebelo 1996). The vegetation of the site consists mainly of mixed *Terminalia sericea*, *Combretum zeyheri* and *Combretum apiculatum* woodlands in various stages of transformation and degradation. Sections have been cleared including the exiting residential erven, abattoir, access roads, Eskom servitudes as well as open grazing areas. Bush encroachment by *Terminalia serricea*, *Dichrostachys cinerea* and various small *Vachelia* species; occurs in disturbed areas

Distribution:

Granite Lowveld (SVI 3) occurs in Limpopo and Mpumalanga Provinces, Swaziland and marginally into Kwazulu-Natal. A north-south belt on the plains east of the escarpment from Thohoyandou in the north, interrupted in the Bolobedu area, continued in the Bivati area, with an eastward extension on the plains around the Murchison Range and southwards to Abel Erasmus Pass, Mica and Hoedspruit areas to the east of Bushbuckridge. Substantial parts are found in the Kruger National Park spanning areas to the east of Orpen Camp southwards through Skukuza and Mkuhlu, including undulating terrain west of Skukuza to the basin of the Mbyamiti River. It continues further southward to the Hectorspruit area with a narrow westward extension up the Crocodile River Valley past Malelane, Kaapmuiden and the Kaap River Valley, entering Swaziland between Jeppe's Reef in the west and the Komati River in the east, through the area between Manzini and Siphofaneni; including the Grand Valley, narrowing irregularly and marginally entering Kwazulu-Natal near Pongola (Mucina *et al.* 2006).

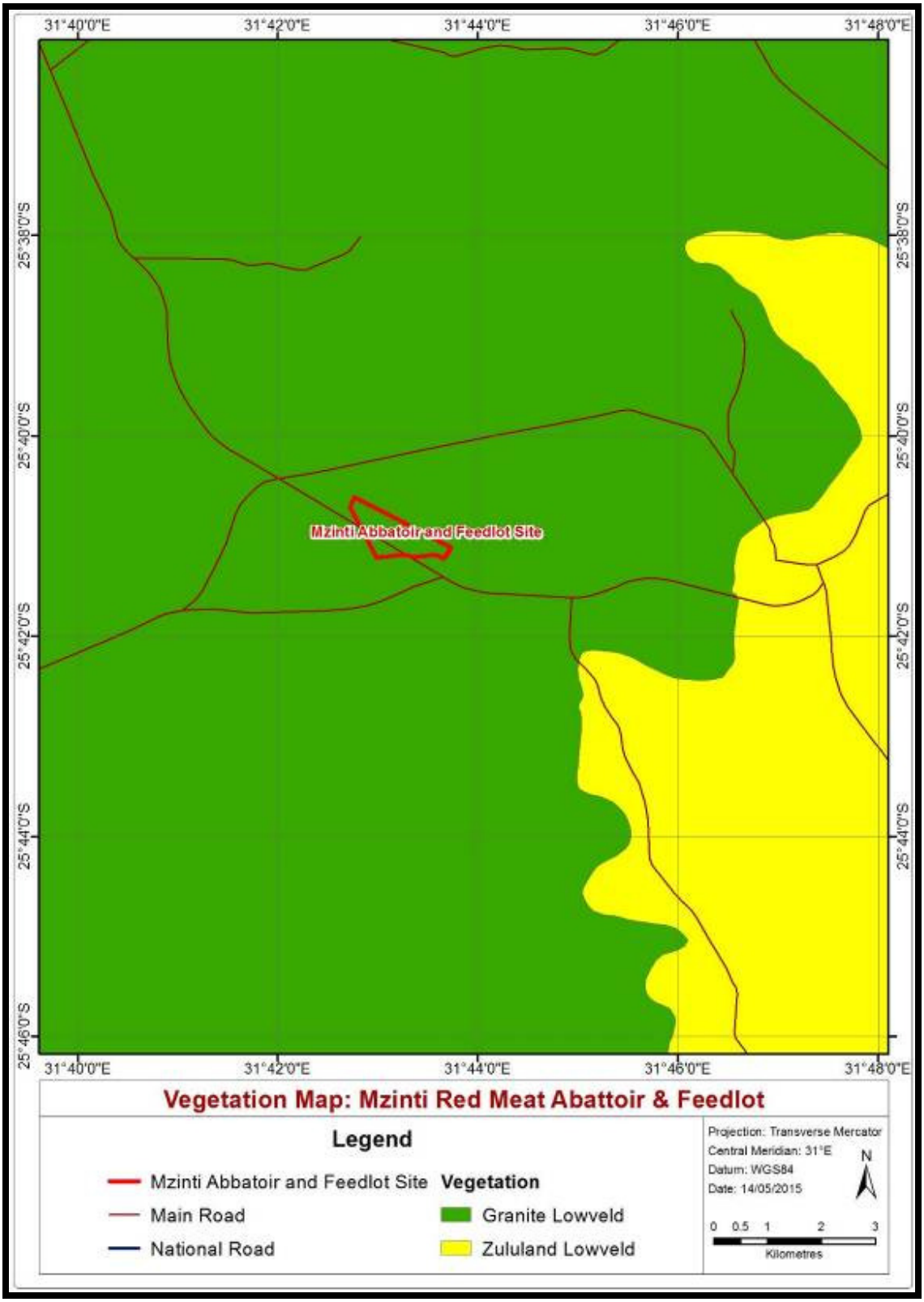

Figure2. Vegetation map for the Mzinti red meat abattoir and feeding lot site.

Vegetation & Landscape Features

Tall shrubland with few trees to moderately dense low woodland on the deep sandy uplands with *Terminalia sericea*, *Combretum zeyheri* and *Combretum apiculatum* and the ground layer including *Pogonarthia squarrosa, Tricholaena monache* and *Eragrostis rigidior*. Dense thicket to open savanna in the bottomlands with *Senegali* (*Acacia) nigrescens, Dichrostachys cinerea, Grewia bicolor* in the woody layer. The dense herbaceous layer contains the dominant *Digitaria eriantha, Panicum maximum* and *Aristida congesta* on fine-textured soils, while brackish bottomlands support *Sporobolus nitens, Urochloa mosambicensis* and *Chloris virgata*. At seep lines, where convex topography changes to concave, a dense fringe of *Terminalia sericea* occurs, with *Eragrostis gummiflua* in the undergrowth (Mucina *et al.* 2006).

General observations applicable across the vegetation of the entire site are as follows:

- The mixed open and closed woodland areas were defined using the occurrence of *Combretum zeyheri, Combretum apiculatum Combretum herorense, Sclerocarya birrea, Vachelia nilotica, Senegali nigescens, Vachelia sieberiana var. woodii, Vachelia karroo,* Vachelia *caffra*, *Combretum apiculatum*, *Combretum imberbe*, *Ziziphus mucronata*, *Strychnos madagascariensis, Euphorbia ingens, Aloe marlothii, Peltophorum africanum, Schotia brachypetala, Spirostachys africana, Gymnosporia heterophylla* and *Dombeya rotundifolia*.
- Evidence of bush-encroachment in certain sections of the site by *Terminalia serricea, Dichrostachys cinerea* and *Vachelia erubescens* as a result of overgrazing by cattle as well as altered fire regime.
- The protected and red listed 'Declining'[*] Cape Poison Bulb (*Boophane disticha*) and River Lily (*Crinum macowanii*) were observed on the site.
- Weed and alien invader floral species where observed on site where both medium-low in diversity and abundance.
- Basal cover was moderate to high throughout the property which would indicate that utilisation for grazing occurs at medium- low intensity;
- Forb species diversity was moderate to low throughout the property due to current utilisation of the property for cattle grazing activities;
- Developed portions (abattoir, houses, access roads) of the property including an existing Eskom powerline servitude showed the most sign of transformation from the natural state with more weed and invaders evident.

[*] A taxon is 'Declining' when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

Geology & Soils

From the north to south the Swazian Goudplaats Gneiss, Makhutswi Gneiss and Nelspruit Suite (granite gneiss and migmatite), and further south still, the younger Mpuluzi Granite (Randian) form the major basement geology of the area. Archaen granite and gneiss weather into sandy soils in the uplands and clayey soils with high sodium content in the lowlands. The underlying geology around Hectorspruit is poorly exposed and consists of the lowermost greenstone formations of the Barberton Supergroup, known as the Onverwacht Group with the mountains to the south being the eastern end of the Barberton Mountain Land. There are few outcrops close to the road but some road cuttings reveal dark ultramafic schists and greenstones. Near Hectorspruit are the bare granite boulders of the Salisbury Kop pluton[1] (Norman and Whitfield 2006). Erosion is very low to moderate (Mucina *et al.* 2006). Cleared areas on the site showed evidence of sheet or surface erosion especially around livestock pathways and drinking points. The embankments of the Mnywane River are eroded due to alteration in the hydrological regimes as well as livestock drinking, grazing and trampling activities. Rill eroded channels were observed along the informal access roads in the area.

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Climate

Summer rainfall area with dry winters. Mean Annual Precipitation from about 450 mm on the eastern flats to around 900 mm near the escarpment in the west. In a north-south direction MAP of the unit appears to peak in Swaziland. MAP for the entire vegetation unit is around 633 mm. Generally a frost-free region. Mean monthly maximum and minimum temperatures for Skukuza are 39.5°C and 0.1°C for January and June respectively with a Mean Annual Temperature (MAT) around 20.9°C.

CONSERVATION

This vegetation unit is currently considered as **Vulnerable**. The conservation target is 19%, with 17% formally protected within the Kruger National Park and approximately 17% conserved in private reserves mainly in the Selati, Klaserie, Timbavati, Mala Mala, Sabi Sand and Manyeleti Reserves. More than 20% already transformed, mainly be cultivation and by settlement development (Mucina & Rutherford 2006)

[1] Discrete, usually granite intrusions of generally rounded shape and relatively limited size that form from a larger, deeper granitic magma (Norman and Whitfield 2006).

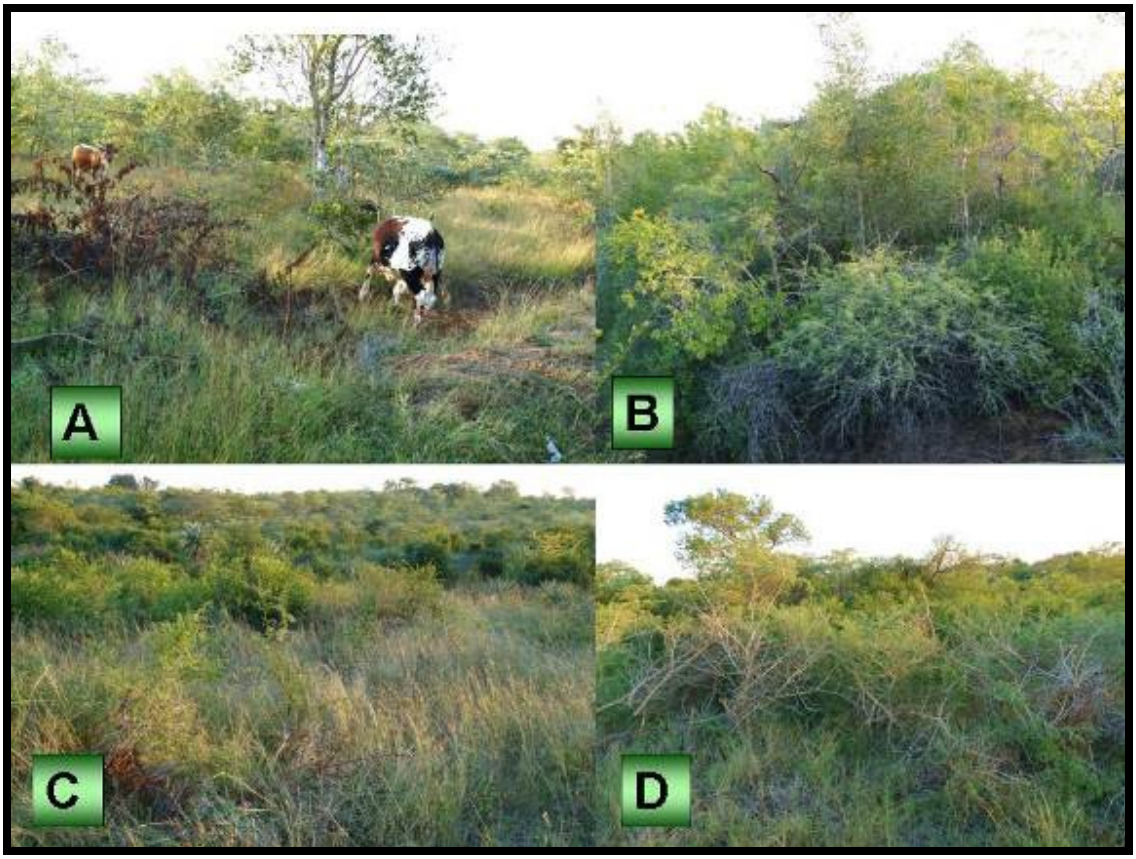

Figure3. A collage of photographs displaying the Granite Lowveld vegetation observed on the site. A: The site is currently utilised for limited livestock grazing activities. Historic and current vegetation clearance for increased grazing areas and access for livestock throughout the site. **B:** Dense closed woodland occurs along the Mnywane River and the southern portions of the site. **C:** Historic and current vegetation clearance occurs in the central and northern sections of the site. Clearance of woody tree and shrub layer within the Eskom powerlines/servitudes. **D:** Bush encroachment occurs in the overgrazed and disturbed areas with dense thickets of *Terminalia serircea, Dichrostrachys cinerea* as well as *Vachelia erubescens.*

Figure4. A collage of photographs displaying the transformed Granite Lowveld vegetation observed on the site. A: The Mzinti red meat abattoir occurs in the central portion of the site. The majority of vegetation has been completely transformed except for a few large Marula *Sclerocarya birrea* subsp. *caffra* around the buildings. **B:** The mixed bushveld vegetation has been historically cleared in the northern and central portions of the site as well as surrounding the site. Existing homesteads occur outside the southern boundary of the site. **C:** Historic and current vegetation clearance occurs in the central and northern sections of the site. Clearance of tree and shrub layer under the current Eskom powerlines/servitude. **D:** Bush encroachment occurs in disturbed areas with dense thickets of *Terminalia serircea* as well as *Vachelia erubescens.* Evidence of bush clearing activities as well as previous wood harvesting activities on the site.

3.2 DOMINANT VEGETATION OBSERVED ON SITE

Vegetation Type	Granite Lowveld (SVI 3)	**Tree cover**	40-80 %
Soil	Light brown sandy soils as well as sandy-loams	**Shrub cover**	5-20 %
Topography	Undulating Plain	**Herb cover**	0-10 %
Land use	Vacant (Cattle Grazing and Mzinti abattoir)	**Grass cover**	40-90 %
Dominant Tree spp.	*Senegali (Acacia) nigrescens, Vachelia (Acacia) karroo, Vachelia siberana var. woodii, Combretum heroense, Combretum apiculatum* subsp *apiculatum, Combretum imberbe, Combretum zeyheri,* , *Dombeya rotundifolia, Seasrsia* (*Rhus*) *pyroides, Schotia brachypetala, Spirostachys africana, Strychnos madagascariensis, Aloe marlothii subsp. marlothii, Euphorbia ingens, Gymnosporia heterophylla, Petophorum africanum, Gymnosporia glaucophylla, Philoneoptera violacea, Sclerocarya birrea, Terminalia sericea, Terminalia prunoides*.		
Dominant Shrub Species	*Vachelia erubsecens, Vachelia exuvialis, Strychnos madagascariensis, Dichrostachys cinerea, Euclea divinorum, Grewia bicolor, Grewia monticola, Maytenus heterophyllum, Euclea cripsa subsp. crispa, Ehretia rigida subsp. rigida, Searsia (Rhus) pyroides var. pyroides, Tephrosia poystachya*		

Dominant Grasses	*Pogonarthia squarrosa, Digitaria eriantha, Eragrostis rigidor, Sporobolus nites, Eragrostis gummiflua, Chloris virgata, Urochloa mosambicensis, Hyparrhenia hirta, Eragrostis lehmanniana, Setaria sphacelata, Panicum maximum, Setaria sphacelata, Melinis repens, Melinis nerviglumis, Aristida congesta*, *Heteropogon contortus Aristida scabrivalvis, Heteropogon contortus., Cynodon dactylon. Microchloa caffra. Hyperthelia dissoluta*
Dominant Herb Species	*Boophane disticha, Sansevieria aetheopica, Crinum macowanii, Aloe parvibracteata, Aloe komatiensis*
Alien Invasive Species	*Argemone ochroleuca* subsp. *ochroleuca*, Solanum sisymbrifolium*, Ipomoea alba*, Ipomoea indica*, Ipomoea purpurea*, Lantana camara*, Ricinus communis*, Solanum mauritianum*,* *

Dominant tree species recorded within the open and closed woodland unit included *Senegali nigrescens, Senegali caffra, Vachelia karroo, Vachelia Acacia tortilis, Combretum heroense, Combretum apiculatum* subsp *apiculatum, Combretum imberbe, Combretum zeyheri, Dombeya rotundifolia, Searsia* (*Rhus*) *pyroides, Gymnosporia heterophylla, Petophorum africanum, Gymnosporia glaucophylla, Philoneoptera violacea, Schotia brachypetala, Peltophorum africanum, Aloe marlothii Sclerocarya birrea subsp. caffra, Terminalia sericea, Terminalia prunoides*.

Shrubs species recorded within the open and closed woodland unit included *Abutilon austro-africanum*, *Bauhinia galpinii*, *Barleria elegans, Vachelia exuvialis, Vachelia erubescens, Strychnos madagascariensis, Dichrostachys cinerea, Euclea divinorum, Grewia bicolour, Combretum herorense, Maytenus heterophyllam, Euclea divinoruim, , Searsia (Rhus) pyroides var. pyroides, Tephrosia poystachya, Asparagus cooperi.*

Several geophytic herbs including *Ornithogalum tenuifloium* and the red listed 'Declining' *Boophane disticha and* River Lily *Crinum macowanii* were recorded. The **perennial herb** *Sansevieria aetheopica* was dominant under the shade of the *Vachelia* and *Senegali* trees. Several *Aloe parvibracteata* were observed in the trampled areas on the site.

Gramminoids (Grasses) included *Hyparrhenia hirta, Pogonarthia squarrosa, Digitaria eriantha, Eragrostis rigidor, Chloris virgata, Urochloa mosambicensis,, Eragrostis lehmanniana, Setaria sphacelata, Panicum maximum, Erogrostis rigidior, Pogonarthria squarrosa, Hyparrhenia hirta, Setaria sphacelata, Melinis repens, Melinis nerviglumis, Aristida congesta*, *Heteropogon contortus Aristida scabrivalvis, Heteropogon contortus, Cynodon dactylon. Microchloa caffra. Hyperthelia dissoluta.*

* alien invasive vegetation

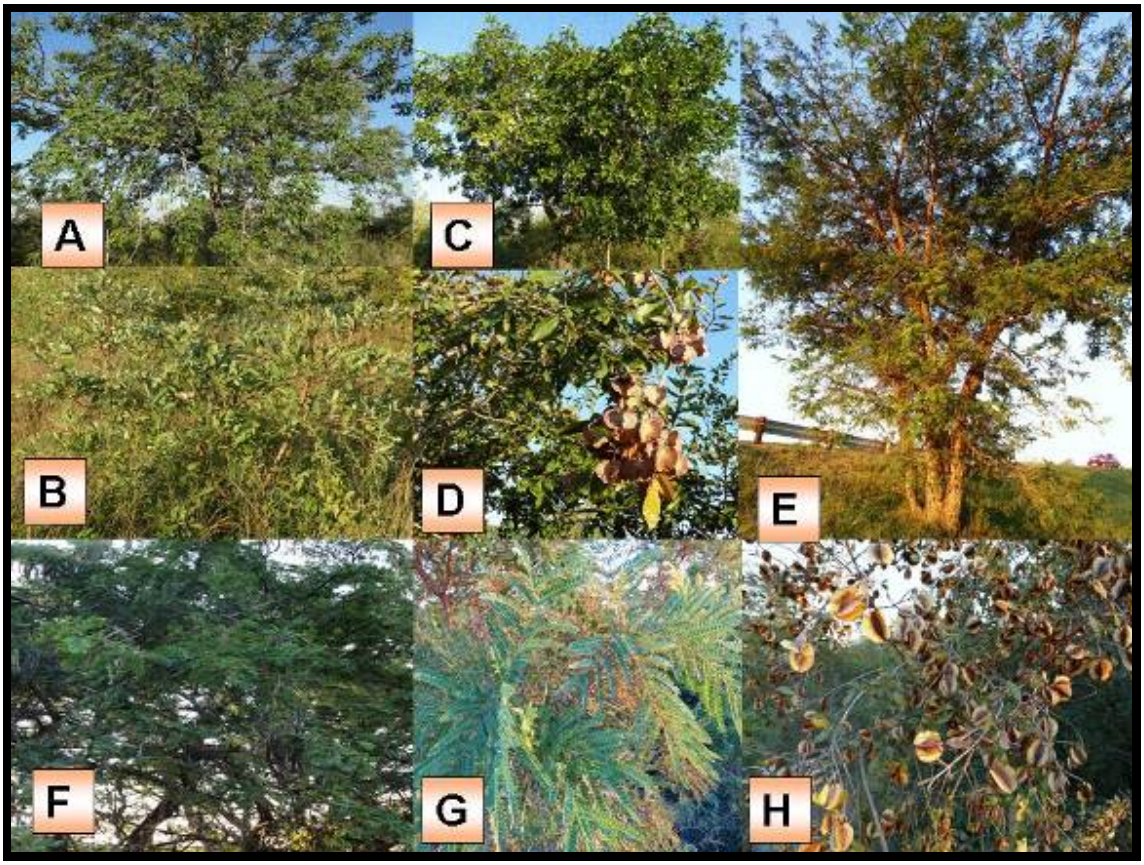

Figure5. A conglomerate of photographs displaying the dominant tree species observed on the site: A: Marula (*Sclerocarya birrea* subsp. *caffra*); **B:** Silver Cluster-Leaf (*Terminalia serricea*); **C:** Weeping Boer-Bean (*Schotia brachypetala)*; **D:** Large-fruited Bushwillow (*Combretum zeyheri*); **E:** Paper-Bark Thorn *(Vachelia sieberiana* var. *woodii*); **F:** Scented-Pod Thorn (*Vachelia nilotica*); **G:** African-Wattle (*Peltophorum africanum*) and **H:** Russet Bushwillow (*Combretum heroense*).

Dominant tree species recorded along the non-perennial Mnywane River included Cluster Fig *Ficus sycamorus*, Marula *Sclerocarya birrea*, Knob Thorn *Senegali nigrescens*, Narrowpod Robust Thorn *Vachelia robusta* subsp. *clavigera*, Tambotie *Spirostachys africana*, Jackal Berry *Diospyros mespiliformis*, Black Monkey Orange *Strychnos madagascariensis*, Camel Foot *Piliostigma thonningii,* Wild Cluster-apple *Annona senegalensis*, Tassel-berry *Antidesma venosum*, Natal Mahogany *Trichelia emetica*, Silver Cluster-Leaf *Terminalia sericea,* Apple Leaf *Lonchocarpus capassa*, Weeping Wattle *Peltophorum africanum*, Weeping Boer-bean *Schotia brachypetala*, Russet Bushwillow *Combretum hereroense*, Large-fruited Bushwillow *Combretum zeyheri*, Red Bushwillow *Combretum apiculatum*, Weeping Collina Bushwillow *Combretum collinum*.

The **shrub layer** commonly contains Silver Cluster-Leaf *Terminalia serricea*, Lowveld Cluster-Leaf *Terminalia prunioides,* Sickle Bush *Dichrostachys cinerea*, Flaky Thorn *Vachelia exuvialis,* Scented Thorn, *Vachelia nilotica*, Buffalo Thorn *Ziziphus mucronata*, Magic Guarri *Euclea divinorum,* Red Spikethorn *Maytenus senegalensis* and Common Spikethorn *Gymnosporia buxifolia*.

The **grass layer** is moderately developed and species such as *Cynodon dactylon, Panicum coloratum*, *Digitaria eriantha*, *Botriochloa radicans*, *Pogonarthia squarrosa, Eragrostis rigidor, Sporobolus nites, Eragrostis gummiflua, Chloris virgata, Panicum maximum*, *Heteropogon contortus, Hyparrhenia filipendula*, *Cymbopogon excavatus, Hyperthelia dissoluta, Elionoris muticus*, and *Urochloa mosambicensis* are most conspicuous.

Forb layer comprises mostly of species indicative to a disturbed environment and included *Merremia tridentate, Dicerocaryum eriocarpum, Asclepias fruticosa, Solanum panduriforme, Commelina africana, Commelina erecta, Sida cordifolia, Ipomea crassipes, Hibiscus trionum, Schizoglossum cordifolium, Asclepias physocarpa, Turbina oblongata, Evolvulus alsinoides, Aptosimum procumbens, Pterodiscus speciosus, Harpagophytum procumbens, Blepharis subvolubilis, Barleria sp., Cucumis zeyheri, Cucumis metuliferus, Berkheya radula, Senecio coronatus, Senecio venosus, Senecio isatidioides, Vernonia hirsute, Ageratum houstonianum, Helichrysum caespititium, Helichrysum aureonitens, Senecio latifolius, Stomatanthes africanus, Geigeria burkei, Indigofera sanguinea, Indigofera* zeyheri and Tephrosia *grandiflora.*

3.3 PROTECTED TREE SPECIES

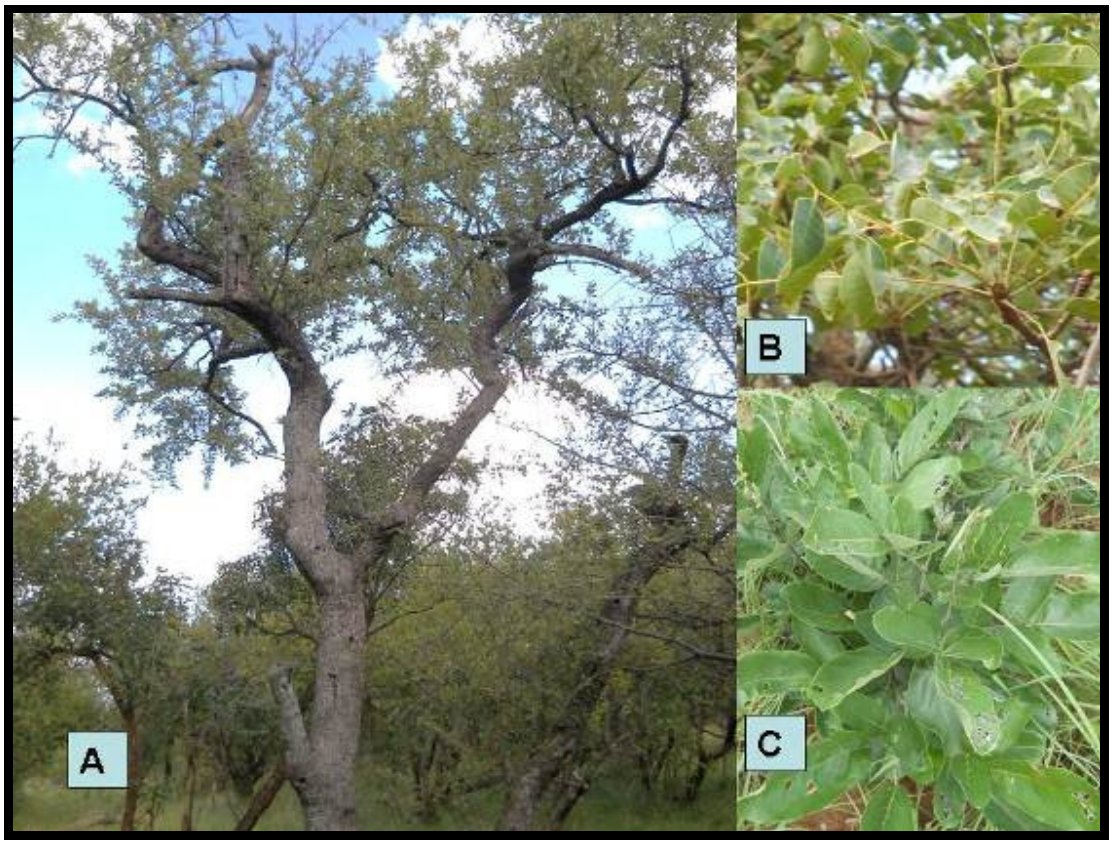

Figure6. A collage of photographs displaying the protected tree species observed on the site. A: Approximately 5 Leadwoods (*Combretum imberbe*) were observed on the site. **B:** Approximately 50 large Marula (*Sclerocarya birrea* subsp. *caffra*) were observed. **C:** Approximately 5 small Apple-Leaf (*Philenoptera violacea*) were observed.

In terms of the National Forests Act 1998 (Act No 84 of 1998) certain tree species can be identified and declared as protected. The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization.

Table1. List of Protected Trees (South African National Botanical Institute, 2007) within the 1/ 4 degree grid 2531 CC

SCIENTIFIC NAME	FAMILY	COMMON NAME	RECORDED SPECIES
Breonadia salicina	Rubiaceae	Matumi	No specimens observed it's a facultative riparian (riverine) species
Elaeodendron transvaalensis	Celastraceae	Bushveld saffron	No specimens observed
Combretum Imberbe	Combretaceae	Leadwood	Approximately 2 specimens observed
Philenoptera violacea	Caesalpiniaceae	Apple-Leaf	Approximately 5 specimens observed
Pittosporum viridiflorum	Pittosporaceae	Cheesewood	No specimens observed
Pterocarpus angolensis	Ceasalpiniaceae	Wild teak	No specimens observed
Sclerocarya birrea subsp. *caffra*	Anacardiaceae	Marula	Confirmed on the site (~50)

The protected tree Apple-leaf (*Philenoptera violacea*) was observed along the Mnywane River. The wood is attractive, hard and dense and used for ornament carving. Leaves are browsed by the livestock and game. Roots and leaves used medicinally. Water excretions by the sap sucking nymphs of *Ptyleus grossus* (Hemiptera) cause the trees to 'rain' during certain times of the year. The butterflies *Charaxes bohemani* and *Coeliades forestan forestan* breed on the tree (Van Wyk & Van Wyk 2013).

Several (~50) protected Marula *Sclerocarya. birrea* ssp. *caffra* were observed in the open and closed woodland vegetation unit as well as scattered individuals around the Mzinti abattoir. Bark of *S. birrea* ssp. *caffra* is used to treat a variety of ailments, notably fever, boils and diarrhoea. Together with butter, it is applied as an ointment for headache and pains of the eyes. It is claimed that blood circulation is aided by a steam bath of extracts of *S. birrea* ssp. *caffra* mixed with extracts from other plants and roots. Steam from the bark is also used to treat eye disorders.

Bark decoction, when mixed with other medicinal plants, treats various infections such as malaria, syphilis, leprosy, hydropsy, dysentery, hepatitis and rheumatism, and is a laxative. It is also used internally and externally as a prophylactic against gangrenous rectitis. Leaves, bark and roots are used externally (as a rub) for snakebite, and internally (as a beverage) for toothache. It has occasionally been used in veterinary medicine. Other products: The tree is a host to the edible mopane caterpillar as well as large sturnid or emperor moth caterpillars (Van Wyk & Van Wyk 2013). The two protected tree Leadwood (*Combretum imberbe*) was observed within the closed woodland and adjacent to the Mnywane River.

The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any Marula *Sclerocarya. birrea* ssp. *caffra,* Leadwood (*Combretum imberbe*) and Apple-Leaf (*Philenoptera violacea*).

3.3 RED LISTED PLANT SPECIES

Figure7. Four Cape Poison Bulbs (*Boophone disticha*) was observed within the open woodland areas within the site.

Four red listed 'Declining' Cape Poison Bulbs (*Boophone disticha*) were observed within the Mzinti abattoir and feedlot site. They were observed within the open woodland vegetation unit. The extremely toxic bulb is used extensively throughout Africa for traditional medicine, and its medicinal uses have been extensively documented. It is very popular in the muthi markets and amongst urban and rural healers. The bulbs are usually very large and always present in the muthi markets. Cunningham (1988) recorded it in the KwaZulu-Natal muthi markets and classed its vulnerability to over-exploitation as 'indeterminate' - i.e. a species whose status is uncertain, but which appears to be heavily exploited and for which more data are required. *Boophone disticha* is presently listed as 'Declining' due its loss of habitat in KwaZulu-Natal and Gauteng and because the volumes traded in the market imply that harvesting is having an impact on the population. The species is, however, long lived and widely distributed. Population numbers on the site are expected to be low due to historic over-harvesting for traditional medicinal use.

Figure8. Two River Lilies (*Crinum cf. macowanii*) were observed within the riparian zone of the Mnywane River. This large, long-lived bulbous plant is common and widespread in eastern South Africa but populations are declining due to over-exploitation for the medicinal plant trade (Williams *et al*., 2008). This plant is classified as Declining (Raimondo *et al*., 2009).

3.4 ALIEN INVASIVE VEGETATION

Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983). CARA defines weeds as alien plants, with no known useful economic purpose that should be eradicated. Invader plants, also considered by the Act, can also be of alien origin but may serve useful purposes as ornamentals, as sources of timber, or may have other benefits (Henderson, 2001). These plants need to be managed and prevented from spreading.

Alien and invasive plant species can be grouped three categories:

- **Category 1** plants are weeds that serve no useful economic purpose and possess characteristics that are harmful to humans, animals or the environment. These plants need to be eradicated using the control methods stipulated in Regulation 15.D of the CARA.
- **Category 2** plants are plants that are useful for commercial plant production purposes but are proven plant invaders under uncontrolled conditions outside demarcated areas.
- **Category 3** plants are mainly used for ornamental purposes in demarcated areas but are proven plant invaders under uncontrolled conditions outside demarcated areas.

Alien invasive vegetation recorded on the site included *Melia azedarach, Solanum mauritianum, Ipomoea indica*, *Ipomoea purpurea*, *Ricinus communis, Senna didymobotrya, Opuntia ficus-indica, Lantanna camara.*

3.5 Land Degradation

The study area is located within an area where soil erosion is regarded as insignificant with large areas being ploughed for crop production. Grazing by cattle has also had a significant effect on remaining grassland areas with heavy and mild overgrazing leading to bush-encroachment and habitat degradation of the remaining mixed woodland vegetation. The non-perennial drainage lines which occur within the region however have been negatively affected by adjacent anthropogenic activities (sand mining, wood harvesting) as well as uncontrolled livestock grazing and trampling along the banks. The Granite Lowveld moderately open woodland has been completely transformed outside the southern boundary and heavily degraded within the adjacent south-western portions. The vegetation has been historically transformed into old agricultural lands, livestock enclosures, sports-fields and homesteads and heavily degraded due to illegal dumping activities, wood harvesting, alien invasive vegetation and frequent fires. The site comprises open and closed woodland in various stages of transformation and degradation. The closed woodland areas adjacent to the non-perennial Mnywane River are dominated by a more natural species composition. These are sensitive areas and have a high diversity of plant and animal species and are not suited for the proposed feeding lot site. The site contains transformed areas with low habitat diversity and ecosystem functioning; no viable populations of natural plants or representation of the natural vegetation. These areas include the existing Mzinti red meat abattoir, residential erven, roads as well as cleared areas and Eskom servitudes. These areas are suitable for the proposed feeding lot site.

4. RESULTS OF THE PRELIMINARY FAUNAL SURVEY OR HABITAT ASSESSMENT

The faunal survey focused on mammals, birds, reptiles and amphibians of the study area. The preliminary survey focused on the current status of threatened animal species occurring, or likely to occur within the study area, describing the available and sensitive habitats, identifying potential impacts resulting from the feeding-lot and providing mitigation measures for the identified impacts. Faunal surveys should ideally be conducted over extended periods during the summer rainy season between November and March. Faunal data was obtained during the 3 day and single night nocturnal survey of the site carried out on foot and vehicle. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. Birds were identified with the use of binoculars (10x50 Steiner Binoculars), Newman's Field Guide as well as by individual calls. Amphibians were identified by male vocalizations, visual observations of adults as well as sweep and dip-netting for juveniles (tadpoles). Reptiles were actively searched for and identified by actual specimens or observations of specimens. The data was supplemented by previous surveys conducted in the area, literature investigations, personal records and historic data.

4.1 MAMMALS

Mpumalanga is faunally diverse with approximately 163 mammal species consisting of 98 smaller and 64 larger species. It is the objective of Mpumalanga Parks Board (MPB) to conserve all of these species in situ. High mammalian species richness occurs in savannahs, which could be as a result of the wide variety of habitats available. In Mpumalanga Province, savanna areas with the availability of sufficient cover, karst areas, wetlands, pans and a well-managed mosaic of short and tall grassland, are habitats that significantly contribute towards the ecological requirements of certain mammal species. Certain species in Mpumalanga, towards which conservation efforts for habitat protection should be directed, have been identified. Priority species can be used to emphasise key habitats, which are of conservation concern. These species thus contribute towards identifying priority areas of conservation importance and in determining the conservation value of land. Anthropogenic land conversion and habitat degradation and fragmentation are major threats to the continued existence of endemic and threatened fauna in the province (Cohen & Gomacho 2002).

It must be stressed that no actual mammal survey or small mammal trapping was undertaken due to time constraints and the extreme limitations that the results from a single site survey conducted during the late summer months would pose. Instead fieldwork was augmented with previous surveys in similar habitats as well as published data. The entire Mzinti site was initially traversed on foot to ascertain the presence of available refuges. Random sampling was also conducted in the open and closed *Combretum* Woodland areas of the site and adjacent to the site and used for reference sites for the mammal species likely to occur in these areas. Refuges such as rank grassland, reed beds, burrows, loosely embedded rocks, trees and tree stumps were surveyed.

The settlements surrounding the Mzinti site and associated illegal hunting and poaching limits the suitability of these areas for larger mammal species. The collection or harvesting of wood (stumps) and rock material as well as the frequent burning of the vegetation reduces available refuge habitat an exposes remaining smaller terrestrial mammals to increased predation levels. The use of wire snares for high intensity poaching activities will significantly affect remaining smaller mammal species such as rabbits and mongooses. Secondary access roads and vehicles (motor cars, motor cycles, quad bikes) increase access to the open areas as well as potential road fatalities. Major road networks with high vehicular traffic increase the risk of road fatalities (hedgehogs, hares) of mammals. Smaller mammal species are extremely vulnerable to feral cats and dogs.

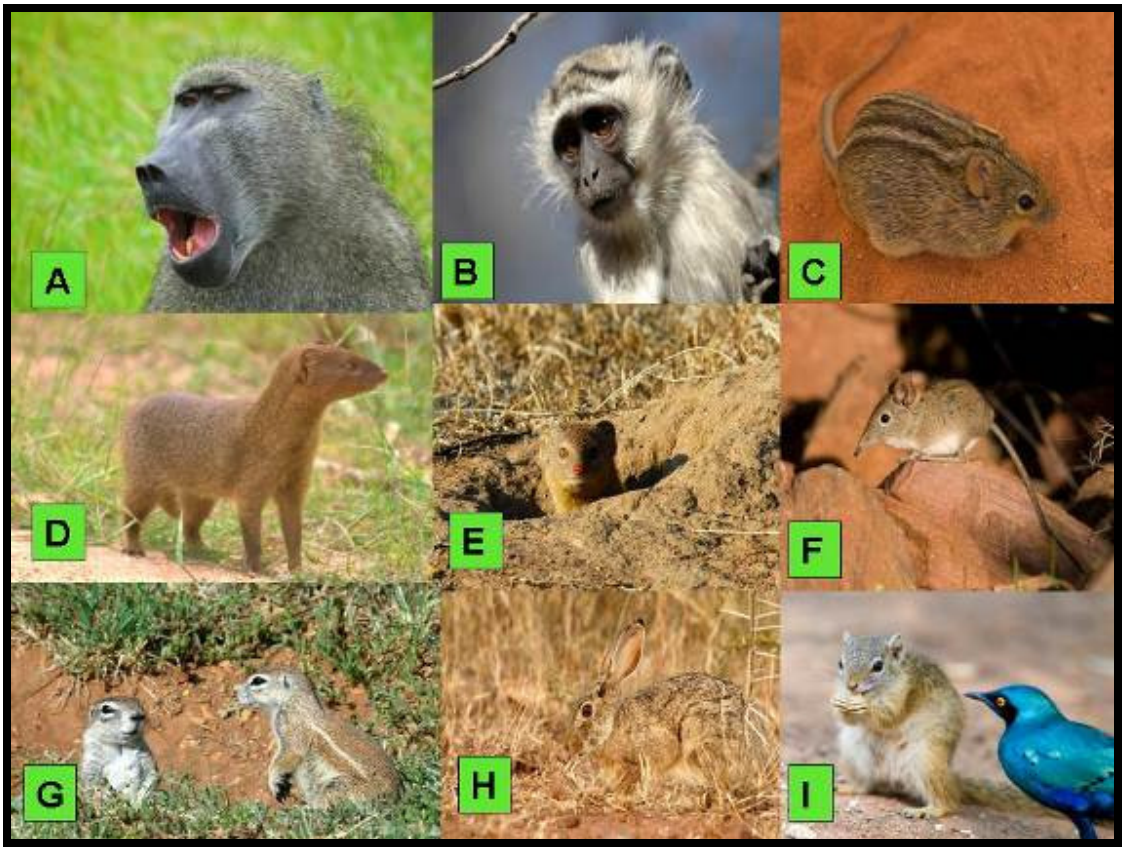

Figure9. A conglomerate of photographs displaying the mammal species recorded or likely to occur on the Mzinti site. A: Chacma Baboon (*Papio cynocephalus ursinus*); **B:** Vervet Monkey (*Ceropithecus aethiops*)*, **C**: Four-striped Grass Mouse (*Rhabdomys pumilio*)*; **D:** Slender Mongoose (*Galerella sanguinea*); **E:** Yellow Mongoose (*Cynictis penicillata*)*; **F:** Eastern Rock-elephant Shrew (*Elephantulus myurus*)*, **G:** Ground Squirrel *(Xerus inauris*)*, **H:** Savanna or Scrub Hare (*Lepus sextalis*)* and **I:** Tree Squirrel (*Paraxerus cepapi*)*.

* Photographs courtesy of Prof. G.D. Engelbrecht University of Limpopo

Table2. Mammal species recorded from the 2531CC QDGC according to MammalMap. Actual species lists for the site will most likely contain far fewer species due high levels of anthropogenic activities on and surrounding the site.

Family	Common name	Genus	Species	Subspecies	Red list category	Atlas region endemic
Bathyergidae	*Southern African Mole-rat	*Cryptomys*	*hottentotus*		Least Concern	Yes
Bovidae	Impala	*Aepyceros*	*melampus*		Least Concern	Yes
Bovidae	Hartebeest	*Alcelaphus*	*buselaphus*		Not listed	Yes
Bovidae	Red Duiker	*Cephalophus*	*natalensis*		Least Concern	Yes
Bovidae	Blue Wildebees	*Connochaetes*	*taurinus*	*taurinus*	Least Concern	
Bovidae	Blesbok	*Damaliscus*	*pygargus*	*phillipsi*	Least Concern	
Bovidae	Kudu	*Kobus*	*ellipsiprymnus*	*ellipsiprymnus*	Least Concern	
Bovidae	Klipspringer	*Oreotragus*	*oreotragus*		Least Concern	Yes
Bovidae	Southern Reedbuck	*Redunca*	*arundinum*		Least Concern	Yes
Bovidae	Mountain Reedbuck	*Redunca*	*fulvorufula*		Least Concern	Yes
Bovidae	*Bush Duiker	*Sylvicapra*	*grimmia*		Least Concern	Yes
Bovidae	Common Eland	*Tragelaphus*	*oryx*		Least Concern	Yes
Bovidae	*Bushbuck	*Tragelaphus*	*scriptus*		Least Concern	Yes
Bovidae	*Greater Kudu	*Tragelaphus*	*strepsiceros*		Least Concern	Yes
Gliridae	Forest African Dormouse	*Graphiurus*	*murinus*		Least Concern	Yes
Herpestidae	*Marsh Mongoose	*Atilax*	*paludinosus*		Least Concern	Yes
Herpestidae	White-tailed Mongoose	*Ichneumia*	*albicauda*		Least Concern	Yes
Herpestidae	*Banded Mongoose	*Mungos*	*mungo*		Least Concern	Yes
Herpestidae	Meller's Mongoose	*Rhynchogale*	*melleri*		Data Deficient	Yes
Hystricidae	*Cape	*Hystrix*	*africaeaustralis*		Least	Yes

	Porcupine				Concern	
Leporidae	*Scrub Hare	*Lepus*	*saxatilis*		Least Concern	Yes
Muridae	Tete Veld Aethomys	*Aethomys*	*ineptus*		Least Concern	Yes
Muridae	Namaqua Rock Mouse	*Aethomys*	*namaquensis*		Least Concern	
Muridae	Single-Striped Lemniscomys	*Lemniscomys*	*rosalia*		Data Deficient	Yes
Muridae	Multimammate Mice	*Mastomys*			Not listed	
Muridae	Natal Mastomys	*Mastomys*	*natalensis*		Least Concern	
Muridae	Southern African Pygmy Mouse	*Mus*	*minutoides*		Least Concern	Yes
Muridae	Angoni Vlei Rat	*Otomys*	*angoniensis*		Least Concern	Yes
Muridae	Southern African Vlei Rat	*Otomys*	*auratus*		Not listed	Yes
Muridae	*Xeric Four-striped Grass Rat	*Rhabdomys*	*pumilio*		Least Concern	Yes
Mustelidae	Honey Badger	*Mellivora*	*capensis*		Near Threatened	Yes
Nycteridae	Slit-faced Bats	*Nycteris*			Not listed	
Nycteridae	Egyptian Slit-faced Bat	*Nycteris*	*thebaica*		Least Concern	Yes
Rhinolophidae	Geoffroy's Horseshoe Bat	*Rhinolophus*	*clivosus*		Near Threatened	Yes
Rhinolophidae	Darling's Horseshoe Bat	*Rhinolophus*	*darlingi*		Near Threatened	Yes
Soricidae	Reddish-gray Musk Shrew	*Crocidura*	*cyanea*		Data Deficient	Yes
Soricidae	Greater Red Musk Shrew	*Crocidura*	*flavescens*		Data Deficient	Yes
Soricidae	Lesser Gray-brown Musk Shrew	*Crocidura*	*silacea*		Data Deficient	Yes
Soricidae	Forest Shrew	*Myosorex*	*varius*		Data Deficient	Yes
Soricidae	Least Dwarf Shrew	*Suncus*	*infinitesimus*		Data Deficient	Yes

Suidae	Red River Hog	*Potamochoerus*	*porcus*		Not listed	Yes
Thryonomyidae	Greater Cane Rat	*Thryonomys*	*swinderianus*		Least Concern	
Vespertilionidae	Cape Serotine	*Neoromicia*	*capensis*		Least Concern	Yes
Vespertilionidae	Banana Pipistrelle	*Neoromicia*	*nanus*		Least Concern	Yes
Viveridae	Common Large-spotted Genet (Rusty-spotted Genet)	*Genetta*	*maculata*		Least Concern	
Viverridae	African Civet	*Civettictis*	*civetta*		Least Concern	Yes
Viverridae	*Cape Genet	*Genetta*	*tigrina*		Least Concern	Yes

An adult male bushbuck and common duiker were observed in the denser *Acacia* woodland vegetation unit. Evidence of Marsh Mongoose (*Atilax paludinosus*), Cape Genet (*Genetta tigrina*) in the form of faeces or spraints as well as quills of Cape Porcupine (*Hystrix africaeustralis*) where observed within the closed woodlands and riparian zone of the non-perennial Mnywane tributary. The non-perennial tributary provides suitable habitat in the form of dense grassland and reed beds for Angoni Vlei Rat (*Otomys angogiensis*). Tree Squirrels (*Paraxerus cepapi*) were observed foraging adjacent to the Cluster Fig. Evidence (spoor) of several antelope species were observed including Greater Kudu (*Tragelaphus strepsiceros*); Bushbuck (*Tragelaphus scriptus*) and Common Duiker (*Sylvicarpa scrptus*). Slender Mongoose and Banded Mongoose were observed within the open grasslands within the woodland areas. Several rodent burrows (most likely Bushveld Gerbils) were observed on the site. No major rocky outcrops were observed on the site hence the lack of rupicolous mammal species such as Eastern Elephant Shrew, Namaqua Rock Mouse and Rock Hyrax. The 1 139 ha Mahushe Shongwe Provincial Nature Reserve to the south of the site, along the Mziniti River provides important habitat for several larger and smaller mammal species.

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

In 2002 the Endangered Wildlife Trust (EWT) and the IUCN's Conservation Breeding Specialist Group instigated a project to initiate a concerted effort by mammal specialists to assess the status of all mammals in South Africa (Friedmann & Daly 2004).

The primary threats impacting negatively on many mammals include habitat loss and land transformation through deforestation, agriculture, timber planting and urban and industrial development. Poisoning, pollution and hunting have also been listed as having a negative impact on a number of mammals. The result of this collaborative effort was a detailed compilation of knowledge from many specialists; resulting in an updated status of Red List as mammal species. Taxon Data Sheets and distribution maps for each of the **295** species and subspecies of South African mammals were evaluated. Of the total number of species and subspecies evaluated; **57 (19.3%)** were assigned threat categories according to the IUCN Red List criteria (version 3.1). These are divided into:

- **10 (3.4%)** classified as Critically Endangered
- **18 (6.1%)** classified as Endangered and
- **29 (9.8%)** classified as Vulnerable

A total of **53 (18%)** species were assessed as being Data Deficient and therefore a threat category could not be assigned to these species. A total of **38 (12.8%)** species were assessed as being Near Threatened and **147 (49.8%)** as Least Concern. As a result of this initiative, increasing data is available for the threatened mammals of the Mpumalanga Province. In Mpumalanga Province, the majority of large mammals which are considered as threatened are only found in National Parks or other conservation areas such as private game reserves, and it is neither practical nor beneficial to re-introduce them into unprotected natural areas. These include the Lion, Spotted Hyaena and African Wild Dog. Threatened small mammals, such as Schreibers' Long-fingered Bat, however, are not confined to conservancies and occur in varied habitats in the province and are significantly impacted on by human activities and urgent conservation attention needs to be directed towards the threatened small mammals in the province.

According to Skinner and Chimimba (2005) as well as MammalMap three mammal species of conservation importance or concern could possibly occur on the site using current distribution records and habitat requirements as an indicator of possible presence. These include Honey Badger, Geoffroy's and Darling's Horeshoe Bat which are all listed as Lower Risk-Near-threatened (Freideman & Daly 2004).

Table3. Mammal species of conservation importance possibly occurring on the site using habitat availability and current distribution records according to Skinner and Chimimba (2005) as an indicator of presence.

FAMILY	GENUS	SPECIES	COMMON NAME	RED LIST CATEGORY (FRIEDMAN & DALY 2004)
Mustelidae	*Mellivora*	*capensis*	Honey Badger	Near Threatened
Rhinolophidae	*Rhinolophus*	*clivosus*	Geoffroy's Horseshoe Bat	Near-Threatened
Rhinolophidae	*Rhinolophus*	*darlingi*	Darling's Horseshoe Bat	Near-Threatened

Figure10. A foraging Honey Badger observed in the southern Kruger National Park*.

* courtesy of Prof. G.D.Engelbrecht U.L.

Honey Badger (*Mellivora capensis*)

Honey Badgers have a wide occurrence and are catholic in their habitat requirements and only appear to not occur in dune desert. Although they use crevices in rocky areas in which to shelter, they are powerful diggers and also excavate refuges. They also use Aardvark, Cape Porcupine, Springhare, Yellow Mongoose burrows which they modify for their purposes. They have a strong tendency to use tracks and roads along which they move. Honey Badgers have extremely large home ranges, females cover over 10km in a day's foraging and have home ranges of 54 km^2. Males cover up to 27km and have a home range of 174 km^2 (Skinner & Chimimba 2005). The open and closed woodlands on the site offers suitable habitat for occasional foraging arrays for Honey Badgers. The high levels of anthropogenic activities within the residential and agricultural areas adjacent to the site severely restricts the suitability for dispersal habitat as well as the R570 with high vehicular traffic results in increased road fatalities. Honey badgers are often run over on roads at night.

Geoffroy's Horseshoe Bat (*Rhinolophus clivosus*)

Geoffroy's Horseshoe Bat is the second largest horseshoe bat in Southern Africa and is typically a savanna woodland species but also occurs in deserts in the drier west as well as grassland habitat in the Drakensberg. The species favours rocky areas, disused mines and caves for roosting. No suitable day roosting areas occur on the site but suitable foraging areas occur within the open and closed woodlands on the site.

Darling's Horseshoe Bat (*Rhinolophus darlingi*)

Darling's Horseshoe Bat is small to medium sized bat which is not a gregarious as Geofrroy's Horseshoe Bat; although colonies of up to a few dozen are known. The species prefers savanna woodland and often associated with rocky or broken terrain. No suitable day roosting areas occur on the site but suitable foraging areas occur within the open and closed woodlands on the site.

4.2 AVIFAUNAL (BIRD) SURVEY

More than 567 bird species have been recorded in Mpumalanga. Approximately 71 Red Data species, of which 35 are threatened, occur within the area. There are no species endemic to Mpumalanga, but the province is the centre of distribution for two species, which are endemic to South Africa, and accommodates a species that is endemic to the Subregion. The Mpumalanga province is represented by the Grassland, Forest and Savanna biomes. Some of South Africa's endemic and most threatened terrestrial and wetland-associated bird species are significantly dependent on the wetlands, short dense and tall grasslands and woodland regions of the Mpumalanga province. A total of 12 Important Birding Areas (IBAs) occur within the province and most are of critical ornithological importance. The Masibekela wetland, near the Lebombo Mountains in the Lowveld region, holds species that are uncommon in Mpumalanga and support relative large numbers and varieties of rallids.

Species richness in the Lowveld is high, due to a diversity of habitats. The presence or absence of bird species with specific habitat requirements can be indicative of the state of the environment. Bird species that can act as important savanna, grassland and wetland indicators, have been selected, in order to identify priority areas of conservation importance for birds, and to determine the conservation value of land within Mpumalanga Province. Habitat loss and degradation are the primary threats that impact severely on viable populations of these sensitive species (Cohen & Gomacho 2002).

The savanna biome is identified here as having a grassy under storey and a distinct woody upper story of trees and tall shrubs. Tree cover can range from sparse to almost closed canopy (along some non-perennial drainage lines in the study area as well as riparian zone of Crocodile River). The woodland comprises predominantly broadleaved, winter deciduous woodland. Soil types are varied but are generally nutrient poor. The savanna biome contains a large variety of species (it is the most species-rich community in southern Africa) but is generally less important from a Red Data bird perspective, as very few bird species are restricted to this biome. Dry Woodland is particularly well represented in the study area. Moist woodland tends to have fewer species than dry woodland. Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of vegetation types above, it is even more important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man made infrastructure. Large areas of Lowveld Granite bushveld habitat occurs to the north, south, west and east of the site as well as the provincial Mahushe Shongwe Game Reserve.

The savanna biome is particularly rich in large raptors, and forms the stronghold of Red Data species such as Whitebacked Vulture, Cape Vulture, Martial Eagle and Tawny Eagle. These large raptors may occasionally utilise the Tonga-Mzinti study area for foraging arrays. Apart from Red Data species, the area provides habitat for several non-Red Data raptor species, such as the Brown Snake Eagle, Blackbreasted Snake Eagle and a multitude of medium-sized raptors for example the migratory Steppe Buzzard, African Harrier Hawk (Gymnogene), Wahlberg's Eagle and African Hawk Eagle. The red listed near-threatened smaller raptors including the Lanner Falcon and Peregrine Falcon have been recorded from the Mbombela and White River pentads. The crepuscular Bat Hawk has been recorded from the White River as well as Mbombela pentads. These birds occur in low densities and have extremely large home ranges. They are known to breed in plantations where it selects large pale barked Eucalyptus trees for nests (A.C.Kemp *in litt.*).

Wetlands and dams: Both wetlands and rivers are of particular importance for birds in the study area, as the area is relatively arid. No palustrine wetland habitats were observed on the site and adjacent areas. Several artificially created farm dams were observed. These dams are important refuges for a variety of waterbirds, including species such as African Fish Eagle as well Black Stork. The dams and larger rivers may be utilised on a temporary basis for foraging by Yellowbilled Stork and Marabou Storks.

Rivers: The Mzinti River as well as the non-perennial Mnywane River on the site provide habitats for birds. The larger rivers are particularly important for stork species such as Black Stork and Yellowbilled Stork and a variety of other waterbirds. The riparian habitat along the Mnywane River Crocodile River could provide refuge for shy and skulking species such as Whitebacked Night Heron. The eroded macro-channel banks of the Mnywane River could provide favourable nesting, foraging and dispersal habitat for the Kingfishers.

A comprehensive bird species list requires intensive surveys compiled over several years. One hundred and forty-four (144) bird species have been recorded within the 2540_3140 pentad during the on-going second South African Bird Atlas Project (SABAP2). Due to time constraints and timing of survey no comprehensive bird lists could be compiled. During the site visitation (total of 20 hrs), 65 bird species were recorded. Species recorded during field survey are common, widespread and typical of a bushveld and riverine habitats. More intensive surveys conducted throughout the year will deliver a more comprehensive species list.

Table4. Bird species of conservation importance observed during current survey and recorded from the 2540_3140 pentad (SABAP 2) in within which the study area is situated and that occur or could possibly within or in the vicinity of the study area according to Harrison *et al.* (1997) based on habitat and food availability on site.

Full Name	*Scientific Name*	Regional Red List Status_2000	Global Red List Status_2013	Regional Red List Status_2014
*White-backed Vulture	*Gyps africanus*	VU	EN	EN
*Martial Eagle	*Polemaetus bellicosus*	VU	VU	EN
European Roller	*Coracias garrulus*	LC	NT	NT

* observed flying overhead during current survey

SENSITIVE OR ENDANGERED SPECIES

Several bird species of conservation and bio-diversity importance occur, or possibly could occur on the site. The major causal factors for population declines include habitat loss, transformation and degradation through destruction of riverine and wetland\marsh habitat; agricultural and livestock modification; poisoning (persecuted directly and indirectly); shooting (especially raptors); invasion of alien vegetation and human made structures (lines, pylons, drowning in reservoirs, road fatalities etc.).

Two threatened bird species were recorded during the brief survey namely an adult Martial Eagle and White-backed Vulture. Both of these birds were observed flying above the site which probably forms part of their foraging areas or territories. Several of the threatened larger raptors such as Tawny Eagle, Bateleur and smaller Peregrine and Lanner Falcon may utilize the site occasionally for foraging and exploratory purposes. The open and closed woodland areas on the site offer suitable foraging habitat for the migratory European Roller.

4.3 REPTILES

Most current knowledge of the reptiles of Mpumalanga is based on an outdated survey done 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 and conservation status and maps of the known distributions. Jacobsen's (1989) survey revealed that 154 reptiles occur in the Mpumalanga Province and of these, 86 species are threatened. However, many of these threatened reptiles have relatively wide distributions and thus this study was restricted to Red Data species and species that are largely restricted to Mpumalanga.

ReptileMAP is the continuation of the Southern African Reptile Conservation Assessment (SARCA). It aims to improve our understanding of the diversity and distribution of reptiles in South Africa, Lesotho and Swaziland, and thereby make possible an improvement in the conservation status of these animals. ReptileMAP also aims to improve public awareness of the value and plight of reptiles and also provide conservation agencies with a clear definition of conservation priorities that will help them to plan their activities. The purpose is to create an integrated and comprehensive database of reptile distribution records for South Africa, Lesotho and Swaziland, to be used towards the production of an up-to-date Atlas and Red Data Book of the reptiles of the region. This will assist the South African National Biodiversity Institute with the legal obligation to document, monitor and protect biodiversity within South Africa's borders. The conservation assessments contained within the updated Red Data Book (Bates et al., 2014) will be conducted according to IUCN criteria and will help to guide and inform conservation planning and action for the reptiles of the region.

The SARCA dataset consists of two relational databases. The distribution database comprises approximately 120,000 distribution records for reptile taxa that occur in southern Africa, mainly in South Africa, Lesotho and Swaziland. The data was supplied by museums, conservation organizations and private individuals, or was drawn from the literature or from SARCA field surveys. Records from the latter relate to tissue samples that have been deposited with the Reptile Tissue Bank at the South African National Biodiversity Institute. Approximately 7000 of the records were submitted by members of the public via an online Virtual Museum, and have associated reptile images (jpegs). The distribution database is linked to an assessment database that is designed to be importable into the IUCN database and that includes many IUCN Species Information Service (SIS) fields. For each of 410 reptile taxa that occur in South Africa, Lesotho and Swaziland, there is an account that includes the recommended red listing category, a description of taxonomic issues, niche, distribution (with map), threats and recommended conservation actions.

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe during field surveys. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to the high levels of habitat destruction and degradation in the area due to intensive agricultural (sugarcane) and livestock grazing activities coupled with increased levels of disturbances around the villages are all causal factors in the alteration of reptile species occurring on the site and surrounding areas. The rocky crests and summits, sheet rocks and wooded hill-slopes to the north of the site provide favourable refuges for certain snake and lizard species (rupicolous and arboreal species). The indiscriminate killing of all snake species around the villages reduces populations drastically. The frequent burning of the limited overgrazed grassland vegetation has a high impact on remaining reptiles. Fires during the winter months will severely impact on the species undergoing brumation, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks. Most reptiles and amphibians are only seasonally active, spending the harsher winter months in seclusion, usually in burrows, under rocks or in crevices, emerging only under more suitable climatic conditions. Some lizards and snakes may be found above ground or sunning themselves during winter.

Of the 15 reptile species considered for this study, 4 have been recorded exclusively from Mpumalanga or are endemic to the Mpumalanga Province. These are Haacke's flat gecko (*Afroedura multiporis haackei*), Mariepskop flat gecko (*Afroedura nov sp. 2 (mariepi)*, Rondavel flat gecko (*Afroedura* sp. nov.) and Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*). Other species considered in this study were: Forest/Natal purpleglossed snake (*Amblyodipsas concolor*), Lowveld shieldnosed snake (*Aspidelaps scutatus intermedius*), Wolkberg dwarf chameleon (*Bradypodion transvaalense* complex), Barberton girdled lizard (*Smaug warreni barbertonensis*), Lebombo girdled lizard (*Smaug warreni warreni*), Swazi rock snake (*Inyoka swazicus*), Montane burrowing skink (*Scelotes mirus*), Breyer's longtailed seps/ Breyer's plated lizard (*Tetradactylus breyeri*). These species are also found in other provinces of South Africa.

Jacobsen *et al* (2014) have described nine new species of *Afroedura* from Limpopo and Mpumalanga Provinces. Although most of these species have been known for well over two decades, molecular studies have allowed for a clearer understanding of their taxonomic affinities. The new species are as follows: *A. rupestris*, *A. maripi*, *A. pongola*, *A. rondevelica*, *A. granitica*, *A. leoloenis*, *A. broadleyi*, *A. waterbergensis* and *A. pienaari*. All previously recognised subspecies have been elevated to specific status, i.e. *Afroedura africana namaquensis* (*A. namaquensis*), *A. multiporis multiporis* (*A. multiporis*) and *A. multiporis haackei* (*A. haackei*) and the Namibian *A. africana tirasensis* (*A. tirasensis*).

Visual surveys and active searching were undertaken during all three site visitations. This method entails active searching in suitable habitat components such as searching in different vegetation units and communities, turning over objects such as logs and loosely embedded rocks, searching in crevices in bark and replacing all surface objects after examining the ground beneath. Steiner 10x50 Binoculars were used to scan open areas for any basking lizards. 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 sign, and identify the detection to the most specific taxonomic level possible. Specimens are only captured when necessary to confirm identification especially of difficult to distinguish species. The detection of rare species should be documented by taking a picture of the individual, being careful to display the diagnostic characteristics of the species. Voucher specimens may be needed to confirm identification of rare species that are difficult to identify (*Lygodactylus* and *Afrodeura* species). No voucher specimens were collected during the survey. Spotlight or nocturnal surveys were made along the existing pathways and access roads, especially after rainfall, in order to record nocturnal species during the survey.

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Low reptile diversity is expected within the sugar cane plantations due to extensive habitat transformation. Reptiles are extremely sensitive to habitat modification. Rich reptile diversity occurs within the 2531 CC QDGC with forty-four (44) species recorded (ReptileMAP).

No major rock outcrops were observed on the site. Rock outcrops provide favourable refuges for certain snake and lizard species (rupicolous species). A few large termite mounds were observed on the site. Termite mounds offer important refuges for numerous frog, lizard and snake species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna. Moribund termite mounds also provide nesting site for numerous snakes, lizards (varanids) and frogs.

The lizards fall into two basic categories, namely terrestrial or rupicolous, with nine species terrestrial and eight rupicolous, i.e., usually associated with a rocky habitat, including bedrock, rocky outcrops and sheet-rocks. The scattered low-lying granite and quartzite outcrops and sheets to the north of the site provide favourable refuges for certain rupicolous snake and lizard species. Reptile species recorded from the granite outcrops, sheetrock as well as under loosely embedded rocks included Southern Roack Agama (*Agama atra atrai*), Giant Plated Lizard (*Gerrhosaurus validus*), Rainbow Skink (*Trachylepis margatifer*), Striped Skink (*Trachylepis striata*), Speckled Rock Skink (*Trachylepis punctatissima*), Variable Skink (*Trachylepis varia*), Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*) and Transvaal Thick-toed Gecko (*Pachydactylus affinis*).

Trees including stumps, bark and holes are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors). These include Southern Tree Agama (*Acanthocercus atricolis atricolis*), Boomsland (*Dispholidus typus typus*), Spotted Bush Snake (*Philothamnus semiveriegatus*) and Common Dwarf Gecko (*Lygodactylus capensis*). The permanent dams as well as rivers offer favourable habitat for Nile Monitors (*Varanus niloticus*), Serrated Hinged Terrapins (*Pelomedusa sinuatus*) as well as Brown Water Snakes (*Lycodonomorphus rufulus*). Among the reptiles, only the Water Monitor (*Vartanus niloticus*), Brown water snake (*Lycodonomorphus rufulus*) and the Green Water Snake (*Philothamnus hoplogaster*), can be considered aquatic and commonly found along rivers and ponds, in search of frogs, which constitute its prey. Several other species such as the Herald or Red-Lipped snake (*Crotaphopeltis hotamboeia*) and the Rhombic skaapsteker (*Psammophylax rhombeatus*) have been included as wetland species, as they commonly occur in vleis and other moist habitats (Jacobsen 1995).

Many of the reptile species recorded within the study site and adjacent areas have wider distributions in South Africa and are eurytopic*. This includes the snake species recorded from the study area namely Black mamba (*Dendroaspis polylepis*), Mozambique Spitting Cobra (*Naja mossambica*), Rhombic Night Adder (*Causus rhombeatus*), Black-headed Centipede Eater (*Aparallactus capensis*), Red-Lipped Herald (*Crotaphopeltis hotamboeia*), Mole Snake (*Pseudaspis cana*) and Puff-adder (*Bitens arietans arietans*). The snake species are mostly terrestrial (6) with the Mole Snake (*Pseudaspis cana*) being a fossorial species living underground in abandoned animal burrows. Two of the snake species are arboreal namely the Boomslang (*Dispholidus typus typus*) and Spotted Bush Snake (*Philothamnus semiveriegatus*).

Nine reptile species were recorded during the survey: Striped Skinks (*Trachylepis punctatissima*) and Rainbow Skinks (*Trachylepis margatiger*) were observed around the Mzinti abattoir sheds as well as buildings as well as on the rough-barked trees. Spotted Sand Lizard (*Pedioplanis lineoocellata*), Flap-necked Chameleon (*Chamaeleo dilepis*), Black-lined Plated Lizard (*Gerrhosaurus intermedius*) and Southern Tree Agama *Acanthocercus atricollis* were observed within the open and closed woodlands adjacent to the Mnywane River. A Nile Monitor (*Varanus niloticus*) was flushed from the rank vegetation along the Mnywane River. A shedding of a Mozambique Cobra (*Naja mossambica*) was observed adjacent to the stormwater pipes under the R570.

* (of an organism) able to tolerate a wide range of habitats or ecological conditions

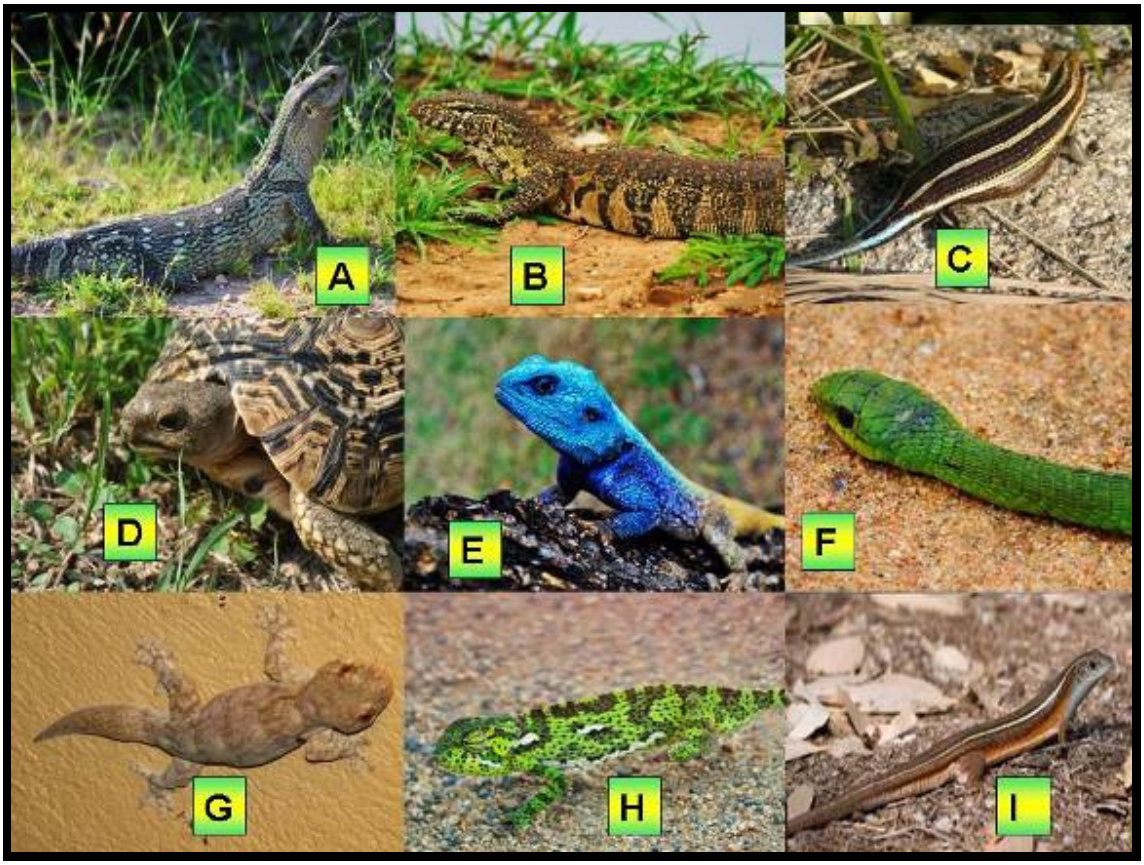

Figure11. A conglomerate of photographs of reptile species recorded (*) or likely to occur on the Mzinti abattoir and feeding lot site. A: White-throated or Rock Monitor (*Varanus albigularis*); B: *Water Monitor (*Varanus niloticus*); **C**: Rainbow Skink (T*rachylepis margaritifer*); **D:** Leopard Tortoise (*Stigmochelys pardalis*) **E:** *Southern Tree Agama (*Acanthocercus atricollis*); **F:** Boomslang (*Dispholidus typus*) and **G:** Tropical House Gecko (*Hemidactylus mabouia*); **H:** *Flap-necked Chameleon (*Chamaeleo dilepis*) and **I:** Black-lined Plated Lizard (*Gerrhosaurus intermedius*).

Table5. Reptile recorded during the South African Reptile Atlas and Conservation Assessment (SARCA) field-survey and supplemented with previous surveys conducted in the Malelane-Thonga area.

Family	Common name	Genus	Species	Subspecies	Red list category	Atlas region endemic
Agamidae	Southern Tree Agama	*Acanthocercus*	*atricollis*	*atricollis*	Least Concern (SARCA 2014)	No
Agamidae	Distant's Ground Agama	*Agama*	*aculeata*	*distanti*	Least Concern (SARCA 2014)	Yes
Atractaspididae	Natal Purple-glossed Snake	*Amblyodipsas*	*concolor*		Least Concern (SARCA 2014)	Yes
Atractaspididae	Black-headed Centipede-eater	*Aparallactus*	*capensis*		Least Concern (SARCA 2014)	No
Atractaspididae	Spotted Harlequin Snake	*Homoroselaps*	*lacteus*		Least Concern (SARCA 2014)	Yes
Chamaeleonidae	Wolkberg Dwarf Chameleon	*Bradypodion*	*transvaalense*		Least Concern (SARCA 2014)	Yes
Chamaeleonidae	Common Flap-neck Chameleon	*Chamaeleo*	*dilepis*	*dilepis*	Least Concern (SARCA 2014)	No
Colubridae	Red-lipped Snake	*Crotaphopeltis*	*hotamboeia*		Least Concern (SARCA 2014)	No
Colubridae	Boomslang	*Dispholidus*	*typus*	*typus*	Least Concern (SARCA 2014)	No
Colubridae	South African Slug-eater	*Duberria*	*lutrix*	*lutrix*	Least Concern (SARCA 2014)	Yes
Colubridae	Swazi Rock Snake	*Inyoka*	*swazicus*		Least Concern (SARCA 2014)	Yes
Colubridae	Olive	*Lycodonomorphus*	*inornatus*		Least	Yes

	House Snake				Concern (SARCA 2014)	
Colubridae	Brown Water Snake	*Lycodonomorphus*	*rufulus*		Least Concern (SARCA 2014)	No
Colubridae	Cape Wolf Snake	*Lycophidion*	*capense*	*capense*	Least Concern (SARCA 2014)	No
Colubridae	South Eastern Green Snake	*Philothamnus*	*hoplogaster*		Least Concern (SARCA 2014)	No
Colubridae	Spotted Bush Snake	*Philothamnus*	*semivariegatus*		Least Concern (SARCA 2014)	No
Colubridae	East African Shovel-snout	*Prosymna*	*stuhlmannii*		Least Concern (SARCA 2014)	No
Colubridae	Short-snouted Grass Snake	*Psammophis*	*brevirostris*		Least Concern (SARCA 2014)	No
Colubridae	Cross-marked Grass Snake	*Psammophis*	*crucifer*		Least Concern (SARCA 2014)	No
Colubridae	Spotted Grass Snake	*Psammophylax*	*rhombeatus*	*rhombeatus*	Least Concern (SARCA 2014)	No
Colubridae	Eastern Tiger Snake	*Telescopus*	*semiannulatus*	*semiannulatus*	Least Concern (SARCA 2014)	No
Cordylidae	Cape Grass Lizard	*Chamaesaura*	*anguina*	*anguina*	Least Concern (SARCA 2014)	Yes
Cordylidae	Common Girdled Lizard	*Cordylus*	*vittifer*		Least Concern (SARCA 2014)	No
Cordylidae	Common Crag Lizard	*Pseudocordylus*	*melanotus*	*melanotus*	Least Concern (SARCA 2014)	Yes
Cordylidae	Baberton Girdled Lizard	*Smaug*	*warreni*	*barbertonensis*	Least Concern (SARCA 2014)	Yes

Elapidae	Black Mamba	*Dendroaspis*	*polylepis*		Least Concern (SARCA 2014)	No
Gekkonidae	Common Tropical House Gecko	*Hemidactylus*	*mabouia*		Least Concern (SARCA 2014)	No
Gekkonidae	Wahlberg's Velvet Gecko	*Homopholis*	*wahlbergii*		Least Concern (SARCA 2014)	No
Gekkonidae	Common Dwarf Gecko	*Lygodactylus*	*capensis*	*capensis*	Least Concern (SARCA 2014)	No
Gekkonidae	Spotted Dwarf Gecko	*Lygodactylus*	*ocellatus*		Least Concern (SARCA 2014)	No
Gekkonidae	Van Son's Gecko	*Pachydactylus*	*vansoni*		Least Concern (SARCA 2014)	No
Gerrhosauridae	Yellow-throated Plated Lizard	*Gerrhosaurus*	*flavigularis*		Least Concern (SARCA 2014)	No
Gerrhosauridae	Black-lined Plated Lizard	*Gerrhosaurus*	*intermedius*		Least Concern (SARCA 2014)	No
Lacertidae	Delalande's Sandveld Lizard	*Nucras*	*lalandii*		Least Concern (SARCA 2014)	No
Leptotyphlopidae	Eastern Thread Snake	*Leptotyphlops*	*scutifrons*	*conjunctus*	Not listed	No
Scincidae	Giant Legless Skink	*Acontias*	*plumbeus*		Least Concern (SARCA 2014)	No
Scincidae	Wahlberg's Snake-eyed Skink	*Afroablepharus*	*wahlbergii*		Least Concern (SARCA 2014)	No
Scincidae	Montane Dwarf Burrowing Skink	*Scelotes*	*mirus*		Least Concern (SARCA 2014)	Yes
Scincidae	Rainbow Skink	*Trachylepis*	*margaritifer*		Least Concern (SARCA 2014)	No

Scincidae	Striped Skink	*Trachylepis*	*striata*		Least Concern (SARCA 2014)	No
Scincidae	Variable Skink	*Trachylepis*	*varia*		Least Concern (SARCA 2014)	No
Typhlopidae	Bibron's Blind Snake	*Afrotyphlops*	*bibronii*		Least Concern (SARCA 2014)	No
Viperidae	Puff Adder	*Bitis*	*arietans*	*arietans*	Least Concern (SARCA 2014)	No
Viperidae	Snouted Night Adder	*Causus*	*defilippii*		Least Concern (SARCA 2014)	No

HABITAT FOR SENSITIVE OR ENDANGERED SPECIES

No threatened reptile species have been recorded from the 2531 CC QDGC or are likely to occur on the site. The majority of species observed on the site are common and widespread and typical of a woodland and riverine environment.

4.4 AMPHIBIANS

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data. Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment.

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in Mpumalanga Province can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles. The general type of reproductive habitat chosen has a strong influence on the entire developmental strategy followed by many species.

Most anuran larvae within Mpumalanga inhabit temporary habitats that range from small pools to larger artificial dams/pans situated in lower lying areas or depressions. Unpredictable temporal and spatial distributions and cyclic patterns of nutrient availability are common features of these habitats. Others develop in more complex permanent aquatic habitats as temporary invaders in established communities such as rivers, streams and the artificially created pans/dams. Numerous physical (e.g. distance from shore, oxygen concentration, substrate qualities, water depth and flow rate, site duration, and temperature) and biological (e.g. presence and distribution of vegetation, other tadpoles, other organisms including predators, and the phenology of all organisms) factors influence the spatial and temporal distribution of tadpoles among microhabitats.

The majority of frog species in Mpumalaga Province are classified as explosive breeders completing their short duration reproductive cycle in the early summer months between (November-January). These frog species only emerge after the first heavy summer rainfalls and are dormant during the cold winter months. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles. Amphibian surveys by Jacobsen (1989), as well as recent and current surveys suggest that 51 species of amphibians currently occur in the Province of Mpumalanga. The present study concentrated mainly on Red Data species and species that are threatened or have relatively restricted distributions.

Eight species are considered as important for setting conservation priorities in Mpumalanga namely Karroo toad *Vandijkophrynus* (*Bufo*) *gariepensis nubicolus*, Cascade Frog *Hadromophryne* (*Heleophryne*) *natalensisis,* Spotted shovel-nosed Frog *Hemisus guttatus*, Yellow-striped Reed Frog *Hyperolius semidiscus,* Plain Stream Frog *Strongylopus wageri*, Giant Bullfrog *Pycicephalus adspersus*, Greater Leaf-folding Frog *Afrixalis fornasinii* and Whistling Rain Frog *Breviceps sopranus* (Theron 2002). During this brief survey; fieldwork was augmented with species lists compiled from personal records (2000-2015); data from the South African Frog Atlas Project (SAFAP) (1999-2003) and published data, and the list provided below is therefore regarded as likely to be fairly comprehensive.

Due to time constraints Short-Term Sampling (STS) was used during the current survey. Short collecting visits to a single site cannot give much insight into the total number of species present. However, using time-constrained collecting techniques, rates of species accumulation in different habitats or sites can be compared if amphibian populations are similar. The first step in time-constrained, short-term sampling is to identify and define the major habitat types at the study site. All habitats should be sampled during the sampling period. Information derived from this broad scale sampling can be used to plan how to distribute subsequent sampling among habitats. Many factors influence the efficiency of short-term surveys, and they must be recognized and controlled if comparisons are to be made among different sites and habitats. Some of these variables are:

- Total time spent on the survey
- Number and experience of fieldworkers
- Topography
- Area of the site
- Weather conditions and climate
- Season, date, and time of day
- Time required sampling each major habitat.

ASSUMPTIONS

The results obtained from short-term sampling are highly dependent on collecting and environmental variables. Some of these variables include weather (both prior and during sampling), collector's experience, and level of sampling effort in each habitat, diversity of collecting techniques used, and phenology of the amphibian species. This is especially important when results from similar habitats are compared. Any effects of these variables must be recognised and controlled. Time constrained searches must standardise collecting effort within the selected habitat types. The current survey was undertaken towards the end of the summer months. Precipitation occurred during the field survey as well as sufficient surface water within the Mnywane River.

As the survey was undertaken mainly during the day and a single night/nocturnal survey only a small proportion of species were recorded. Comprehensive herpetological surveys can only be undertaken throughout the duration of the wet season (November-March). It is only during this period that accurate frog species lists can be compiled. The majority of amphibian species recorded on the site were along the non-perennial Mnywane River or drainage line and seasonal pools and included Drakensberg River Frog (*Amietia* (*Afrana*) *queckensis*); Snoring Puddle Frog (*Phrynobatrchus natalensis*), Southern Foam Nest Frog (*Chiromantis xerampelina*) and Painted Reed Frog (*Hyperolius marmoratus taeniatus*). Several Dwarf Puddle Frogs (*Phrynobatrachus mababiensis*) were calling from the grassy banks and shallow edge of the drainage line during the day. Several recently metamorphosed or juvenile Guttural Toads (*Amietophrynus gutturalis*) were observed migrating within the riparian zone as well as adjacent access roads.

During this survey; fieldwork was augmented with species lists compiled from personal records (1999-2010); data from the site collected for the South African Frog Atlas Project (SAFAP) (1999-2003) and published data, and the list provided below is therefore regarded as likely to be fairly comprehensive.

Figure12. A conglomerate of photographs displaying the frog species recorded on the Mzinti abattoir and feeding lot site (*) or likely to occur along the non-perennial Mnywane River. A: Painted Reed Frog (*Hyperolius marmoratus taeniatus*); **B:** Water-lily Frog (*Hyperolius pusilus*), D: Golden Leaf-folding Frog (*Afrixalus aureus*); **E:** Red Toad (*Schismaderma carens*) **F:** Drakensberg River Frog (*Amietia quecketii*); **H:** Banded Rubber Frog (*Phrynomerus bifasciatus*); **H:** Southern Foam Nest Frog (*Chiromantis xerampelina*); **I:** Bubbling Kassina (*Kassina senegalensis*); **J:** Russet-Backed Sand Frog (*Tompoterna marmorata*); **K:** Tremelo Sand Frog (*Tomopterna cryptotis*), **L:** Eastern Olive Toad (*Amietophrynus garmani*); **M:** Mottled Shovel-nosed Frog (*Hemisus marmoratus*); **N:** Bushveld Rain Frog (*Breviceps adspersus*); **O:** Dwarf Puddle Frog (*Phrynobatrachus mababiensis*) and **P:** Plain Grass Frog (*Ptychadaena anchietae*).

Table6. Frog species recorded from the 2531 CC QDGC during the SAFAP (FrogMAP).

Family	Common name	Genus	Species	Red list category	Atlas region endemic
Brevicepitidae	Bushveld Rain Frog	*Breviceps*	*adspersus*	Least Concern	No
Brevicepitidae	Mozambique Rain Frog	*Breviceps*	*mossambicus*	Least Concern	No
Brevicepitidae	Plaintive Rain Frog	*Breviceps*	*verrucosus*	Least Concern	No
Bufonidae	Guttural Toad	*Amietophrynus*	*gutturalis*	Least Concern	No
Bufonidae	Red Toad	*Schismaderma*	*carens*	Least Concern	No
Heleophrynidae	Natal Ghost Frog	*Hadromophryne*	*natalensis*	Least Concern	N
Hyperoliidae	Painted Reed Frog	*Hyperolius*	*marmoratus*	Least Concern	No
Hyperoliidae	Water Lily Frog	*Hyperolius*	*pusillus*	Least Concern	No
Hyperoliidae	Yellowstriped Reed Frog	*Hyperolius*	*semidiscus*	Least Concern	No
Hyperoliidae	Tinker Reed Frog	*Hyperolius*	*tuberilinguis*	Least Concern	No
Hyperoliidae	Bubbling Kassina	*Kassina*	*senegalensis*	Least Concern	No
Phrynobatrachidae	Dwarf Puddle Frog	*Phrynobatrachus*	*mababiensis*	Least Concern	No
Phrynobatrachidae	Snoring Puddle Frog	*Phrynobatrachus*	*natalensis*	Least Concern	No
Pipidae	Common Platanna	*Xenopus*	*laevis*	Least Concern	No
Ptychadenidae	Plain Grass Frog	*Ptychadena*	*anchietae*	Least Concern	No
Pyxicephalidae	Drakensberg River Frog	*Amietia*	*quecketti*	Least Concern	Yes
Pyxicephalidae	Bronze Caco	*Cacosternum*	*nanum*	Least Concern	No
Pyxicephalidae	Mountain Caco	*Cacosternum*	*parvum*	Least Concern	No
Pyxicephalidae	Clicking Stream Frog	*Strongylopus*	*grayii*	Least Concern	No
Pyxicephalidae	Natal Sand Frog	*Tomopterna*	*natalensis*	Least Concern	No

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

Figure13. The threatened Giant Bullfrog (*Pyxicephalus adspersus*) (left photo) is often confused with the smaller African Bullfrog (*Pyxicephalus edulis*) (right photo) which occurs in the lowveld.

The Giant Bullfrog (*Pyxicephalus adspersus*) is a protected frog species whose conservation status has been revised and is included as a Red Data Species under the category 'Lower Risk near-threatened' (Minter *et al.* 2006). Bullfrog density commonly varies within certain habitats (open grassland habitat). High densities are often associated with specific microhabitats or patches (hydrophilic or aquatic ephemerophytic grass and sedge dominated seasonal or temporary pans or depressions) that can be identified and randomly sampled. Giant Bullfrogs have not been recorded from the Hectorspruit or Malelane areas during the South African Frog Atlas Project (SAFAP) or previous surveys conducted by the consultant. Giant Bullfrogs were recorded in the Kruger National Park during the South African Frog Atlas Project (SAFAP) but were most likely incorrectly identified and more likely to be the smaller African Bullfrog (*Pyxicephalus edulis*). The African Bullfrog (*Pyxicephalus edulis*) is a 'Protected' frog species. Marginally suitable habitat occurs for African Bullfrog on the site.

5. SENSITIVE ENVIRONMENTS/HABITATS ON AND SURROUNDING THE SITE

From a desktop study using inter alia aerial photographs and Google Earth ^{TM} imagery as well as a preliminary site investigation (27th – 29th of April 2015) the following four sensitivity categories of areas were identified:

High: Areas with high species richness and habitat diversity comprising natural indigenous plant species. These areas are ecologically valuable and important for ecosystem functioning.

Medium-High: An area with a relatively natural species composition; a threatened or unique ecosystem; moderate species and habitat diversity. These areas are ecologically valuable and important for buffering adjacent ecosystem functioning.

Medium-Low: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity but is currently degraded. Could be developed with mitigation and expected low impact on adjacent ecosystems.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants. Development could be supported with little to no impact on the adjacent natural vegetation / ecosystem.

The Mpumalanga Biodiversity Conservation Plan (MBCP) has been jointly developed by the Mpumalanga Tourism and Parks Agency (MTPA) and the Department of Agriculture and Land Administration (DALA). The MBCP is a spatial biodiversity plan for Mpumalanga that is based on scientifically determined and quantified biodiversity objectives, intended to guide conservation and land-use decisions in support of sustainable development.

The MBCP mapped the distribution of Mpumalanga's known biodiversity into six categories, namely:

(a) Protected areas (already protected and managed for conservation);

(b) Irreplaceable areas (no other options available to meet targets – protection is crucial);

(c) Highly Significant areas (protection needed, very limited choice for meeting targets);

(d) Important and Necessary areas (protection needed, greater choice in meeting targets);

(e) Ecological Corridors (mixed natural areas with most choices, including for development);

(f) Areas of Least Concern (natural areas with most choices, including for development);

(g) Areas with No Natural Habitat Remaining (transformed areas that make no contribution to meeting targets).

The MBCP is accompanied by land-use planning guidelines to guide planning and development within each of the biodiversity conservation categories throughout the Province. In each category there are different land use and development consequences. The Mzinti site is situated mainly within areas classified as 'Modified' as well as 'Natural' areas which comprise Granite Lowveld (see Figure 14). The 'Protected Area' comprises the Mahushe Shongwe Game Reserve, which was initiated in 1986 as the first community conservation project within the former KaNgwane homeland. Revenues generated from hunting and game meat sales are shared between the Mpumalanga Parks Board (MPB) and the Mzinti community. Mahushe Shongwe is 1200 ha and is located just north of the Mawewe Cattle-Game project, which is a 9000 ha integrated wildlife and livestock area that was created in 1994. The entire region is under heavy environmental pressure, mainly because of high population densities due to apartheid spatial planning, irrigation development for sugar cane, the expansion of urban and semi-urban areas, the cutting of trees for energy fuel, and livestock grazing (Peel and Stalmans, 1997; Stalmans, 2001).

The **open and closed mixed woodland or Granite Lowveld vegetation** on and surrounding the Mzinti site has a high diversity of plant (especially tree species) and animal species (especially birds and frogs). The site offers suitable habitat for red listed plant and protected tree species and have a **Medium-High sensitivity** and **conservation potential/value** as well as **ecosystem functioning.** The non-perennial Mnywane River and associated woodland riparian zone are considered as High sensitivity as well as and **conservation potential/value** as well as **ecosystem** and **hydrological functioning.**

The **Degraded** and **Transformed Bushveld or Granite Lowveld** areas on the Mzinti site are influenced by various factors namely the existing Mzinti abattoir, residential development and extensive vegetation transformation or clearance. These effects has led the area to become totally degraded with pioneer weedy grass and forb species and declared invasive weeds dominating the vegetation. There is no resemblance to natural vegetation and the area is transformed. Low faunal diversity is expected from these heavily degraded areas on the site. From vegetation and faunal perspective the degraded and transformed areas of Granite Lowveld have a **low sensitivity and conservation potential/value** as well as **ecosystem functioning.**

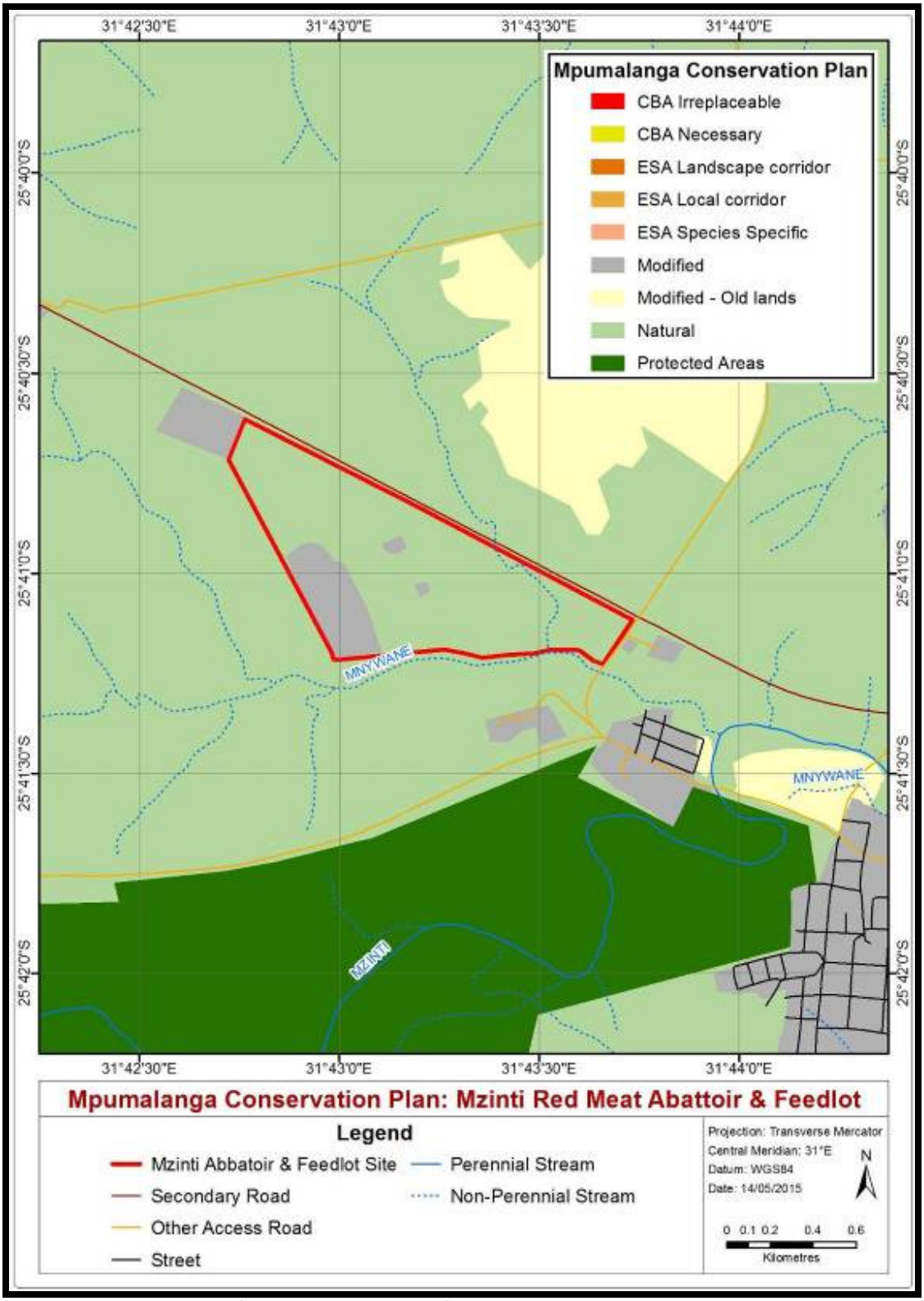

Figure14. Mpumalanga Conservation Plan (MCP) for the proposed Mzinti abattoir and feeding lot project

5.1 GRANITE LOWVELD (SVI 3)

This vegetation unit is currently considered as **Vulnerable**. The conservation target is 19%, with 17% formally protected within the Kruger National Park and approximately 17% conserved in private reserves mainly in the Selati, Klaserie, Timbavati, Mala Mala, Sabi Sand and Manyeleti Reserves. More than 20% already transformed, mainly be cultivation and by settlement development (Mucina & Rutherford 2006)

The vegetation open and closed mixed woodland Granite Lowveld vegetation has high species richness with mostly climax species present. The area is mostly natural with some areas degraded due to human actions such as overgrazing by cattle, bush-encroachment, wood harvesting and collection of medicinal plants. The open and closed woodland provides important habitat for the red listed 'Declining' *Boophone distichta* and *Crinum macowanii* as well as 'NFA protected' *Combretum imberbe, Philenoptera violacea* and *Sclerocarya birrea* ssp. *caffra*. The mixed species open and closed woodland/bushveld provides important habitat for several faunal species, especially birds. This unit has from a plant ecological and ecosystem functioning point of view a **medium-high conservation value**

5.2 NON-PERENNIAL MNYWANE RIVER

Rivers are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment (O'Keefe, 1986). Any impact on the perennial tributary on the eastern boundary of the site is therefore also likely to impact on upstream and downstream areas. Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Streamside riparian areas support a wealth of biological diversity (e.g., Naiman *et al.*1993) and are ecologically important regardless of their role as corridors. Areas preserved along streams include a diversity of habitats and maintain the integrity of aquatic ecosystems by providing shade, nutrients, and structure while reducing sedimentation and pollution (Gregory et al. 1991). Conservation and restoration of these habitats are, therefore, important to maintaining the biological diversity of ecosystems that include riparian habitats.

Riparian zones may act as potential refugia for certain fauna and could allow for possible re-colonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007). The riparian vegetation provides vital refuge, foraging and migratory passages for species migrating to and away from the rivers. The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams).

Riparian areas have one or both of the following characteristics:

- distinctly different vegetative species than adjacent areas; and
- species similar to adjacent areas but exhibiting more rigorous or robust growth form.

The riparian vegetation is dependant on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more mesic species (water-loving) being located closest to the river channel, often with their roots in the water, and the less water-loving terrestrial species further away from the river.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- enhancing water quality in the river by the interception and breakdown of pollutants;
- interception and deposition of nutrients and sediments;
- stabilisation of riverbanks and macro-channel floor;
- flood attenuation;
- provision of habitat and migration routes for fauna and flora;
- provision of fuels, building materials and medicines for communities (if done on a sustainable basis); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).

The riparian areas or buffer strips along the non-perennial Mnywane River is under threat from habitat transformation from upstream and surrounding agricultural activities, alien vegetation invasion (*Jacaranda mimosifolia*, *Melia azedarach*) as well as wood harvesting and collecting. The entire non-perennial tributary and associated riparian zone including a minimum **32m buffer zone** from the edge of the riparian zone must be considered a 'no-go' area for development. Activities should be restricted within the riparian zone. No further vegetation removal must occur except for the removal of invasive plant and tree species. Clearance of alien invasive vegetation (*Melia azedarach, Lantana camara*) is a priority along the drainage line. Where invasive removals leave the soil exposed alternative indigenous vegetation should be introduced preventing further seeding and possible erosion and siltation. This is especially important in the rehabilitation of the riparian zone. Water abstraction from the seasonal or non-perennial drainage line could potentially result in further habitat modification and degradation and should not be permitted without appropriate approval from authorities (DWS).

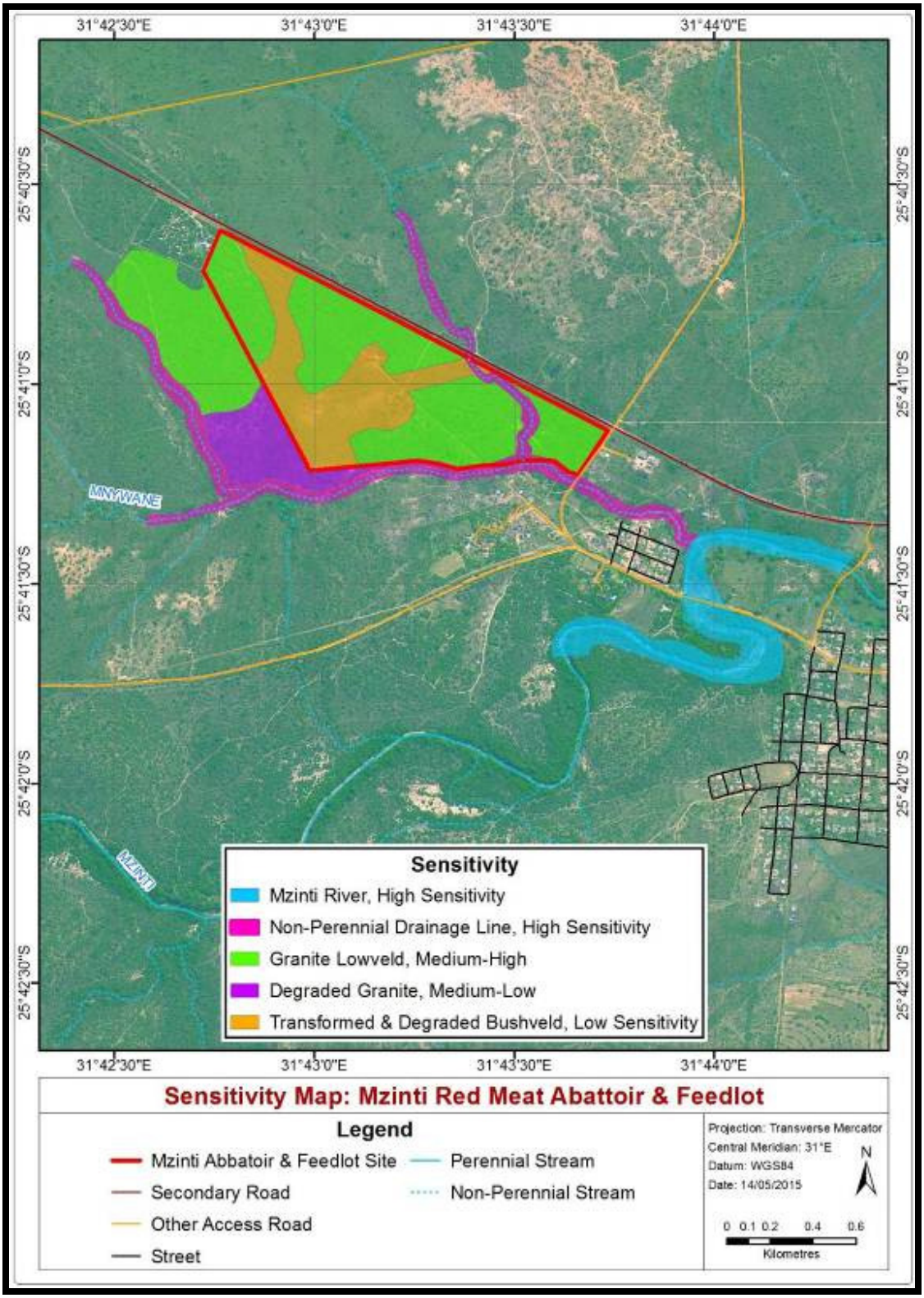

Figure15. Preliminary sensitivity map for the proposed Mzinti red meat abattoir and feeding lot project.

6. Impact ranking of potential impacts to associated vegetation and fauna

Table7. The impact rating criteria used for determining potential impacts of the Mzinti red meat abattoir and feeding lot project.

Descriptive criteria		
Nature	**Include a descriptive sentence**	
Probability	**Categories 1 – 5**	
	1	Improbable (less than 24% chance of occurring)
	2	Probable (25 – 49%)
	3	Likely (50 – 69%)
	4	Very likely (70 – 89%)
	5	Definite (90 – 100%)
Frequency	Categories 1 – 5	
	1	Very rare to remote (once or twice a decade)
	2	Unusual to occasional (once or twice every 5 years)
	3	Frequent (a few times a month)
	4	Very frequent (a few times a week, to daily)
	5	Continuous (daily to a significant percentage of every day)
Extent	Categories 1 – 5	
	1	Footprint / site
	2	Local
	3	Regional
	4	National
	5	International (trans-boundary)
Duration	Categories 1 – 5	
	1	Short (few days to a few months, less than a phase)
	2	Short (few months, or less than a phase in total)
	3	Medium (a few years, significant part of a phase)
	4	Long (lifespan of development (i.e. all of operation)
	5	Permanent
Intensity	Categories 1 – 5	
	1	Very low – natural processes not affected
	2	Low – natural processes slightly affected
	3	Medium – natural processes continue but in a modified manner
	4	Medium-high – natural processes are modified significantly
	5	High – natural processes disturbed significantly so that they cease to occur (temporarily / permanently)
Significance	**Significance = P + F + E + D + I** Minimum value of 5, maximum of 25 Status determines if positive / negative	
	Any positive value	No impact High to low consequence, probability not an issue as positive, **no mitigation required**
	– 5	Low-Low consequence, probably, **minimal mitigation may be required**
	– 6 to 10	Medium-Medium consequence, probably, **mitigation is advised / preferred**
	– 11 to 15	Medium to high-Medium to high consequence, probably to very probable, **mitigation is necessary**
	– 16 to 20	High-High consequence, probably / definite, **mitigation is essential**
	– 21 to 25	Extreme-Very high consequence, definite, **Fatal flaw!**

Table8. Summary table of the potential impacts of the de-commissioning or removal of the section of the Mzinti red meat abattoir and feeding lot project.

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Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed feed- lot.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years)	Local Footprint / site	Long (lifespan of development (i.e. all of operation)	Low – natural processes slightly affected	Medium to high- Medium to high consequence, probably to very probable, **mitigation is necessary**
Destruction of suitable habitat for red listed plants and animals.	Improbable (less than 24% chance of occurring)	Unusual to occasional (once or twice every 5 years)	Local Footprint / site	Long (lifespan of development (i.e. all of operation)	Low – natural processes slightly affected	Medium-Medium consequence, probably, **mitigation is advised / preferred**
Deterioration of water quality within adjacent Mnywane non-perennial River.	Likely (50 – 69%)	Frequent (a few times a month)	Local	Long (lifespan of development (i.e. all of operation	Medium – natural processes continue but in a modified manner	Medium to high- Medium to high consequence, probably to very probable, **mitigation is necessary**
Erosion and sediment from removed towers.	Likely (50 – 69%)	Very frequent (a few times a week, to daily)	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Long (lifespan of development (i.e. all of operation)	Medium – natural processes continue but in a modified manner	Medium to high- Medium to high consequence, probably to very probable, **mitigation is necessary**

8. POTENTIAL IMPACTS ON THE FAUNA OF THE SITE

The existing Mzinti red meat abattoir and proposed feeding lot site is situated within Granite Lowveld vegetation which is classified as a 'Vulnerable' vegetation type (Mucina & Rutherfford 2006). The Mzinti site is situated adjacent to the seasonal or non-perennial Mnywane River as well as to the north of the Mzinti River and provincial Mahushe Shongwe Nature Reserve as well as the Mawewe Cattle-Game project, which is a 9000 ha integrated wildlife and livestock area that was created in 1994. The Mnywane River and associated closed woodland riparian zone as well as adjacent natural Granite Loveld vegetation provides important habitat for certain threatened plant (*Boophone distichta, Crinum cf. macowanii*) and protected tree species as well as providing suitable habitat for certain threatened faunal species and all future activities on the site including the proposed new feeding lot site must be appropriately managed during all phases of the project in order to minimise potential impacts to the natural Granite Lowveld vegetation as well as Mvywane River.

8.1 Habitat Destruction

At a local Mzinti scale the proposed Mzinti abattoir and feeding lot site should be restricted to the already transformed and degraded Granite Lowveld vegetation units which comprise low plant diversity and limited suitable habitat for any threatened plant and animal species. The remaining fauna associated with the site require the conservation of the natural open and closed woodlands (Granite Lowveld) and non-perennial Mnywane River and associated riparian areas on the site. This could potentially form an appropriate natural biological corridor connecting the site with similar habitats around the site and should conserve the majority of suitable habitat for faunal species likely to occur on the site and immediate surrounding area. It is important that all activities are severely restricted in the sensitive habitats on the site.

The existing Mzinti red meat abattoir and proposed feeding lot site will most likely result in a **medium-low**, **short, medium** and **long-term negative** impact if the feeding lot is situated within the adjacent transformed and degraded Granite Lowveld vegetation units. It is important that the feeding lot site is restricted to these transformed and degraded areas on the site and not in the natural open and closed woodlands and especially the riparian areas of the non-perennial Mnywane River and a minimum of a 32m bushveld buffer zone. Impacts on the site will depend on the areas to be developed as well as adequate management of the remaining natural Granite Lowveld and non-perennial Mnywane River. Should the sub-division be approved, it is therefore recommended that the following mitigation measures be implemented:

Further, direct and indirect impacts include increased access and human presence into the natural woodland areas and disturbances of sensitive or secretive species associated with the non-perennial Mnywane River and closed woodland riparian zone on the site. Increased human pressure and activities in these sensitive habitats could result in major environmental degradation if environmentally sensitive practices are not followed and maintained throughout all stages of the development.

Mitigation and Recommendations

During the **CONSTRUCTION/ESTABLISHMENT** phase of the proposed feeding lot site workers must be limited to areas under construction and access to the undeveloped areas, especially the surrounding open and closed woodlands, non-perennial Mnywane River and riparian zone must be strictly regulated (ideally fenced off and "no-go" areas during construction activities). Provision of adequate toilet facilities must be implemented to prevent the possible contamination of surface (Mnywane River) and ground (borehole) water in the area. All temporary soil stockpiles, litter and rubble must be removed on completion of construction. No dumping of waste material in surrounding open areas. All alien invasive plant and tree species should be removed from the site especially along the non-perennial Mnywane River to prevent further invasion. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited. All alien vegetation should be eradicated over a five-year period. Invasive species (*Melia azadercah, Lantana camara, Pistia stratiodes*) should be given the highest priority.

Where the removal of alien species may leave spoil exposed such as along the Mnywane River, alternative indigenous species should be established before eradication takes place. The attention of property owners must be drawn to the most recent Declared Weeds List (2001) in the *Conservation of Agricultural Resources Act* 43 of 1983 and the associated penalties and prohibitions. Horticultural activities such as fertilisers, herbicide and pesticide runoff, increase in alien vegetation and weedy species, dumping of refuge and building material must be strictly managed and be environmentally sensitive and should meet the following requirements:

- Limited irrigation by water-wise gardening (use indigenous to the area plants which are adapted to the local conditions).
- Strict fertiliser, pesticide and herbicide control (limited usage for proposed development)
- Invertebrate pests on the site should be controlled in the following manner:
- The least environmentally damaging insecticides must be applied. Pyrethroids and Phenylpyrazoles are preferable to Acetylcholines. Use insecticides that are specific to the pest (species specific) in question. The lowest effective dosages must be applied. Suppliers advice should be sought. Do not irrigate for 24 hours after applying insecticides in areas where there is a chance of contaminating water-courses. Fungal pathogens should be used in preference to chemical insecticides.
- Reduction of weed and erosion by minimum tillage gardening practices (groundcovers and mulching better in all respects).

- No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas must be strictly regulated and managed.

8.2 Deterioration in Water Quality

Abattoir waste can be defined as waste or waste water from an abattoir which could consist of the pollutants such as animal faeces, blood, fat, animal trimmings, paunch content and urine. Abattoir waste could therefore be regulated through either the Environment Conservation Act, 1989 (protection of the total environment i.e. water, air, soil, humans, flora and fauna), or the National Water Act, 1998. Agriculturally derived pollutants include plant nutrients (nitrogen and phosphorus) from fertilisers and animal manure, organic wastes and low levels of pesticides. Either of theses classes of pollutants may be in dissolved form within the runoff water, or be adsorbed onto particulate soil material washed from the land. Agricultural runoff may be surface or subsurface. Surface runoff is governed by rainfall characteristics, particularly intensity and duration, by vegetation cover, soil type and slope. Wastes from livestock are also rich in N and P and unless properly recycled into arable lands, or subjected to tertiary sewage treatment to remove N and P, such wastes can be a major source of N and P loading to aquatic ecosystems (Tilman 1999).

Animal manures are a valuable fertilizer and soil conditioner, if applied under proper conditions at crop nutrient requirements. Potential sources of manure pollution include open feedlots, pastures, treatment lagoons, manure stockpiles or storage, and land application fields. Oxygen-demanding substances, ammonia, nutrients (particularly nitrogen and phosphorus), solids, pathogens, and odorous compounds are the pollutants most commonly associated with manure. Manure is also a potential source of salts and trace metals, and to a lesser extent, antibiotics, pesticides and hormones. This problem has been magnified as poultry and livestock production has become more concentrated. AFO pollutants can impact surface water, groundwater, air, and soil. In surface water, manure's oxygen demand and ammonia content can result in fish kills and reduced biodiversity. Solids can increase turbidity and smother benthic organisms. Nitrogen and phosphorus can contribute to eutrophication and associated algae blooms which can produce negative aesthetic impacts and increase drinking water treatment costs. Turbidity from the blooms can reduce penetration of sunlight in the water column and thereby limit growth of submerged aquatic vegetation, which serve as critical habitat for fish, crabs, and other aquatic organisms. Decay of the algae (as well as night-time algal respiration) can lead to depressed oxygen levels, which can result in fish kills and reduced biodiversity. Filamentous algae smothers the stones-in-current (SIC) biotope which offers important habitat for benthic macro-invertebrates.

Eutrophication is also a factor in blooms of toxic algae and other toxic micro-organisms. These organisms can impact human health as well as animal health. Human and animal health can also be impacted by pathogens and nitrogen in animal manure. Nitrogen is easily transformed into the nitrate form and if transported to drinking water sources can result in potentially fatal health risks to infants. Trace elements in manure may also present human and ecological risks. Salts can contribute to salinization and disruption of the ecosystem. Antibiotics, pesticides, and hormones may have low-level, long-term ecosystem effects.

Organic waste discharged from livestock farms or deposited into stream during livestock grazing, are considered to be oxygen-demanding. When discharged into a receiving water body micro-organisms (bacteria, fungi, protozoans) use up dissolved oxygen while consuming or decomposing the waste. The rate at which this process occurs is measured as the *biological oxygen demand* (BOD). Manure may have BOD concentrations in excess of 1000 mg 0-1. Livestock waste is a source of bacteriological contamination. It may occur when livestock manure is deposited in the stream either directly or during surface runoff. Faecal coliforms (FC) and fecal streptococci (FS), whilst not pathogenic, are the primary indicators of the potential presence of pathogens. Pathogenic organisms, when present in animal waste, can be transferred to humans via water. Some potential diseases that may be transferred to humans via cattle, for example, are salmonellosis, anthrax, turberculosis, tetanus, colibacilosus, etc. Peak faecal coliform concentrations are frequently related to runoff events (Dallas *et al.* 1994).

Mitigation

- Abattoirs aim at optimising the recovery of edible portions from the meat processing cycle for human consumption. Significant quantities of secondary waste materials not suitable for further consumption are however generated. Since water is often used to wash excessive waste solids to drain, waste solids should be carefully managed to promote water conservation. Types of solid waste resulting from pre-treatment could be summarised as: Dewatered solids mainly hair, stomach fibres / residues; disposal routes could include removal by farmers for pig feed, compost supplementation. Blood solids, normally converted into blood meal, however at small abattoirs blood represents a severe problem; Hides could be sent to tanneries for processing leather; Other waste, including animal trimmings, feeds, heads and condemned animals could be used in pet food manufacture; Hooves could be sent for gelatine recovery.

- Maintenance of riparian zone buffer strips (minimum 32m) from proposed feeding-lot site to reduce the risk of surface water contamination via surface runoff. The riparian zone is a three-dimensional assemblage of vegetation and organisms adjacent to flowing water that form the ecotone between the terrestrial and aquatic ecosystems..

- Exclusion of livestock from stream edges and damp hill slopes, avoidance of overgrazing and exposure of bare soil to reduce the potential for soil erosion and encourage preservation of riparian vegetation.

- Exclusion of livestock from the Mnywane River and stream-banks to prevent waste entering directly into the water.

- Control of grazing pressure to ensure the maintenance of rapid filtration rates (by reducing the amount of trampling), good pasture or grass recovery rates and preservation of the grass and litter layer.

- Controlled runoff from feedlots and proper storage (with impervious linings) and disposal of manure (manure is suited for application to cropland).

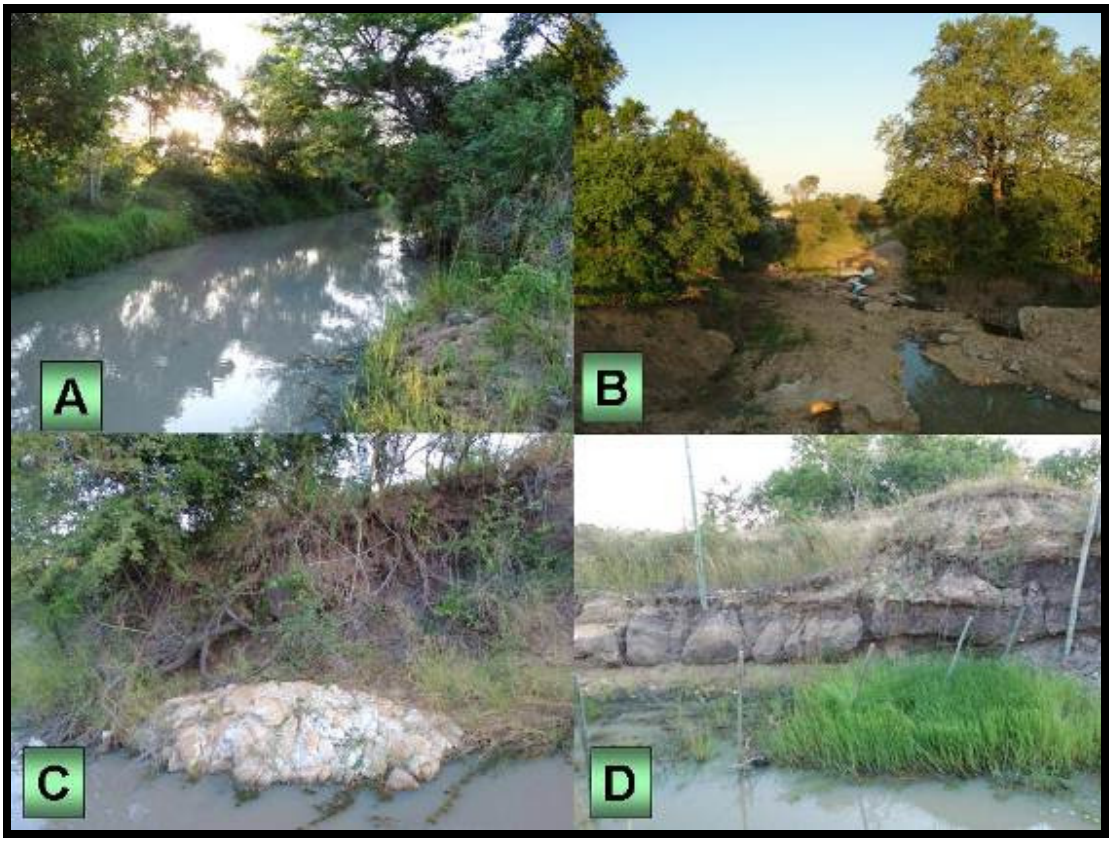

Figure16. A collage of photographs displaying the current impacts on the Mnywane River. A: The non-perennial Mnywane River natural hydrological patterns have been disrupted by existing concrete weirs and stormwater pipes under the R570 and access roads. **B:** The Mnywane River downstream from the site has been heavily impacted on by high levels of anthropogenic activities including fishing, wood and sand harvesting and livestock grazing and drinking activities. **C & D:** The macrochannel banks of Mnywane River have been eroded by un-controlled livestock grazing activities as well as altered flow regimes. Increased erosional force below stormwater pipes result in the scouring of the banks.

6.3 Erosion and Surface runoff

Soil disturbance accompanying land clearing, burning, ploughing and heavy grazing may lead to increased surface runoff thereby causing sediment to enter the stream or river. Compaction of the soil by grazing animals can alter the infiltration capacity. Intensive cultivation can break down soil aggregates, again altering the natural rates of infiltration and run-off. Where soils adjacent to streams are exposed through removal of vegetation, the potential of lost soil to degrade surface waters may be high, leading to turbidity and then sedimentation of the stream. Increased infiltration may result in a higher rate of leaching. Leaching occurs when dissolved and un-dissolved substances, such as salts, nutrients and other materials are washed out of the top layers of soil. This reduces fertility so that a soil may require addition of fertilisers to sustain a particular land use, increasing the risk of contamination of adjacent surface waters. **In** undisturbed terrain, leaching is most noticeable where the average annual rainfall is greater than 600 mm.

The amount of sediment lost from a catchment depends on local factors such as slope and soil type and on the presence and extent of the riparian zone buffer strip. Livestock watering at the bank-side may also cause substantial erosion and sediment input into adjacent water bodies. Sheet erosion occurs when run-off surface water carries away successive thin layers of soil over large patches of bare earth. This type of erosion is most severe on sloping soils, which are weakly structured with low infiltration, which promotes rapid run-off. It occurs on the site where vegetation has been destroyed. Continual erosion in sheet-eroded slopes is a common cause of gully erosion. Gully erosion results from increased flow along a drainage line, especially where protective vegetation has been removed and soils are readily transported. A gully has steep, bare sides and is often narrow and deep. Once formed, a gully usually spreads upstream through continual slumping of soil at the gully head. Gully erosion can be associated with salting as the saline sub-soils are readily eroded. As the site is on a gently undulating environment towards the Mnywane River; adequate erosion control measures must be implemented throughout all stage of the development. Erosion preventative measure must be implemented from the proposed feeding-lot site.

Mitigation and recommendations

The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season in order to prevent erosion and siltation. The dry months are also the period when the majority of species are either dormant or finished with their breeding activities. Future soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from drainage areas.. The careful position of soil piles, and runoff control, during all phases of development, and planting of some vegetative cover after completion (indigenous groundcover, grasses etc.) will limit the extent of erosion occurring on the site. Sufficient measures must be implemented to prevent the possible contamination of the surface water and surrounding groundwater.

Vegetation plays a critical role in the hydrological cycle by influencing both the quantity and quality of surface run-off. It influences the quantity of run-off by intercepting rainfall, promoting infiltration and thus decreasing run-off. Vegetation can influence water quality in two ways: by binding soils thus protecting the surface layer, and by intercepting surface run-off thus buffering the wetlands against suspended and dissolved substances. When the speed of the run-off is reduced, suspended particles can settle out and dissolve substances, such as nutrients, can be assimilated by plants. The vegetation has a filtering effect. Storm-water and runoff from the proposed feeding-lot site should be channelled through natural woodland and grassland buffer areas or into shallow seasonal retention/attenuation ponds reducing the erosional force and the potential risk of contamination and erosion of the lower lying non-perennial Mnywane River.

The eroded areas of the non-perennial Mnywane River should be appropriately rehabilitated and re-vegetated with indigenous (to the area) vegetation in order to prevent further erosion and siltation of downstream habitats. Severely eroded macrochannel embankments below the current stormwater pipes under the R570 should be stabilised with gabions with sediment trapping material and adequately rehabilitated

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