SPECIALIST ECOLOGICAL SURVEY AND HABITAT ASSESSMENT FOR THE PROPOSED P-166 ROAD; WHITE-RIVER-MBOMBELA, MPUMALANGA PROVINCE

Compiled for **Royal Haskoning*DHV*** by**:**

Vegetation Aspect

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Abbreviations

AOO	Area Of Occupancy
CBA	Critical Biodiversity Area
DEAT	Department of Environmental Affairs and Tourism
Mamsl	Metres Above Mean Sea Level
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act (No. 10 of 1998)
MTPA	Mpumalanga Tourism and Parks Agency
NEMBA ToPS	National Environmental Management: Biodiversity Act Threatened or Protected Species (No. 10 of 2004)
NFA	National Forests Act (No. 30 of 1998)
PRECIS	National Herbarium Pretoria Computerised Information System
SANBI	South African National Biodiversity Institute

Terminology

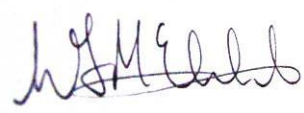
Biodiversity	The structural, functional and compositional attributes of an area, ranging from genes to landscapes.
Degraded	An ecosystem that is in a poor ecological state, usually through impacts such as invasion by alien plants, severe overgrazing, poor burning regimes, etc. These systems still contain a moderate proportion of indigenous flora.
Geophyte	Plants that produce their growth points from organs stored below the ground, an adaption to survive frost, drought and / or fire.
Rupicolous	Faunal species living on and amongst rocks (several lizard species).
Transformed	Transformed ecosystems are no longer natural and contain little or no indigenous flora. Examples include agricultural lands, plantations, urban areas, etc.

Declaration of Independence

We declare that we have been appointed as independent consulting ecologists with no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2010. We 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 *30th of March 2015*

L.R.Brown *30th of March 2015*



W.L.McCleland *24th of February2015*

D.R. McKenzie *24 of February2015*

1. Background Information

Prof. L.R. Brown and Mr. C. L. Cook were appointed by Royal HaskoningDHV (previously SSI) to undertake a preliminary ecological assessment for the scoping phase of the proposed EIA for the P-166 road from the north of White River to the south of Mbombela (Nelspruit). Six alternatives alignments were proposed for the new P1-66 road linkage. It must be stressed that no comprehensive vegetation or faunal surveys have been undertaken due to severe financial and time constraints as well as access on privately owned properties; but merely a brief assessment of the current ecological status of the proposed road alignments. By surveying the proposed road alignment as well as immediate areas adjacent to the proposed alignment 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. Three separate site investigations were undertaken of the proposed alignments; conducted on the 20-21st October 2012; 22-24th April 2013 and the 19-21st February 2014.

ECOREX Consulting Ecologists was appointed by Royal HaskoningDHV to conduct a walk-through survey on four alternative routes for the proposed P166 by-pass road between Rocky Drift and White River, Mpumalanga Province. The survey was performed on recommendation from the MTPA as there are known populations and records of conservation-important plants and animals on or adjacent to the proposed routes. The walk-through was undertaken by Mr. Duncan McKenzie from ECOREX over a three days period between late January and early February 2015. The walk-through coincide dwith the flowering period of the plant species with the highest threat status known to occur on the route, namely the Critically Endangered *Aloe simii*.

2. TERMS OF REFERENCE

In order to meet the objectives of the project, the following terms of reference informed the scope of the study:

2.1. Objectives of the Specialist Ecological Survey

- To provide a basic description of the fauna and vegetation units occurring along the proposed P-166 road alignments. List the prominent plant species (trees, shrubs, grasses and other herbaceous species of special interest) present for vegetation unit and ecosystem delimitation.
- To identify plant and animal/faunal species (mammals, birds reptiles, amphibians) of conservation importance; which could possibly occur along the proposed P-166 road alignments. The aim of the detailed ecological study or walk-through conducted by ECOREX is to provide input into the EIA-phase ecological assessment for the P166 project. The ecological assessment will comprise a more detailed assessment of threatened species and species of conservation importance in a part of the study area identified as needing to be subject to a more detailed assessment as requested by the Mpumalanga Tourism & Parks Agency (MTPA).

2.2 Scope of study

- A brief field survey (7 days) of the proposed P-166 road alignments undertaken between October 2012 and February 2014.
- Undertake a walk-through of all the sections of the proposed P166 road servitude, Phumlani 2 Alternative, and White River Alternative in the White River/ Msholozi part of the study area. The walk-through was undertaken in the summer growing season in January/ February when one of the focus species identified (*Aloe simii*) is flowering. The walk-through of the alternative alignments was restricted to three days in Jan/Feb 2015.
- The walk-through assessment must focus on locating all conservation-important plant and animal species, including Red Data species, species protected under the Mpumalanga Nature Conservation Act (MNCA, Act 10 of 1998) or the National Forest Act (NFA, Act 30 of 1998), and species listed under the National Environmental Management: Biodiversity Act Threatened or Protected Species (NEMBA ToPS, Act 10 of 2004).
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal and plant

species (Red Data/Listed Species), which could possibly occur along the proposed P-166 road alignments and immediate adjacent areas.

- Prepare an ecological sensitivity map of the proposed P-166 road alignments. The report will include tables with numbers and localities of all species located, as well as strip maps highlighting Red Data plants/ animals.
- Documentation of the findings of the study in a report and will include recommendations regarding appropriate mitigation measures, where applicable.

3. METHODOLOGY

The proposed route was analysed prior to the field survey for available literature and database information pertaining to the vegetation and threatened species of the study area. The Braun-Blanquet survey technique to describe plant communities as ecological units was used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area. The vegetation survey was conducted by Prof. LR Brown and the faunal survey by Mr CL Cook during the period from the 20th - 21st of October 2012, 22nd - 24th April of 2013 and the 19th- 21st of February 2014. During the field surveys, selected natural areas were covered on foot and the majority of the rest of the road alignment by vehicle. Limited surveys were undertaken within the transformed vegetation units and habitats along the proposed alignments. The walk-through was undertaken by Mr. Duncan McKenzie from ECOREX over a three day period between late January and early February 2015.

3.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure and the proposed alignments. This was used as far as possible in order to identify potential “hot-spots” along the proposed three alternative road alignments and reserves, e.g. Patches of undisturbed Legogote Sour Bushveld vegetation, river crossings, palustrine wetlands (valley bottom and hillslope seepage), large granite outcrops and sheets. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and land use.

3.2 Literature Survey

Conservation-important plant species listed for the quarter-degree grids 2530BDand 2531ACin the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database, as well as PRECIS data from the South African National Biodiversity Institute (SANBI), were used to produce a list of the most likely occurring species, which were searched for during fieldwork. Conservation-important plants include those listed as species of conservation concern by 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).

A detailed literature search was undertaken to assess the current status of threatened faunal species that have been historically known to occur in the Mbombela (Nelspruit)-White River 2530BD, 2530CD and 2531BA quarter degree grid cells (QDGC's) as well as 2530_3055, 2525_3055, 2520_3055, 2515_3055 and 2515_3100 pentads for avifuana/birds (SABAP2). 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) as well as internet using POSA (http://posa.sanbi.org). *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 10th of March 2014) 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 (http://sabap2.adu.org.za accessed on the 11th of March 2014). 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. 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 12th of March 2014) for reptiles.

3.3 Fieldwork

Field work for the preliminary vegetation survey was conducted by Prof. LR Brown and the faunal survey by Mr CL Cook during the period from the 20th & 21st of October 2012, 22-24th April 2013 and the 19-21st February 2014. During the field surveys, selected natural areas were covered on foot and the majority of the rest of the road alignment by vehicle.

Fieldwork for the walk-though was performed over three days during late January/ early February 2015 to coincide with the flowering period of the plant species with the highest threat status known to occur on the route, namely the Critically Endangered *Aloe simii*. The entire length of each route was walked, scanning and locating plants and animals using meandering transects across the width of the servitude routes provided by Royal HaskoningDHV. The width of the servitude varied from *c*. 60 m to *c.* 300m. Co-ordinates of all conservation-important plants and animals located were recorded with a Garmin GPSMap 62s, and each plant species was photographed and total numbers of individual counted within a *c*. 20m radius. Faunal records were gathered using visual cues such as sightings, tracks and scats, as well as auditory recognition for birds (McKenzie, 2015).

3.4 Assumptions, Limitations and Knowledge Gaps

3.4.1. Seasonality

The preliminary vegetation and faunal surveys were restricted to the early (October) and late summer months (April). The walk-through assessment was based on a single field survey in the middle of the growing season, and only species of plants visible and / or flowering in mid-summer were detected. It is possible that plants which flower at other times of the year are under represented. Many sections of the route were also dominated by the tall yellow thatch grass (*Hyperthelia dissoluta*) and this limited visibility in these areas. Some plants may have been overlooked due to the 2 m and taller vegetation.

3.4.2 Overlooked Species

Certain plant species, particularly geophytes, will only flower in seasons when conditions are optimal and may thus remain undetected, even over a survey that encompasses several seasons. Other plant species may be overlooked because of very small size and / or extreme rarity. Several faunal species are highly secretive and may remain undetected over extensive surveys conducted for extended periods.

3.4.3 Access

Access to the very western-most portion of the White River route was denied to the research team despite a personal request to the landowner. Approximately 800 m of the route was therefore not surveyed. This section comprises mostly mown grassland, timber plantations and recently cleared alien tree infested areas and the likelihood of finding significant conservation-important flora and fauna species in that section is low.

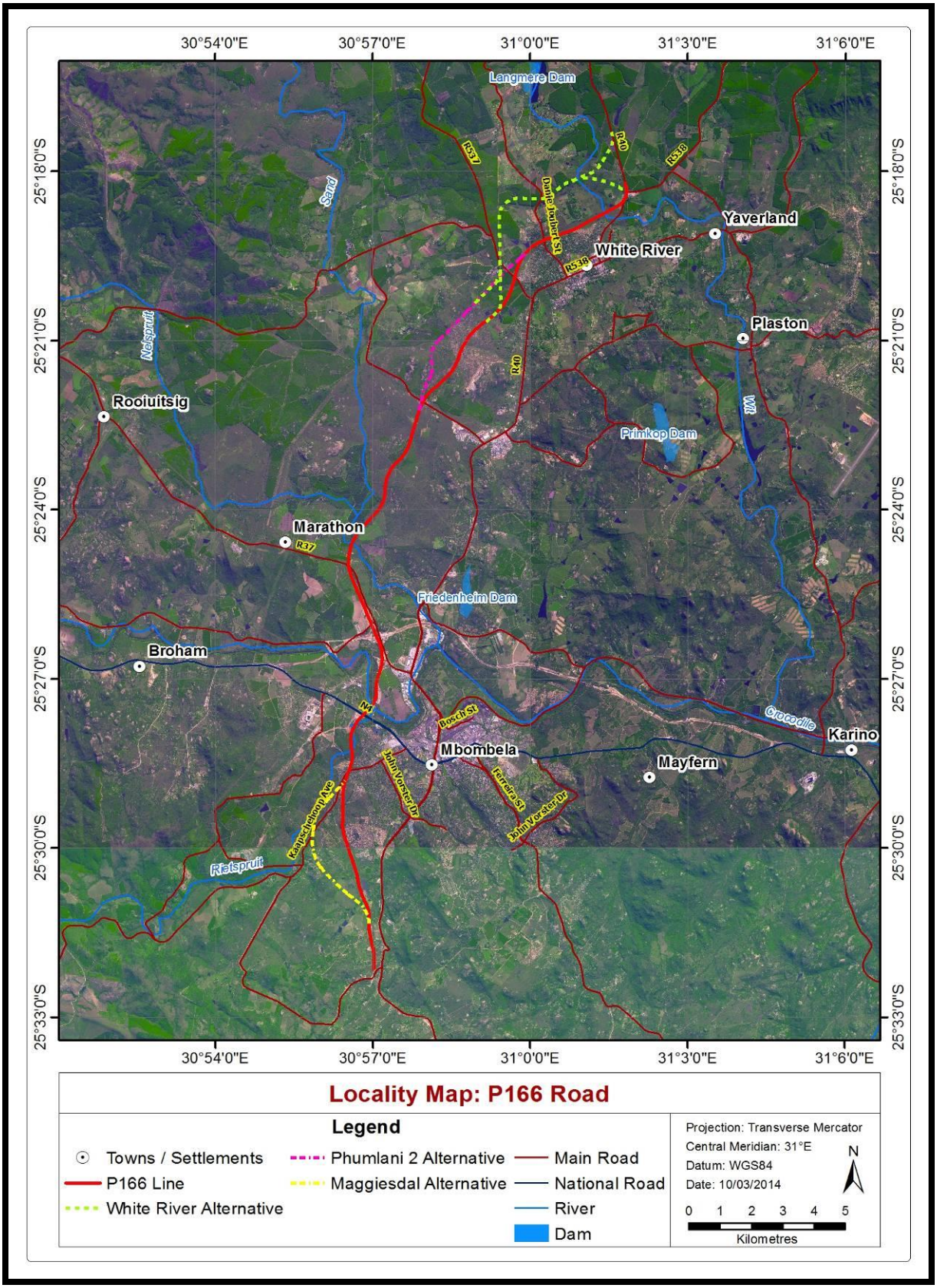


Figure1. A locality map of the proposed P-166 alignment.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

CONDITIONS RELATING TO THIS REPORT

4.1 VEGETATION ASPECT

Approach

Conclusions reached and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant species are absent.

The study area falls within the savanna biome of South Africa and specifically in the **Central Bushveld Bioregion (SVcb)** (Mucina & Rutherford 2006). This bioregion has the highest number of vegetation types of the savannah bioregions. On a smaller scale the study area is located within **Legogote Sour Bushveld (SVI 9)** (Mucina & Rutherford 2006). Some of the stretches along the routes cannot be considered representative of this vegetation type due to the disturbance levels from former and current *Eucalyptus* plantations, old agricultural lands, dumping, frequent heavy burning and alien plant infestation, but some stretches are representative and appear to be in good ecological condition.

Altitude across the four portions varies from *c*. 770 m.a.m.s.l. near the start of the Msholozi Route to *c.* 980 m.a.m.s.l. near the start of the White River Alternative Route.

The Phumlani and MsholoziRoutes are classified as either Heavy or Moderately Modified or Other Natural Areas by the MBSP. The White River Alternative Route covers mostly Heavy or Moderately Modified Areas, although some portions cross narrow sections of Critical Biodiversity Area (CBA): Irreplaceable. Approximately half of the White River Route is classified as either Heavy or Moderately Modified or Other Natural Areas, the other half being classified as CBA: Irreplaceable (Lötter *et al.,* 2014).

The study area is not situated in any floristic centres of endemism according to Van Wyk & Smith (2001).

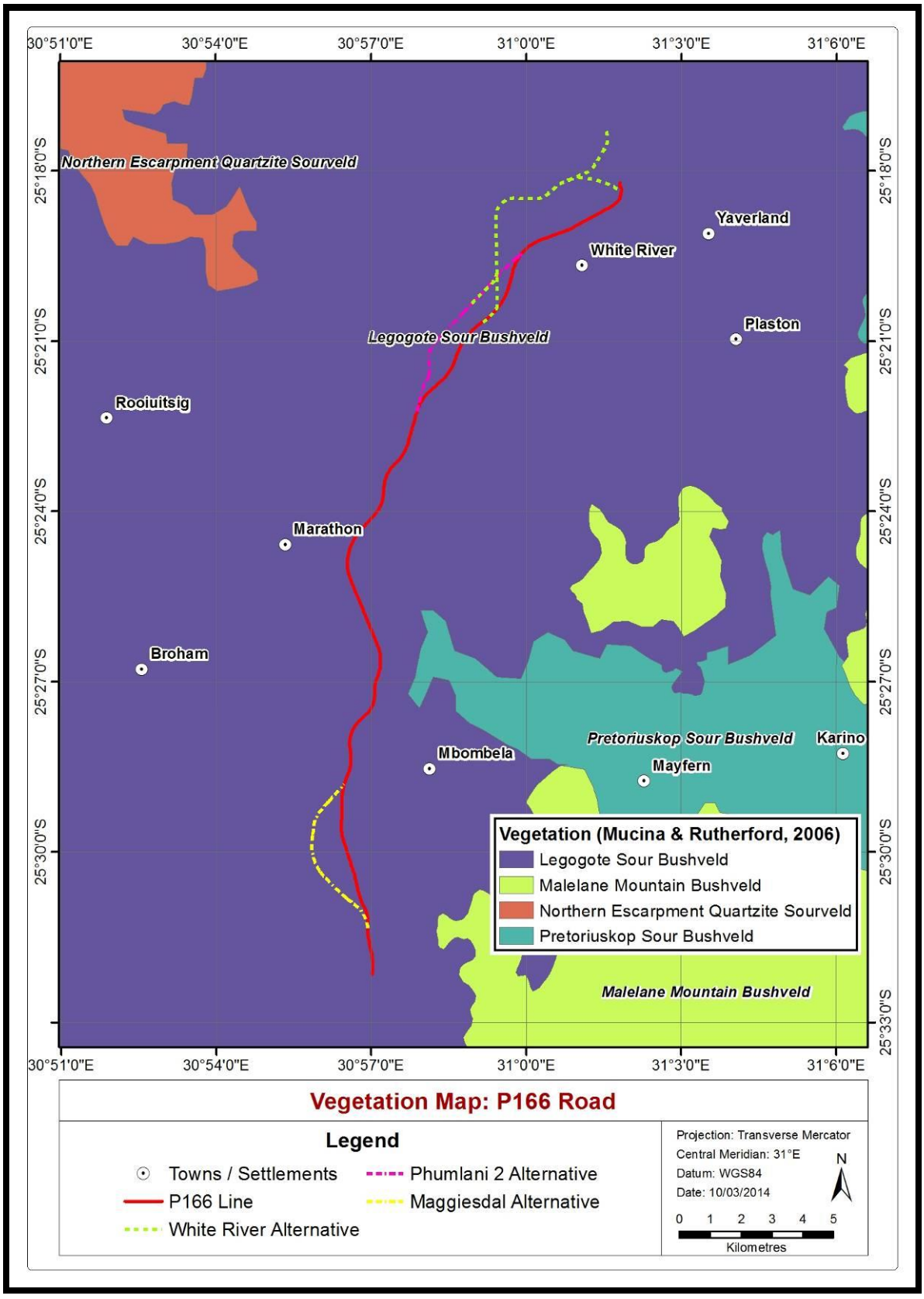


Figure2. Vegetation type of the study area (adapted from Mucina & Rutherford 2006).

Landscape Features

Gently to moderately sloping upper pediment slopes with dense woodlands including many medium to large shrubs often dominated by *Parinari curatelifolia* and *Bauhinia galpinii* with *Hyperthelia dissoluta* and *Panicum maximum* in the undergrowth. Short thicket dominated by *Acacia ataxacantha* occurs on rocky sites. Exposed granite outcrops have low vegetation cover, typically with *Englerophytum magaliesmontanum, Aloe perticola* and *Myrothamnus falbellifolia* (Mucina & Rutherford 2006).

Geology & Soils

The largest part of the area comprises gneiss and migmatite from the Nelspruit suite with large granite outcrops. Soils are of Mispah, Glenrosa and Hutton forms, shallow to deep, sandy or gravely and well drained. Diabase intrusions are common, giving rise to Hutton soils. Dominant land types Ab, Fa and Ae.

Climate

Summer rainfall with dry winters with Mean Annual Precipitation of approximately 667 mm of rain (Figure 3). The area is within the summer rainfall area with the highest rainfall in summer (120 mm – December) and the lowest rainfall during June (2 mm). The average midday temperatures range from 21°C in June to 28°C in January with the coldest temperatures (6°C) during the winter in July (Figure 4).

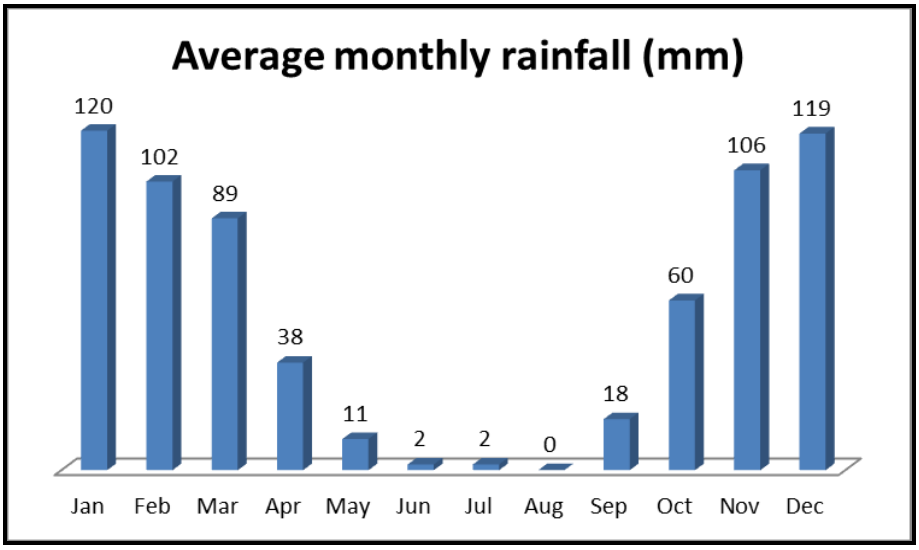


Figure3. Average monthly rainfall for the area.

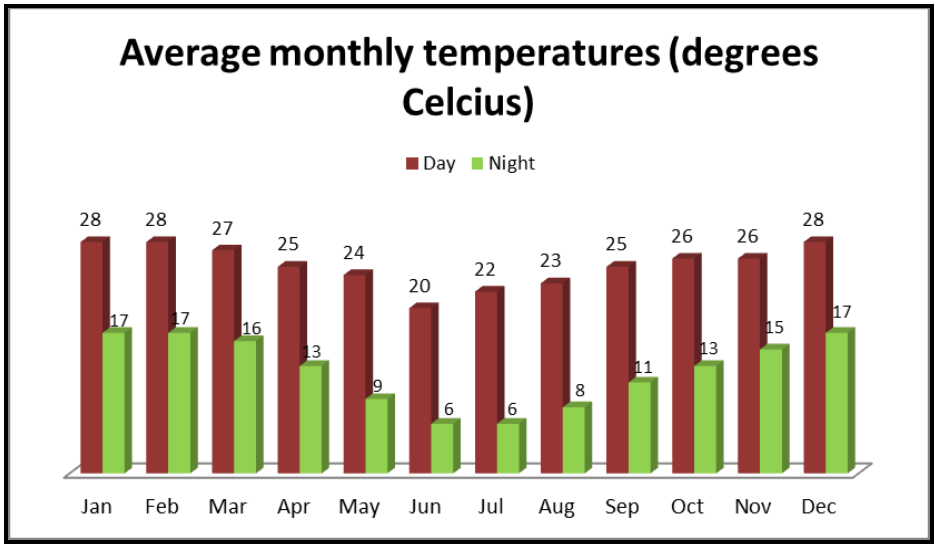


Figure4. Average monthly temperatures for the study area.

4.2 LEGOGOTE SOUR BUSHVELD (SVI 9)

Figure5. A photograph of Legogote Sour Bushveld situated on the dense woodland slopes dominated by various woodland species and poorly vegetated granite domes around Mbombela/Nelspruit.

The vegetation is characterised by the presence of medium to large shrubs that form dense woodland areas on the slopes, while various *acacia* species are present in the lower-lying areas with *Dichrostachys cinerea* prominent in some localities. The large granite outcrops do not have much vegetation cover though smaller forb species do grow in the crevices where soil and litter have collected. Large areas have been transformed due to mainly forest plantations, with some areas transformed due to cultivation of crops. The soil ranges from deep Hutton to shallow but well-drained Mispah.

Dominant taxa in this vegetation type include:

Woody species	*Pterocarpus angolensis, Sclerocarrya birrea, Acacia sieberiana, Acacia caffra, Ximenia caffra, Ficus thonningii, Combretum zeyheri, Schotia brachypetala, Diospyros lycioides, Gymnosporia buxifolia, Terminalia sericea, Englerophytum magalismontanum*

Grasses	*Cymbopogon excavatus, Hyparrhenia hirta, Setaria sphacelata, Hypethelia dissoluta, Andropogon shirensis, Scizachyrium sanguineum, Heteropogon contortus*

Forbs	*Gerbera viridifolia, Waltheria indica, Hypoxis rigidula, Xerophyta retinervis*

Endemic species to this vegetation type:

Aloe simii

Alien species within this vegetation type:

Lantana camara, Solanum mauritianum, Melia azedarach, Psidium guajava

Conservation status: Endangered with target of 19%. Only about 2% statutorily conserved in the Bosbokrand and Barbeton Nature Reserves, and a further 2% in private reserves including the Mbessan and Kaapsehoop Reserves and the Mondi Cycad Reserve. It has been greatly transformed (50%), mainly by plantations and also by cultivated areas and urban developments.

4.3 PRETORIUSKOP SOUR BUSHVELD (SVI 10)

Figure6. Pretoriouskop Sourveld Bushveld situated on a hillslope and is the typical open tree savanna dominated by several tree and shrub species.

The vegetation type is similar to the Legogote Sour Bushveld (SVI 9) but is drier and occurs mostly as open tree savannah that is characterised by the prominence of *Dichrostachys cinerea* and *Terminalia sericea* (Mucina & Rutherford 2006). The area is classified as open savannah with various *Acacia* species present and occurs on the upland areas. The geology is mainly granite from the Nelspruit Suite and the soil is shallow to medium deep. Large areas have been transformed due to cultivation and the development of settlements.

Dominant taxa in this vegetation type include:

Woody species	*Acacia nilotica, Acacia tortilis, Combretum apiculatum, Combretum zeyheri, Peltophorum africanum, Combretum molle, Terminalia sericea, Dichrostachys cinerea, Strychnos madagascariensis, Grewia bicolor*

Grasses	*Elionurus muticus, Hyparrhenia hirta, Panicum coloratum, Eragrostis rigidior, Heteropogon contortus*

Forbs	*Waltheria indica, Schkuhria pinnata,,*

Alien species within this vegetation type:

Lantana camara, Solanum mauritianum, Opuntia stricta, Psidium guajava

Conservation status: Least threatened with a conservation target of 19% conserved. Some 40% conserved in the Kruger National Park. About 16% transformed by cultivation and by the development of settlements.

4.4 RED DATA SPECIES

An investigation was also carried out on rare and protected plants that might possibly occur in the region. For this investigation the National Red List of Threatened Plants of South Africa, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) was used.

Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the plant communities include the tree, shrub and herbaceous layers.

The **conservation priority** of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Savanna Biome of South Africa.

The following four **conservation priority** categories were used for each vegetation unit:

High: Area with high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity; between 5-20% pioneer/alien plant species present; that would need moderate to major financial input to rehabilitate to an improved condition; and where low density development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation are maintained**.**

Low-medium: Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

Alien plants are indicated in red, red data/endemic in green.

4.5 RESULTS

Seven distinct vegetation units could be identified (Figures 7a-e) namely:

1. Wetland
2. Sour Bushveld
3. Riverine areas
4. Bushveld
5. Afforested plantations / Developed areas

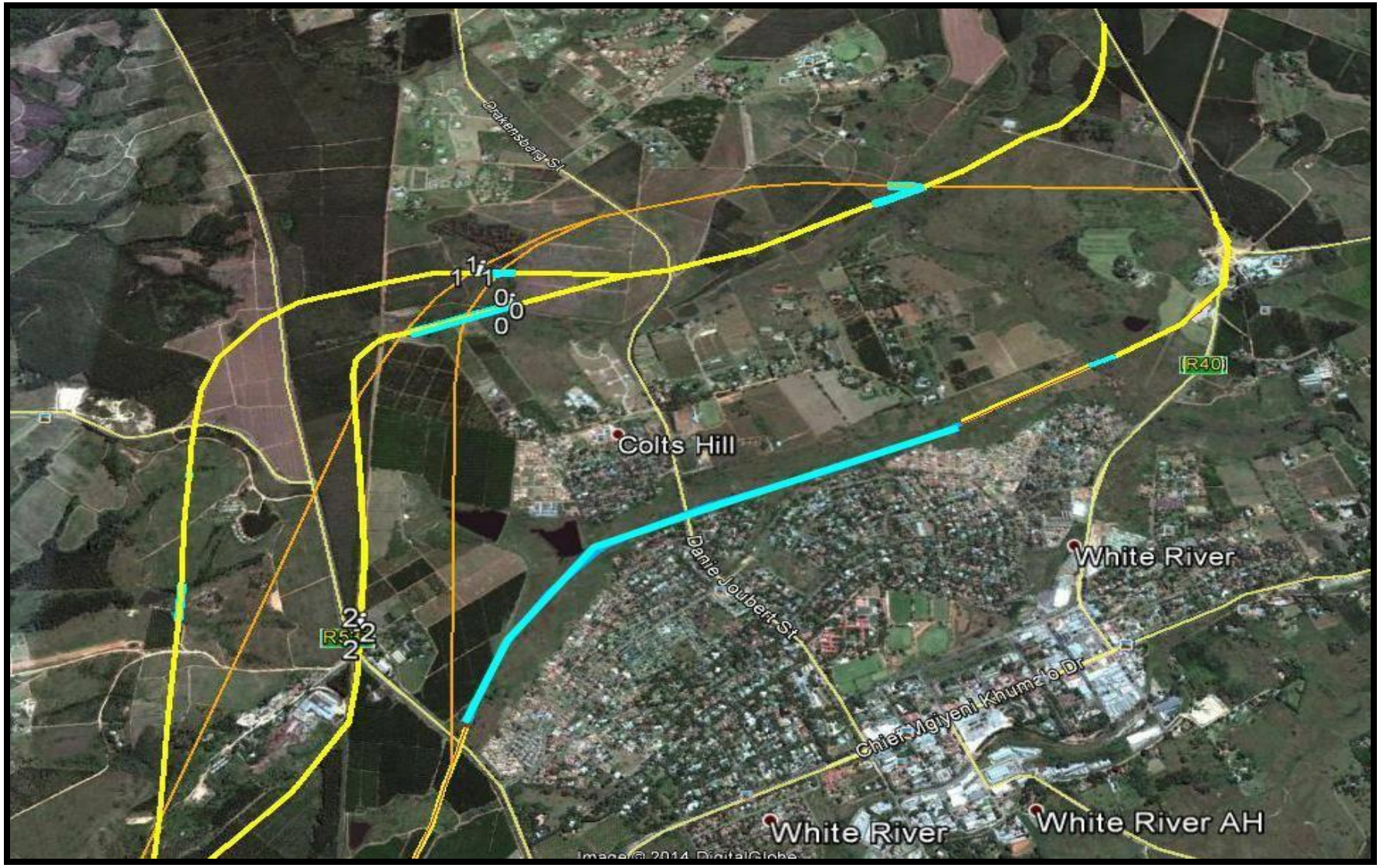


Figure7a. Vegetation units of study area [Wetland (Unit 1) = Blue; Sour Bushveld (Unit 2) = Green; Riverine areas (Unit 3) = Pink; Bushveld (Unit 4) = Orange; Plantations/Developed areas (Unit 5) = Yellow]

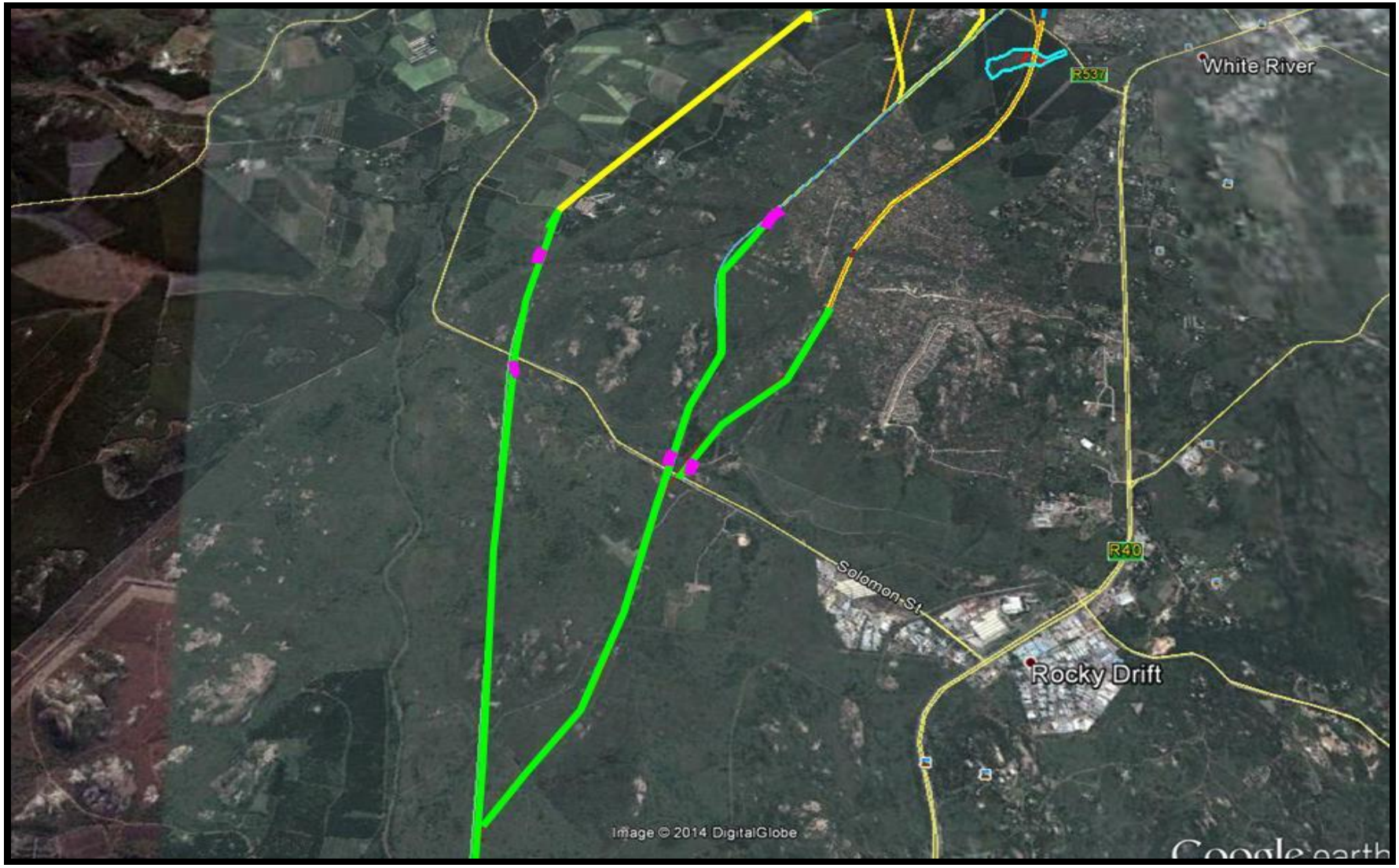


Figure7b. Vegetation units of study area [Wetland (Unit 1) = Blue; Sour Bushveld (Unit 2) = Green; Riverine areas (Unit 3) = Pink; Bushveld (Unit 4) = Orange; Plantations/Developed areas (Unit 5) = Yellow]

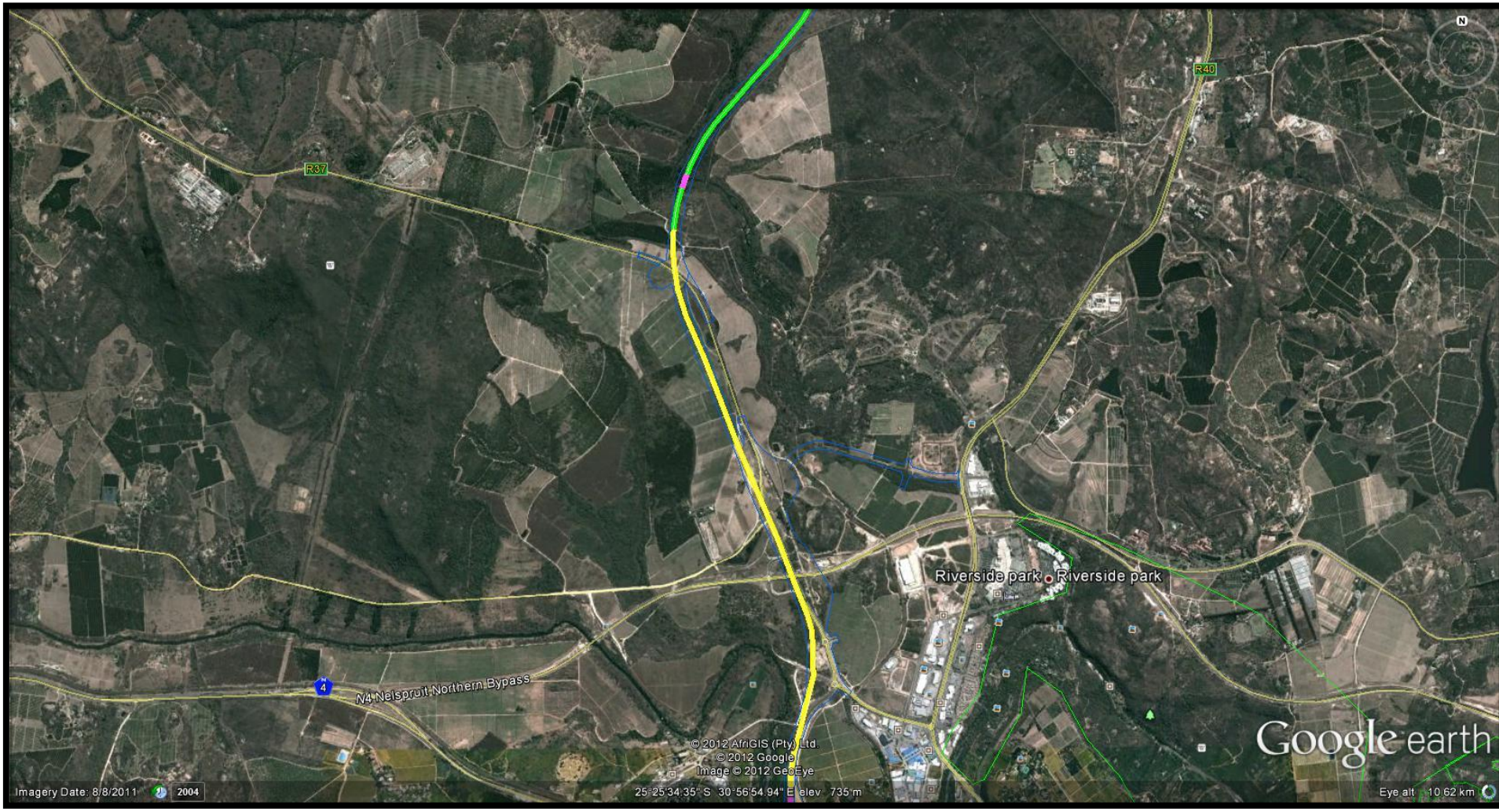


Figure7c. Vegetation units of study area [Wetland (Unit 1) = Blue; Sour Bushveld (Unit 2) = Green; Riverine areas (Unit 3) = Pink; Bushveld (Unit 4) = Orange; Forest/Developed areas (Unit 5) = Yellow]

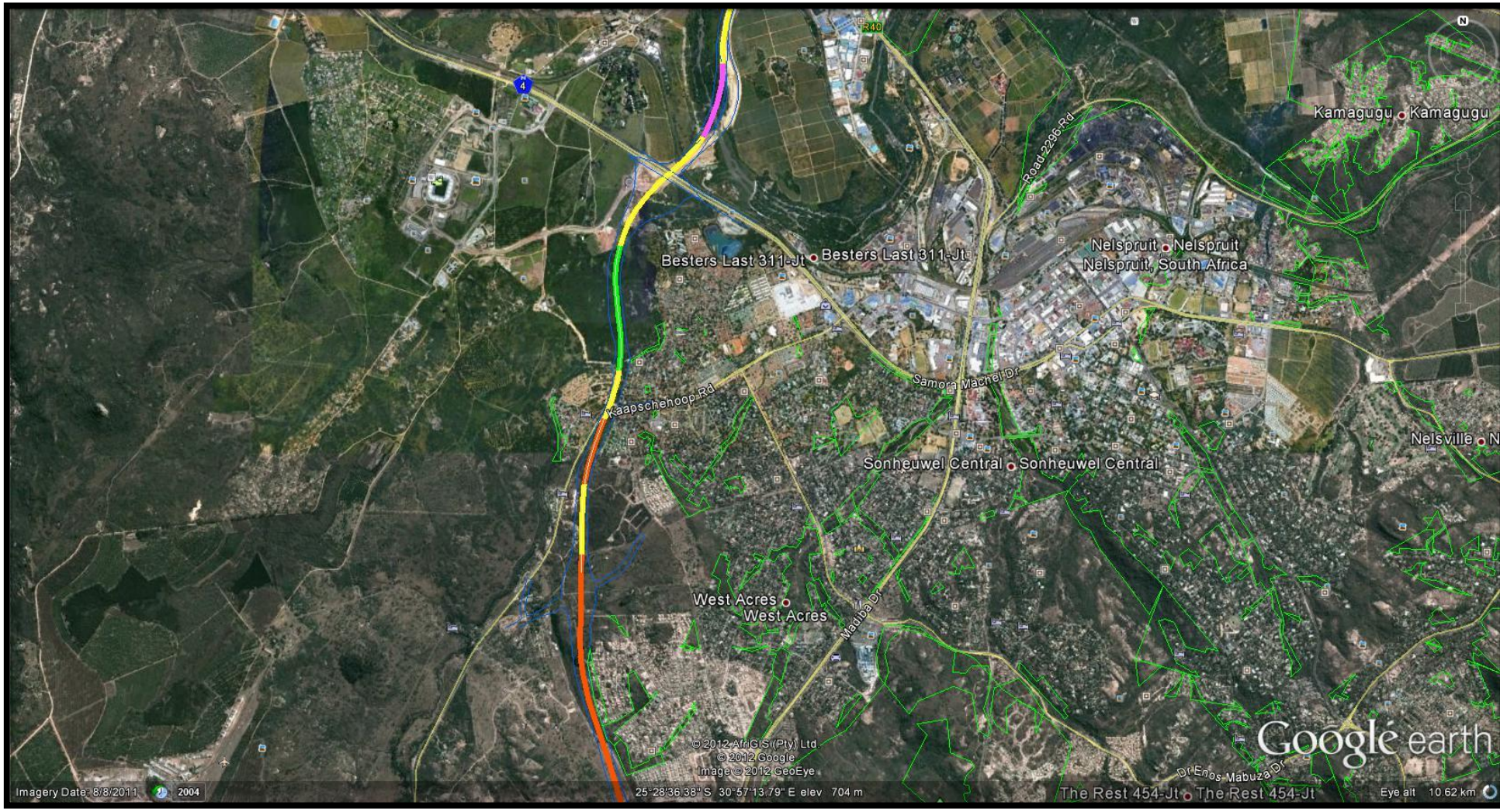


Figure 7d. Vegetation units of study area [Wetland (Unit 1) = Blue; Sour Bushveld (Unit 2) = Green; Riverine areas (Unit 3) = Pink; Bushveld (Unit 4) = Orange; Forest/Developed areas (Unit 5) = Yellow]

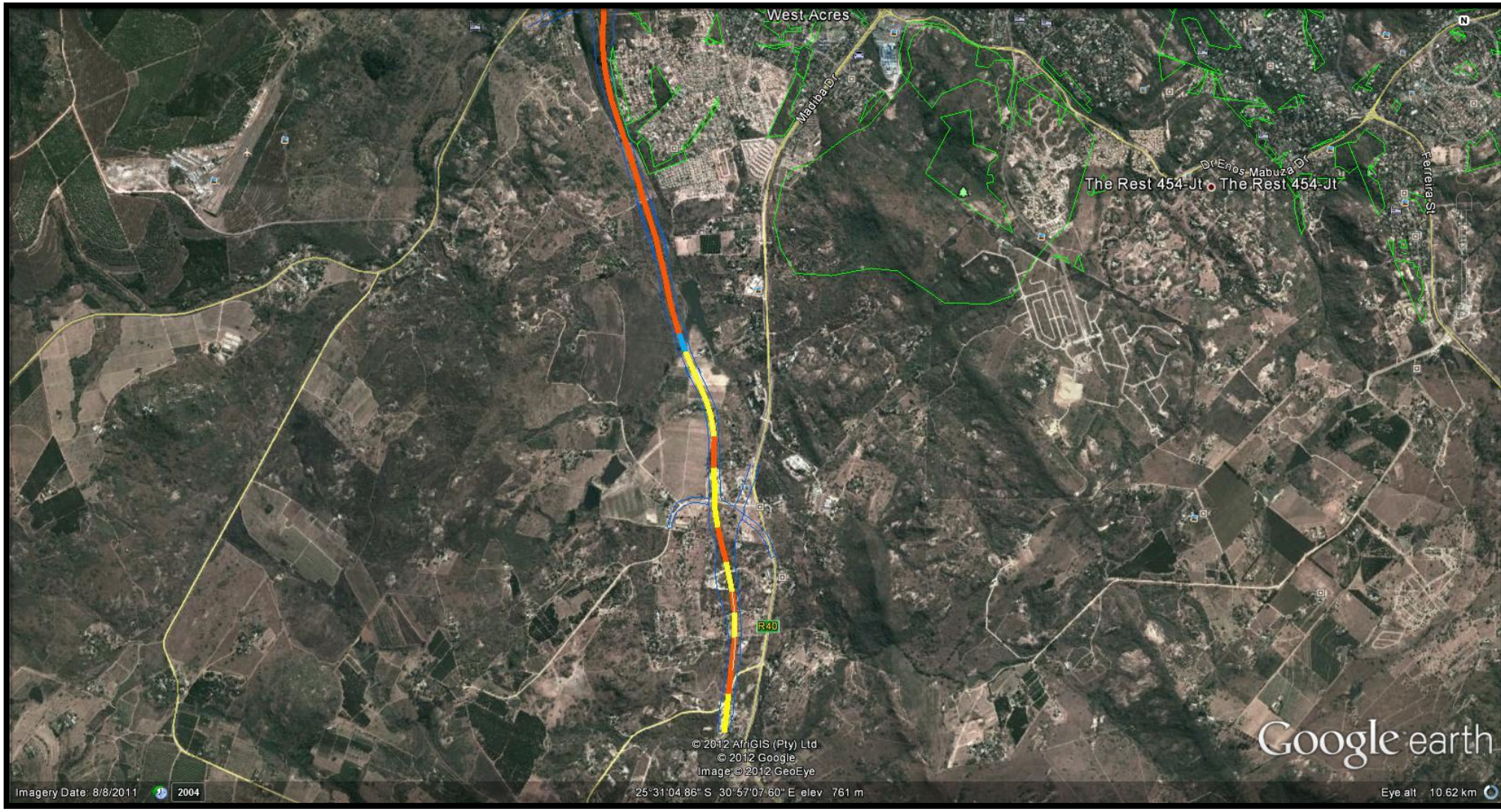


Figure7e. Vegetation units of study area [Wetland (Unit 1) = Blue; Sour Bushveld (Unit 2) = Green; Riverine areas (Unit 3) = Pink; Bushveld (Unit 4) = Orange; Forest/Developed areas (Unit 5) = Yellow]

VEGETATION UNITS

4.5.1. Wetlands

Mapping unit	1	**Tree cover**	0%
Soil	Clay	**Shrub cover**	1%
Topography	Broad valley bottom; artificially channelled	**Herb cover**	35-55%
Land use	Cultivation & natural	**Grass cover**	25-35%
Unit status	Slightly degraded wetland	**Rock cover**	2%
Conservation priority	High	**Erosion**	1%
Dominant spp.	*Phragmites mauritianus, Imperata cylindrica, Agrostis lachnantha, Typha capensis, Kyllinga alba, Monopsis decipiens, Eulophia angolensis*		

This vegetation unit is located on northern part of the study area in the town of White River. The soil is dark grey clay. Few woody species occur (*Acacia sieberiana* var. *woodii*) covering less than 1% of the area. The herbaceous component is dominant with the forbs covering between 35 and 60% of the area with the grasses between 25-35%. Except for single large rocks in the stream no other rocks were observed.

The vegetation is characterised by typical wetland species such as the grasses *Phragmites mauritianus, Imperata cylindrica, Agrostis lachnantha,* and the forbs *Typha capensis, Kyllinga alba, Eulophia angolensis, Monopsis decipens* and various *Cyperus* spp. The declining red data plant *Gunnera perpensa* and Critically Endangered *Aloe simii* are also present within the channelled valley bottom wetland in the White River Nature Reserve. The grass and forb layers are dominant and cover up to 80% of the area. Single individual trees such as the exotic *Eucalyptus camaldulensis* are present in this unit.

The vegetation is typical wetland with the permanently wet and seasonal zones present with development on the temporary wet zone in the form of housing developments. The development within the wetland zone due to houses has also resulted in local people planting small crops and other plants directly in the seasonal wet zone of the wetland. It is also in these areas where the natural vegetation has been cleared and the soil worked and the water channelled. Various pioneer plant species such as *Tagetes minuta* and *Bidens pilosa* are present in these areas.

Red data species

One red listed Critically Endangered species namely *Aloe simii* was observed within this vegetation unit within the White River Nature Reserve. Two declining species *Gunnera perpensa w*ere found to be present in the seasonal wetland habitats around the White River and *Eucomis autumnalis* subsp. *clavata* within the Rocky Drift alignment. The habitat is also suitable for various hygrophilous and hydrophilic orchid species that were not flowering during the time of the survey.

The following is a list of species identified in this unit:

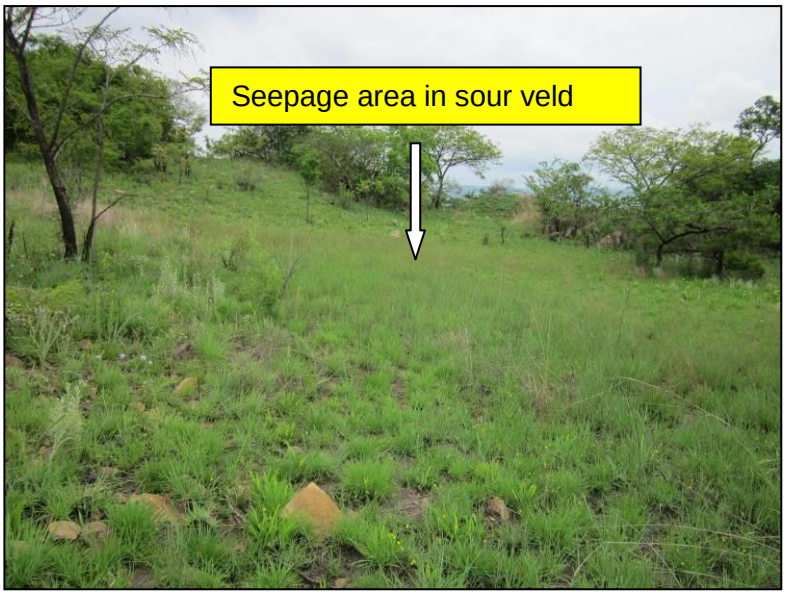
WOODY SPECIES
Eucalyptus camaldulensis
Acacia sieberiana var *woodii*
GRASSES
Agrostis lachnantha
Cynodon dactylon (L.) Pers.
Eragrostis plana
Imperata cylindrica (L.) Raeusch.
Phragmites mauritianus Kunth
Leersia hexandra
FORBS
Aloe simii Pole Evans
Ageratum conyzoides
Bidens pilosa L.
Canna indica L.
Conyza albida Spreng.
Cyperus rupestris Kunth
Cyperus species
Eriosema species
Eucomis autumnalis subsp. clavata
Eulophia angolensis (Rchb.f.) Summerh.
Gunnera perpensa L.
Kyllinga alba Nees
Mariscus congestus (Vahl) C.B.Clarke
Monopsis decipiens (Sond.) Thulin
Nephrolepis species
Pteridium aquilinum (L.) Kuhn
Richardia brasiliensis Gomes
Schoenoplectus corymbosus (Roth ex Roem. & Schult.) J.Raynal
Sida alba L.
Tagetes minuta L.
Trachycalymma cucullata (Schltr.) Bullock
Typha capensis (Rohrb.) N.E.Br.
Verbena bonariensis L.
Wahlenbergia undulata (L.f.) A.DC.
Zornia milneana Mohlenbr.

4.5.2. Sour Bushveld

Mapping unit	2	**Tree cover**	10-15%
Soil	Sandy loam with clay	**Shrub cover**	40-50%
Topography	Varies (1-5^0)	**Herb cover**	12%
Land use	Natural	**Grass cover**	55-65%
Unit status	Natural woodland / grazing	**Rock cover**	1-15%
Conservation priority	High	**Erosion**	1%
Dominant spp.	*Acacia sieberiana* var. *woodii; Pterocarpus angolensis*		

This woodland is occurs on rocky terrain that varies from level to mildly steep rocky outcrops. The soil is shallow on the higher-lying rocky areas and varies from shallow to medium deep in the lower-lying more level areas. Soil texture is sandy to loam with some clay present. The woody layer covers between 10 and 50% of the area. The grasses cover between 55 and 65% and the forbs up to 12% of the area.

The vegetation consists of open to closed woodland with smaller open grassland patches in-between. The trees *Acacia sieberiana* var. *woodii* and *Pterocarpus angolensis* dominate the vegetation. Various grass and forb species are present and include *Tristachya rehmannii, Brachiaria serrata, Eragrostis superba, Fuirena pubescens, Monopsis decipiens, Hypoxis iridifolia, H. rigudula* and *Gerbera jamesonii*.



In some places seeps were also found within the grassland patches between the woody species. These seeps provide a moist habitat and also form part of wetlands. The species present within what seems to be seasonal seeps comprise a mixture of terrestrial and moist loving species. The vegetation is natural with most of the species being climax species. Smaller degraded patches are present, mostly due to human influences, but overall the area has a high species richness and diversity. The woody layer varies from an open to closed canopy thereby providing a variety of habitats for the different plant and insect species present.

Red data species

Two declining species *Crinum macowanii* and *Eucomis atumnnalis* subsp. *clavata* were found to be present in this unit. Suitable habitat exists for other red data species.

The following is a list of species identified during the survey:

WOODY SPECIES
Acacia sieberiana DC.
Bauhinia galpinii N.E.Br.
Jacaranda mimosifolia D.Don
Lantana camara L.
Lippia rehmannii H.Pearson
Parinari capensis Harv.
Pterocarpus angolensis
Searsia leptodictya
Zanthoxylum capense (Thunb.) Harv.
GRASSES
Brachiaria serrata (Thunb.) Stapf
Eragrostis curvula (Schrad.) Nees
Eragrostis racemosa (Thunb.) Steud.
Eragrostis superba Peyr.
Hyparrhenia hirta (L.) Stapf
Melinis nerviglumis (Franch.) Zizka
Panicum natalense Hochst.

Themeda triandra
Tristachya rehmannii Hack.
Urochloa panicoides P.Beauv.
FORBS
Acalypha species
Becium obovatum (E.Mey. ex Benth.) N.E.Br.
Bulbostylis hispidula (Vahl) R.W.Haines
Cheilanthes hirta Sw.
Commelina benghalensis L.
Crinum macowanii Baker
Cucumis species
Eriosema salignum E.Mey.
Eucomis autumnalis* subsp. *clavata
Fuirena pubescens (Poir.) Kunth
Gerbera jamesonii Bolus ex Adlam
Helichrysum kraussii Sch.Bip.
Hypoxis iridifolia Baker
Hypoxis rigidula Baker
Ledebouria revoluta (L.f.) Jessop
Monopsis decipiens (Sond.) Thulin
Pellaea calomelanos (Sw.) Link
Pentanissia angustifolia (A.Rich. ex DC.) Verdc.
Tephrosia capensis (Jacq.) Pers.
Thesium utile A.W.Hill
Thunbergia atriplicifolia E.Mey. ex Nees
Trachyandra species
Triumfetta sonderi Ficalho & Hiern
Verbena bonariensis L.
Vernonia natalensis Sch.Bip. ex Walp.
Zornia milneana Mohlenbr.

4.5.3. Riverine areas

Mapping unit	3	**Tree cover**	10-20%
Soil	Clay and loam	**Shrub cover**	25%
Topography	N/A	**Herb cover**	6%
Land use	Grazing/washing/drinking	**Grass cover**	1-25%
Unit status	Natural to degraded	**Rock cover**	3-10%
Conservation priority	High	**Erosion**	variable
Dominant spp.	*Various*		

Various riverine areas are present within the proposed route. These areas vary from slightly degraded to heavily degraded due to adjacent anthropogenic activities.

The more natural section of rivers and riparian zones along the route (photo above) are characterised by the prominence of various hydrophilic plant species such as *Phragmites, Schoenoplectus corymbosus, Paspalum dilatatum, Cyperus textilis,* while the woody species include *Acacia sieberiana,* and *Acacia ataxacantha*. Unfortunately the category 1 declared alien invader shrub *Lantana camara* has infested large areas thereby displacing large numbers of the indigenous vegetation and together with it animal life.

The riverine systems mostly support a diversity of plant and animal life and are important in the transport and channelling of water. They also provide water to underground systems on which many plant communities depend for their survival especially during the dry months of the year. From a vegetation point of view large areas are degraded while other have a more natural species composition.

Red data species

One red data species namely the 'Declining' *Crinum macowanii* was found within this unit.

The following is a list of species identified during the survey (species in red indicate declared alien invader species):

WOODY SPECIES
Acacia ataxacantha DC.
Acacia sieberiana DC.
Acacia robusta
Acacia exuvialis
Combretum apiculatum
Ziziphus mucronata
Kigelia africana (Lam.) Benth.
Spirostachys africana
.*Diospyros mespiliformis*
Lantana camara L
Solanum mauritianum Scop.
Zanthoxylum capense (Thunb.) Harv.
GRASSES
Cynodon nlemfuensis Vanderyst
Panicum deustum Thunb.
FORBS
Eulophia streptopetala
Crinum macowanii

4.5.4. Bushveld

Mapping unit	4	**Tree cover**	5-10%
Soil	Sandy loam with clay	**Shrub cover**	30%
Topography	Varies (1-5^0)	**Herb cover**	5%
Land use	Natural	**Grass cover**	55-65%
Unit status	Degraded woodland	**Rock cover**	15-25%
Conservation priority	Medium	**Erosion**	1%
Dominant spp.	*Acacia sieberiana; Englerophytum magalismontanum;*		

This woodland is occurs on undulating rocky hills and slopes. The soil is shallow and leached though patches that are slightly deeper with loamy soil are present. The woody layer covers between 5 and 35% of the area, the grasses between 55 and 65%, and the forbs up to 12% of the area.

The vegetation consists of open woodland with smaller dense patches on the rocky crests. Large open grassland areas occur between the sparsely spread trees. The trees *Acacia sieberiana* is dominant on the slopes and

lower-lying areas while *Englerophytum magalismontanum* is prominent in the crests. Other species present and include *Eragrostis curvula, Urochloa panicoides, Cephalaria zeyheriana, Eulophia petersii, Selaginella dregei* and *Vernonia natalensis*.

Large sections of this unit are used for grazing while others have been mowed and excavated. Various roads pass through this unit causing together with the houses on the properties, fragmentation of the vegetation. These degraded areas are overgrown with the exotic invasive grass *Pennisetum clandestinum*, while pioneer weedy species such as *Tagetes minuta, Bidens pilosa* and *Conyza albida* are present.

Red data species

The area is mostly degraded and no red data species or suitable habitats were observed during the survey.

The following is a list of species identified during the survey:

WOODY SPECIES
Canthium mundianum Cham. & Schltdl.
Englerophytum magalismontanum (Sond.) T.D.Penn.
Lannea discolor (Sond.) Engl.
GRASSES
Cynodon dactylon
Eragrostis curvula
Pennisetum clandestinum
Urochloa panicoides
FORBS
Acrotome hispida Benth.
Aloe species
Bidens pilosa
Cephalaria zeyheriana Szabó
Chaetacanthus setiger (Pers.) Lindl.
Cheilanthes hirta Sw.
Chlorophytum polyphyllum (Baker) Kativu
Conyza albida
Cyperus obtusiflorus VAHL
Eulophia petersii Rchb.f.
Euphorbia species
Kyllinga alba Nees
Sansevieria aethiopica Thunb.
Selaginella dregei (C.Presl) Hieron.
Tagetes minuta
Vernonia natalensis Sch.Bip. ex Walp.

4.5.5. Afforested plantations/Developed areas

Mapping unit	5	**Tree cover**	0-100%
Soil	Loamy	**Shrub cover**	0-25%
Topography	Level to mild slopes	**Herb cover**	1%
Land use	Commercial plantations, houses and other developments	**Grass cover**	0-20%
Unit status	Transformed	**Rock cover**	0 %
Conservation priority	Low	**Erosion**	0%
Dominant spp.	N/A		

This vegetation unit occurs on loamy soil with low rock cover all along the proposed P-166 route.

The largest areas have been planted with various *Eucalyptus* spp and *Pinus* spp. for commercial properties or have been developed due to human settlements.

The vegetation is completely transformed due to more than 80% thereof being developed with roads, houses, and plantations. Very little of the natural vegetation of the area has remained. In the areas along the roads of the various human settlements the vegetation is transformed with the grass *Eragrostis curvula* and the anthropogenic grass *Hyparrhenia hirta* present in many areas.

Red data species

No red data species were found within this vegetation unit though.

The following is some of the prominent species present in the area (species in red = exotic invaders):

WOODY SPECIES

Eucalyptus spp.

Pinus spp.

GRASSES

Cynodon dactylon (L.) Pers.

Eragrostis curvula (Schrad.) Nees

Themeda triandra Forssk.

Urochloa panicoides

FORBS

Commelina species

Corchorus asplenifolius Burch.

Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Dammer

Tagetes minuta L.

Tribulus terrestris L.

Verbena tenuisecta Briq.

Vernonia poskeana Vatke & Hildebr.

4.6 RESULTS OF THE ECOREX WALK-THROUGH

4.6.1. Flora

Approximately 70 species of conservation-important plant species potentially occur within the study area (**Error! Reference source not found.**1). Many of these species have a low or moderate likelihood of occurring along the proposed routes primarily due to unsuitable habitat or altitude and degraded habitat. Twenty seven species of plants from this list were confirmed during fieldwork across the four routes surveyed which included 8660 individual plants counted in 466 points (2). The species name, co-ordinate and total numbers of each plant recorded along the four routes is presented in Appendix 1 ((McKenzie, 2015).

Of the 27 species recorded, one species has been assessed as Critically Endangered (*Aloe simii*) and one species Vulnerable (*Aloe kniphofioides*) (Raimondo *et al*., 2009). A further three species were listed as Declining (*Crinum macowanii, Eucomis autumnalis* subsp. *clavata* and *Gunnera perpensa*). The remaining species are protected under either the MNCA or NFA or both (2).

Table1. Potentially occurring conservation-important plant species within the study area (McKenzie, 2015)

Species	Family	Red Data	Protected	Habitat	Flowering time	Likelihood	Reason
Agapanthus inapertus	AGAPANTHACEAE		MNCA	Wetland edge, rocky outcrops	Dec-Mar	Confirmed	
Boophane disticha	AMARYLLIDACEAE	Declining	MNCA	Wide habitat tolerance	Jul-Oct	Moderate	Presence of suitable habitat
Clivia caulescens	AMARYLLIDACEAE	NT	MNCA	Forest	Oct-Nov	Low	Unsuitable habitat and altitude
Crinum macowanii	AMARYLLIDACEAE	Declining	MNCA	Grassland	Oct-Dec	Moderate	Presence of suitable habitat
Cyrtanthus eucallis	AMARYLLIDACEAE	VU	MNCA	Grassland	Jul-Mar	Low	Unsuitable habitat and altitude
Cyrtanthus spp.	AMARYLLIDACEAE		MNCA	Grassland, wetland	Jul-Nov	Moderate	Presence of suitable habitat
Scadoxus spp.	AMARYLLIDACEAE		MNCA	Thickets, rocky outcrops	Aug-Nov	Confirmed	
Sclerocarya birrea subsp. *caffra*	ANACARDIACEAE		NFA	Savannah	Aug-Dec	Confirmed	
Brachystelma ssp.	APOCYNACEAE		MNCA	Grassland, rocky outcrops	Jul - Jun	Confirmed	
Ceropegia spp.	APOCYNACEAE		MNCA	Thicket, forest edge	Nov-Mar	Confirmed	
Huernia ssp.	APOCYNACEAE		MNCA	Rocky and sandy soils	Aug - May	Moderate	Presence of suitable habitat
Orbea spp.	APOCYNACEAE		MNCA	Rocky and sandy soils	Aug - May	Moderate	Presence of suitable habitat
Pachypodium saundersiae	APOCYNACEAE		MNCA	Rocky outcrops	Feb-May	Moderate	Presence of suitable habitat
Stapelia ssp.	APOCYNACEAE		MNCA	Savannah, rocky outcrops	Jul - Jun	Confirmed	
Ilex mitis var. *mitis*	AQUIFOLIACEAE	Declining		Forest	Sep-Dec	Low	Unsuitable habitat
Aloe cooperi subsp. *cooperi*	ASPHODELACEAE	Declining	MNCA	Grassland and open woodland	Nov-Feb	Moderate	Presence of suitable habitat
Aloe kniphofioides	ASPHODELACEAE	VU	MNCA	Mountain grassland; open, rocky woodland	Sep-Nov	Confirmed	
Aloe simii	ASPHODELACEAE	CR	NEMBA, MNCA	Edges of wetlands; grassland	Jan-Mar	Confirmed	
Aloe ssp.	ASPHODELACEAE		MNCA	Grassland, rocky outcrops	Jul-Jun	Confirmed	
Kniphofia ssp.	ASPHODELACEAE		MNCA	Wetland, grassland, rocky outcrops	Sep-Mar	Low	Unsuitable habitat and altitude
Curtisia dentata	CORNACEAE	NT	NFA, MNCA	Forest	Oct-Mar	Low	Unsuitable habitat
Alsophila dregei	CYATHEACEAE		MNCA	Wetland	N/A	Confirmed	

Dioscorya sylvatica	DIOSCOREACEAE	VU	MNCA	Forest	Oct-Jan	Low	Unsuitable habitat
Pterocarpus angolensis	FABACEAE		NFA, MNCA	Open woodland, sour bushveld	Sep-Nov	Confirmed	
Gunnera perpensa	GUNNERACEAE	Declining		Wetland	Sep-Feb	Confirmed	
Eucomis autumnalis subsp. *clavata*	HYACINTHACEAE	Declining	MNCA	Grassland, wetland	Aug-Nov	Confirmed	
Merwilla plumbea	HYACINTHACEAE	NT	MNCA	Open grassland, wetlands, rocky ridges	Sep-Nov	Moderate	Presence of suitable habitat
Hypoxis hemerocallidea	HYPOXIDACEAE	Declining		Grassland and mixed woodland	Sep - Mar	Moderate	Presence of suitable habitat
Gladiolus ssp.	IRIDACEAE		MNCA	Grassland	Jul-Jun	Confirmed	
Rapanea melanophloeos	MYRSINACEAE	Declining		Forest, outcrops in rocky grassland	Jun-Dec	Low	Unsuitable habitat
Ansellia africana	ORCHIDACEAE	Declining	MNCA	Riverine forest, tall woodland	May-Aug	Moderate	Presence of suitable habitat
Brachycorythis spp.	ORCHIDACEAE		MNCA	Grassland	Sep - Feb	Confirmed	
Disa extinctoria	ORCHIDACEAE	NT	MNCA	Damp grassland, swamps	Dec-Jan	Low	Unsuitable habitat and altitude
Disa ssp.	ORCHIDACEAE		MNCA	Grassland	Jul-Jun	Low	Unsuitable habitat and altitude
Eulophia ssp.	ORCHIDACEAE		MNCA	Grassland	Jul-Jun	Confirmed	
Habenaria ssp.	ORCHIDACEAE		MNCA	Grassland	Jul-Jun	Moderate	Presence of suitable habitat
Platycoryne mediocris	ORCHIDACEAE	EN	MNCA	Wooded grassland	Dec-Jan	Low	Only known from one locality in South Africa
Satyrium ssp.	ORCHIDACEAE		MNCA	Grassland	Jul-Jun	Moderate	Presence of suitable habitat
Adenia gummifera var. *gummifera*	PASSIFLORACEAE	Declining	MNCA	Thicket, scrub forest	Oct-Apr	Low	Unsuitable habitat
Pittosporum viridiflorum	PITTOSPORACEAE		NFA	Thicket, forest, dense woodland	Nov-Dec	Moderate	Presence of suitable habitat
Faurea rochetiana	PROTACEAE		MNCA	Open woodland, sour bushveld	Jun-Jan	Confirmed	
Berchemia zeyheri	RHAMNACEAE		MNCA	Riverbanks, open woodland, rocky outcrops	Oct-Nov	Moderate	Presence of suitable habitat
Breonadia salicina	RUBIACEAE		NFA	Riverbeds, streambanks	Nov-Dec	Moderate	Presence of suitable habitat
Encephalartos humilis	ZAMIACEAE	VU	NEMBA, MNCA	Rocky grassland	N/A	Low	Unsuitable habitat and altitude

Table2. Summary of plant species located during fieldwork conducted during the walk-through conducted by ECOREX (McKenzie, 2015)

Species	No.of encounters	Total no. of specimens	Conservation Status
Agapanthus inapertus	12	90	Protected: MNCA
Aloe barbertoniae	77	341	Protected: MNCA
Aloe boylei	6	22	Protected: MNCA
Aloe kniphofioides	1	5	Vulnerable, Protected MNCA
Aloe petricola	62	700	Protected: MNCA
Aloe simii	15	115	Critically Endangered, Protected NEMBA, MN
Aloe spicata	2	3	Protected: MNCA
Alsophila dregei	2	2	Protected: MNCA
Brachycorythis pubescens	1	1	Protected: MNCA
Brachystelma gracile	1	3	Protected: MNCA
Ceropegia carnosa	1	1	Protected: MNCA
Crinum macowanii	4	15	Declining, Protected: MNCA
Eucomis autumnalis subsp. *clavata*	2	21	Declining, Protected: MNCA
Eulophia angolensis	59	4573	Protected: MNCA
Eulophia petersii	9	38	Protected: MNCA
Eulophia streptopetala	4	101	Protected: MNCA
Eulophia zeyheri	1	1	Protected: MNCA
Faurea rochetiana	4	15	Protected: MNCA
Gladiolus dalenii	37	457	Protected: MNCA
Gladiolus densiflorus	135	2055	Protected: MNCA
Gladiolus papilio	3	22	Protected: MNCA
Gunnera perpensa	4	4	Declining
Habaneria epipactidea	1	1	Protected: MNCA
Pterocarpus angolensis	9	15	Protected: NFA, MNCA
Scadoxus puniceus	3	11	Protected: MNCA
Sclerocary birrea subsp. *caffra*	9	35	Protected: NFA
Stapelia leendertziae	2	13	Protected: MNCA
27	466	8660	

The specific results for each of the four routes are presented below:

4.6.2 Msholozi Route

A total of 2094 plants of 16 species were located within the Msholozi Route during fieldwork (Table3). The bulb *Gladiolus densiflorus* (protected under the MNCA) accounted for 1327 of these. High numbers of the succulents *Aloe petricola* (447) and *Aloe barbertoniae* (171, both protected under the MNCA) were also counted. Two Near-Threatened species were confirmed; 13 individuals of *Crinum macowanii* and one of *Eucomis autumnalis* subsp. *clavata,* both listed as Declining. Three trees protected under the NFA or MNCA were also counted: *Faurea rochetiana, Pterocarpus angolensis* and *Sclerocarya birrea* subsp. *caffra*. Smaller numbers of the remaining species, all protected under the MNCA, were found throughout. This is the only route where the herbs *Brachystelma gracile* and *Habenaria epipactidea* were observed.

Table3. Summary of plant species located during fieldwork in the Msholozi Route (McKenzie, 2015)

Species	No. of Encounters	Total no. of Specimens	Conservation Status
Agapanthus inapertus (clumps)	1	5	Protected: MNCA
Aloe barbertoniae	43	171	Protected: MNCA
Aloe petricola	41	447	Protected: MNCA
Aloe spicata	2	3	Protected: MNCA
Brachystelma gracile	1	3	Protected: MNCA
Crinum macowanii	3	13	Declining, Protected: MNCA
Eucomis autumnalis subsp. *clavata*	1	1	Declining, Protected: MNCA
Eulophia angolensis	5	45	Protected: MNCA
Eulophia petersii	3	20	Protected: MNCA
Eulophia streptopetala	3	6	Protected: MNCA
Faurea rochetiana	4	15	Protected: MNCA
Gladiolus densiflorus	76	1327	Protected: MNCA
Gladiolus papilio	1	10	Protected: MNCA
Habaneria epipactidea	1	1	Protected: MNCA
Pterocarpus angolensis	9	15	Protected: NFA, MNCA
Sclerocary birrea subsp. *caffra*	7	12	Protected: NFA, MNCA
TOTAL	**205**	**2094**	

4.6.3 Phumlani Alternative Route

This route produced a total of 1350 conservation-important plants consisting of 14 species (Table 4), with high numbers of the provincially protected *Gladiolus densiflorus* (728), *Aloe petricola* (253) and *Aloe barbertoniae* (170). A number of species were unique to this route, including the herbs *Brachycorythis pubescens, Ceropegia carnosa*and *Scadoxus puniceus* and the succulent *Stapelia leendertziae* (all protected under the MNCA). Two plant species of conservation-concern were confirmed; two specimens of *Crinum macowanii* and 20 of *Eucomis autumnalis* subsp. *clavata,* both listed as Declining (McKenzie, 2015).

Table4. Summary of plant species located during fieldwork in the Phumlani Alternative Route (McKenzie, 2015)

Species	No.of Encounters	Total no. of Specimens	Conservation Status
Agapanthus inapertus (clumps)	6	10	Protected: MNCA
Aloe barbertoniae	34	170	Protected: MNCA
Aloe boylei	4	11	Protected: MNCA
Aloe petricola	21	253	Protected: MNCA
Brachycorythis pubescens	1	1	Protected: MNCA
Ceropegia carnosa	1	1	Protected: MNCA
Crinum macowanii	1	2	Declining, Protected: MNCA
Eucomis autumnalis subsp. *clavata*	1	20	Declining, Protected: MNCA
Eulophia petersii	6	18	Protected: MNCA
Eulophia streptopetala	10	89	Protected: MNCA
Gladiolus densiflorus	59	728	Protected: MNCA
Scadoxus puniceus	3	11	Protected: MNCA
Sclerocary birrea subsp. *caffra*	2	23	Protected: NFA
Stapelia leendertziae (colonies)	2	13	Protected: MNCA
TOTAL	**151**	**1350**	

4.6.4 White River Route

The White River Route produced 5028 individual plants of conservation-concern of 11 species (Table 5). The orchid *Eulophia angolensis* accounted for 4528 of these and is clearly abundant along the route. Other significant numbers included 277 *Gladiolus dalenii* plants and 75 clumps of *Agapanthus inapertus* (both protected under the MNCA). Three Red List species were confirmed along this route, the most significant of which is the succulent*Aloe simii* which is classified as Critically Endangered and is protected under NEMBA and the MNCA. A total of 115 plants were counted in four distinct colonies, two of which were new localities. *Aloe kniphofioides* was recorded adjacent to the route in the White River Nature Reserve where *c.* 10 plants are known from recent MTPA and other records. This plant is listed as Vulnerable under the current national assessment and is protected under the MNCA. The final Red List species recorded is *Gunnera perpensa* (Declining). This species grows in large colonies are four were located along the wetland (McKenzie, 2015).

Table5. Summary of plant species located during fieldwork in the White River Route (Mckenzie, 2015)

Species	No.of Encounters	Total no. of Specimens	Conservation Status
Agapanthus inapertus (clumps)	5	75	Protected: MNCA
Aloe boylei	2	11	Protected: MNCA
Aloe kniphofioides	1	10	Vulnerable, Protected: MNCA
Aloe simii	13	115	Critically Endangered, Protected NEMBA, MNCA
Alsophila dregei	2	1	Protected: MNCA
Eulophia angolensis	54	4528	Protected: MNCA
Eulophia streptopetala	1	5	Protected: MNCA
Gladiolus dalenii	17	277	Protected: MNCA
Gladiolus papilio	2	12	Protected: MNCA
Gunnera perpensa (colonies)	4	4	Declining
Eulophia zeyheri	1		Protected: MNCA
TOTAL	**102**	**5038**	

4.6.5 White River Alternative Route

This route produced by far the lowest plant totals of all the routes which is not surprising as it covered mostly transformed habitat. Only 181 individual plants of conservation-concern were recorded of two species: Gladiolus dalenii had 180 of these and Eulophia streptopetala represented by just a single specimen (Table 6). Both species are protected under the MNCA (Mckenzie, 2015).

Table6. Summary of plant species located during fieldwork in the White River Alternative Route (McKenzie, 2015).

Species	No.of Encounters	Total no. of Specimens	Conservation Status
Eulophia streptopetala	1	1	Protected: MNCA
Gladiolus dalenii	20	180	Protected: MNCA
TOTAL	**21**	**181**	

4.7 DISCUSSION

4.7.1 Vegetation Types

The vegetation of the study area comprises two vegetation types namely the **Legogote Sour Bushveld (SVI 9)** and the **Pretoriuskop Sour Bushveld (SVI 10)** (Mucina & Rutherford 2006). The largest part of the proposed road alignment will passes through the Legogote Sour Bushveld (SVI 9) which is classified as **Vulnerable** in the Mpumalanga Biodiversity Sector Plan (MBSP) (Lötter *et al*., 2014) as well as in the National List of Threatened Ecosystems (DEAT, 2011). The Pretoriuskop Sour Bushveld (SVI 10) vegetation type is **not threatened** with large areas conserved in the Kruger National Park. This region is economically important in terms of wood production agriculture and especially tourism. Various red data and endemic species have been recorded in the area while invader plants are also a concern. The Legogote Sour Bushveld (SVI 9) is poorly conserved with only 2% statutorily conserved, while 40% of the Pretoriuskop Sour Bushveld (SVI 10) is conserved in the Kruger National Park (Mucina & Rutherford, 2006).

4.7.2 Threatened Plant Species

Five species of conservation-concern recorded during the walk-though and are described in more detail below:

Figure8. The Critically Endangered *Aloe simii* were observed within the temporary wet zone of the channelled valley bottom wetland in White River alignment.

Aloe simii

This Critically Endangered (Raimondo *et al*., 2009) species favours moist grassland and wetland edge and currently occupies an Area of Occupancy (AOO) of only 10 km^2 between Sabie and White River. It is only known from five fragmented localities having lost most of its habitat to afforestation and wetland degradation, urbanisation and rural development (Lötter *et al*., 2006). A significant total of 115 plants were counted along the White River Route in 15 separate encounters, including at least two previously unknown colonies. It is possible that this sub-population contains 20% of the known population of *Aloe simii* (*pers. obs*. D. McKenzie). These figures exclude the small population that was artificially established some years ago *c*. 70 m to the north of the proposed route, immediately east of Danie Joubert Street bridge. *Aloe simii* was not recorded along any of the other routes (Mckenzie, 2015).

Aloe kniphofioides

Aloe kniphofioides is a grassland species found only between northern Eastern Cape and south-eastern Mpumalanga. It has undergone a population reduction of an estimated 30% due to afforestation, alien plant infestation, mining and other forms of habitat destruction and is currently assessed as Vulnerable (Lötter *et al*., 2006) A small colony of about 10 plants grows *c.* 90 m north of the proposed White River alignment in the centre of the route, within the White River Nature Reserve (Mckenzie, 2015).

Crinum macowanii

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[1]. Two plants were located on the Phumlani Alternative Route and 13 plants were confirmed on the Msholozi Route (McKenzie, 2015). This plant is classified as Declining (Raimondo *et al*., 2009).

Eucomis autumnalis* subsp. *clavata

This bulb is also in high demand for the medicinal plant trade and has undergone a reduction in population size across its range. It ranks among the most traded plants in muthi markets in KwaZulu-Natal and Gauteng and approximately 428 000 bulbs are sold annually (Lötter *et al*., 2006). Two small populations were located during fieldwork; 20 plants in one colony on the Msholozi Route and a single plant on the Phumlani Alternative Route (McKenzie, 2015). A small colony (5 plants) was observed within a small hillslope seep adjacent to the P1-66 Rocky-Drift alignment. This plant is classified as Declining (Raimondo *et al*., 2009).

[1] Williams *et al*., 2008

Gunnera perpensa

In South Africa, this common and widespread aquatic herb is absent only from the dry interior, always growing in colonies sometimes covering large areas. It is listed as Declining due to ongoing harvesting for the medicinal plant trade where large numbers are traded annually (Williams *et al*., 2008). Four colonies were located in the valley bottom wetland areas on the White River Route (McKenzie, 2015).

4.7.3 Protected Tree Species

Figure9. The protected tree *Pterpcarpus angolensis* was co-dominant in the sour bushveld vegetation unit around Rocky Drift.

The protected* tree *Pterocarpus angolensis* is present in the Sourveld Bushveld vegetation Unit 2 where it is a co-dominant tree. This deciduous tree that can grow up to 18 m tall is found on the rocky slopes within this unit. The tree is economically important due to the use of its wood for furniture and musical instruments. It also has medicinal properties and is used for the treatment of malaria, pain and eye problems.

Figure10. Several large Marula (*Sclerocarya. birrea* ssp. *caffra*.) were observed within the Bushveld (vegetation unit 4).

* 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

The protected tree Marula *Sclerocarya. birrea* ssp. *caffra* was observed in the bushveld vegetation unit 4. 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.

5. FAUNAL ASPECT

The preliminary faunal survey focused on habitat availability for mammals, avifauna (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 proposed P-166 road servitude and immediate adjacent areas. Faunal surveys should ideally be conducted over extended periods during the summer rainy season between October until and March. This is especially pertinent to amphibian surveys; with the majority of frog species being explosive breeders, initiating their short-duration reproductive events after early summer rainfall mainly in November and December. Faunal data was obtained during three individual site inspections carried out between the 20th of October 2012 until the 21st of February 2014 mainly by vehicle as well as selected natural habitats carried out on foot. A specialist faunal walk-through was conducted by ECOREX along the proposed alternative alignments in February 2015. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Amphibians were identified by visual observations of adults. Reptiles were actively searched for and identified by actual specimens or observations of specimens during site inspection along the proposed P-166 alignment. The data was supplemented by previous surveys conducted in the area, literature investigations, personal records and historic data.

5.1 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).

The settlements surrounding the P-166 road alignment 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.

Agricultural lands are in nature inhospitable environments, and only burrowing small mammals can co-exist in such situations. Rodents such as the Bushveld and Highveld gerbils can at times become pests in agricultural lands when they excavate planted seeds. The Yellow and Slender mongooses can subsist by preying on the few vertebrates managing a precarious existence due to surrounding road networks as well as hunting with dogs and wire snares.

Afforested plantations offer suitable habitat for several larger mammal species such as Bushbuck, Common Duiker, Bushpig and South African Porcupine. Population sizes are dependent on the amount of hunting and illegal poaching activities.

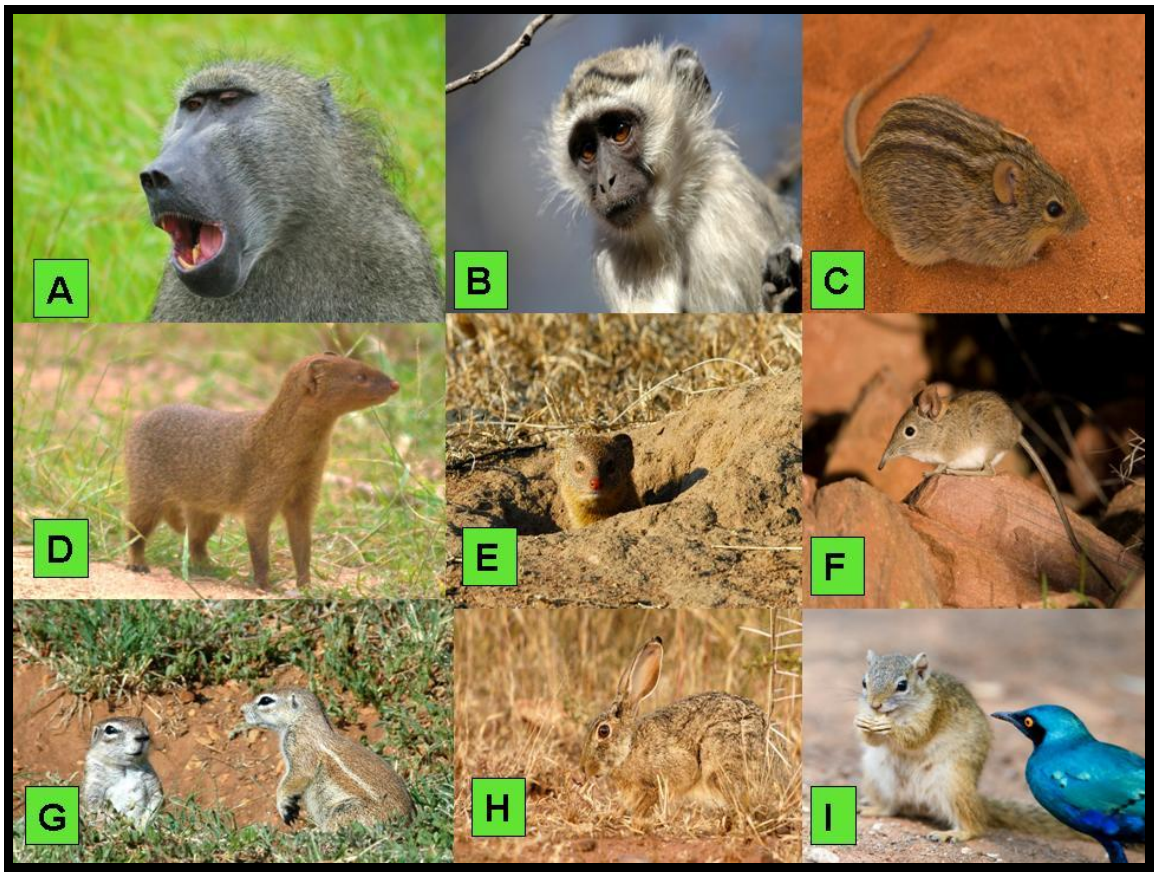


Figure11. A conglomerate of photographs displaying the mammal species recorded from the P-166 servitudes. A: Chacma Baboon (*Papio cynocephalus ursinus*); **B:** Vervet Monkey (*Ceropithecus aethiops*)*, **C**: Four-striped Grass Mouse (*Rhabdomys pumilio*)*; **D:** Slender Mongoose (*Galerella sanguinea*); **E:** Yellow Mongoose (*Cynictis penicillata*)*; **F:** Eastern Rock-elephant Shrew (*Elephantulus myurus*)*, **G:** Ground Squirrel *(Xerus inauris*)*, **H:** Savanna or Scrub Hare (Lepus saxatilis)* and **I:** Tree Squirrel (*Paraxerus cepapi*)*.

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

Table7. List of mammal species recorded during the brief field surveys as well as supplemented from previous surveys within the White River-Nelspruit area. Species in bold are introduced or exotic species.

COMMON NAME	SCIENTIFIC NAME
Eastern Rock Elephant-Shrew	*Elephantulus myurus*
South African Ground Squirrel	*Xerus inauris*
Tree Squirrel	*Paraxerus cepapi*
Scrub Hare	*Lepus saxatilis*
House Mouse	*Mus musculus*
African (Common) Mole-rat	*Cryptomys hottentotus*
Greater Canerat	*Thryonomys swinderianus*
Woodland Dormouse	*Graphiurus murinus*
Rock Dormouse	*Graphiurus platyops*
Spiny Mouse	*Acomys spinosissimus*
Four-striped Grass Mouse	*Rhabdomys pumilio*
Desert Pygmy Mouse	*Mus indutus*
Pouched Mouse	*Saccostomus campestris*
Natal Multimammate Mouse	*Mastomys natalensis*
Southern Multimammate Mouse	*Mastomys coucha*
Namaqua Rock Mouse	*Micaelamys namaquensis*

Vlei Rat	*Otomys irroratus*
Grey Climbing Mouse	*Dendromus melanotis*
Chestnut Climbing Mouse	*Dendrobus mystacalis*
African Marsh Rat	*Dasymys incomtus*
House Rat	***Rattus rattus***
Bushveld Gerbil	*Tatera leucogaster*
Highveld Gerbil	*Tatera brantsii*
Reddish-Grey Musk Shrew	*Crocidura cyanea*
South African Ground Squirrel	*Xenus inauris*
Southern African Hedgehog	*Atelerix frontalis*
Striped Polecat	*Ictonyx striatus*
South African Large-spotted Genet	*Genetta tigrina*
Marsh Mongoose	*Atilax paludinosus*
Dwarf Mongoose	*Helogale parvula*
Yellow Mongoose	*Cynictis penicillata*
Slender Mongoose	*Galerella sanguinea*
White-Tailed Mongoose	*Ichneumia albicauda*
Lesser Bushbaby	*Galago moholi*

*Side-striped Jackal	*Canis adustus*
Black-backed Jackal	*Canis mesomelas*
Cape Porcupine	*Hystrix africaeaustralis*
Smith's Red Rock Rabbit	*Pronolagus saundersiae*
Springhare	*Pedetes capensis*
Caracal	*Felis caracal*
Common Duiker	*Sylvicarpa grimmia*
Steenbok	*Raphicerus campestris*
Chacma Baboon	*Papio cynocephalus ursinus*
Vervet Monkey	*Ceropithecus aethiops*

Threatened 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

* recorded during walk-though by ECOREX (McKenzie, 2015)

- **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.

Table8. 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)
Canidae	*Canis*	*adustus*	Side-striped Jackal	Near-Threatened
Hipposideridae	*Miniopterus*	*schreibersii*	Schreibers' Long-fingered Bat	Near Threatened
Hyaenidae	*Crocuta*	*crocuta*	Spotted Hyaena	Near Threatened
Manidae	*Manis*	*temmickii*	Ground Pangolin	Vulnerable
Mustelidae	*Mellivora*	*capensis*	Honey Badger	Near Threatened

Side-striped Jackal *Canis adustus*

The Side-striped Jackal avoids open savanna grassland favouring the more thickly wooded country. Throughout their distribution range they are associated with well-

watered habitats. They are more strictly nocturnal than the Black-backed Jackal, but on occasion move after sunrise and just before sunset. Where Black-backed Jackal and Side-striped Jackal occur sympatric, the former are more aggressive and dominate pushing the Side-striped Jackals into sub-optimum habitat. Tracks of a single individual were observed in natural vegetation near the southern section of the Phumlani Alternative Route by ECOREX (McKenzie, 2015).

Schreibers' Long-fingered Bat *Miniopterus schreibersii*

Occurs in large numbers, over wide distribution, but is potentially threatened because of tendency to roost in very large numbers in limited sites, and due to genetic distinctiveness of subpopulations. At subpopulation level two of these nearly qualify for Vulnerable under criteria B2ab (ii, iii, iv, v). Seasonal movement between summer & winter roosts occurs throughout South Africa. However, genetic research suggests the South African population is subdivided & seasonal migration occurs primarily within biomes and not between them. Habitat management; wild population management; monitoring; public awareness; genome resource; limiting factor; work in local communities. The three subpopulations are sufficiently genetically distinct to warrant recognition as discrete management units, which are functionally independent. This is supported by the possibility that the bats are becoming locally adapted to environmental conditions surrounding their roosts. Subpopulations should therefore be managed independently, and the unique environmental conditions facing each subpopulation should be considered in formulations of management and conservation plans. This should be accompanied by education campaigns. Note that many roosts occupied by *M. schreibersii* are also utilised by other bat species eg. *Rhinolophus capensis, R. clivosus, Myotis tricolour* (Miller-Butterworth *et al.* 2004).

Figure12. A Spotted Hyaena taken in the KNP, resident population are restricted to larger conservation areas in Mapumalanga Province.

Spotted Hyaena *Crocuta crocuta*

The Spotted Hyaena is predominantly a savanna species, associated in parts of its distribution range with open plains, in others with open woodland and semi-desert scrub. In Mpumalanga, the North West and Limpopo Province resident populations are confined to the larger conservation areas, including the Kruger National Park and surrounding game reserves. The records from the western parts of the North West Province and Limpopo Province are probably vagrants from Botswana. (Skinner & Chimimba 2005). Conservation dependent as almost all individuals are in conservation areas and a change in conservation status would elevate their status. No suitable habitat within the proposed P-166 servitude due to high levels of habitat transformation and anthropogenic disturbances.

Figure13. Ground Pangolin foraging during the day (photograph courtesy of Prof. G.D. Engelbrecht UL).

Ground Pangolin (*Manis temminckii*)

This species is uncommon throughout its known range, which extends from south of the Sahara to the east of Africa and to the northern parts of South Africa. The Ground Pangolin seems to favour areas with moderate temperatures not dropping below 0° C. The ground pangolin is a savanna species and does not occur in the swamps, grasslands, forest or desert. Within this broad category they are catholic in their habitat requirements, occurring in scrub in areas of low rainfall (250mm per year), and various types of savanna woodland, floodplain grassland, bushveld, rocky hills, and on sandveld with a much higher rainfall (up to 1 400mm per annum). Swart *et al.* (1999) have hypothesized that their absence from parts of southern Africa may be due tio the effects of temperature on certain ant activity and the nest characteristics, especially *Anoplolepis custodiens* (primary food source), which escape the cold winter nights by hibernating deep below the soil surface (Skinner & Chimimba 2005).

This solitary species occurs in low numbers, and occupies large home ranges and move between different burrow sites. The Ground pangolin uses the burrow system of Aarvarks, Springhares and Warthogs. The males in the Sabi Sand nature reserve have home ranges of up to 2000ha whereas the female move in areas of 500ha. Their major threat seems to be the muti trade as there is a high demand for their scales. Only one young is born per year, seemingly in the drier months). They are also vulnerable to

agricultural developments and seem to be susceptible to insecticides. The South African Red Data Book for Mammals (Smithers, 1986) classifies the Pangolin as a Threatened species with a **Vulnerable** status and was down-listed to Lower Risk, **Near-Threatened** (Skinner & Chimimba 2005). Freitag & Van Jaarsveld (1997) rank the Pangolin fourth in conservation priority in a list of 197 mammal species for the former Transvaal. No pangolins have as yet survived in captivity, possibly due to their specialised diet. Therefore, breeding these animals in captivity and replacing them in the wild is not possible at this stage (Cohane & Gamacho 200

Figure14. A foraging Honey Badger taken in the southern Kruger National Park*

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.

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

Tracks of a single individual Side-striped Jackal were observed in natural vegetation near the southern section of the Phumlani Alternative Route by ECOREX (McKenzie, 2015). No evidence of any other rare or threatened mammal species were observed during the preliminary faunal surveys but suitable habitat occurs for Schreiber's Long-fingered Bat, Honey Badgers and Ground Pangolin within the open bushveld areas between White River and Nelspruit. The Honey Badger may occur within the *Eucalyptus* plantations in search of apiaries or beehives. It must be stressed that the Ground Pangolin and Honey Badger are extremely secretive and elusive species which may not be observed over extended field surveys.

5.2 AVIFAUNA (BIRDS)

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.

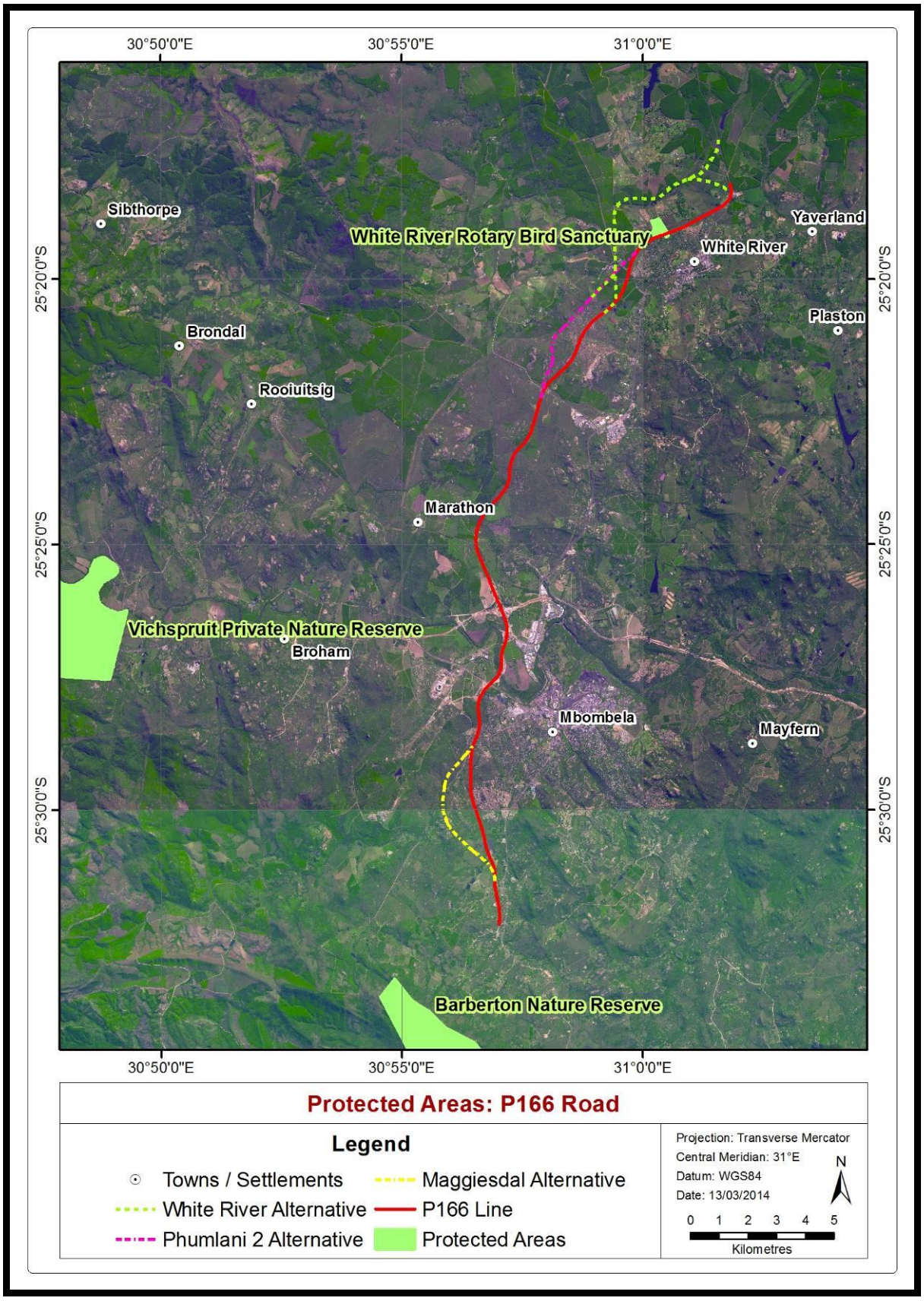


Figure15. The proposed White River alignment runs adjacent to and bisecting a portion of the White River Rotary Bird Sanctuary or White River Nature Reserve. This alignment is **not preferred or supported** from an ecological perspective.

SENSITIVE OR ENDANGERED SPECIES

Table9: Red Data List bird species recorded from the 2515.3100, 2515.3055, 2520.3055, 2525.3055 and 2530.3055 pentads 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.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS ACCORDING TO BARNES (2000)	HABITAT PREFERENCE
Black Stork	*Ciconia nigra*	Near threatened	Cliffs for roosting and breeding, and rivers and dams for foraging. Confirmed within the Mbombela 2525.3055 pentad
African Crowned Eagle	*Stephanooaetus coronatus*	Near threatened	Forest and woodland habitats and strongly associated with the Lowveld and escarpment forests of eastern South Africa. Confirmed within the Mbombela 2530.3055 pentad.
Bat Hawk	*Macheiramphus alcinus*	Near threatened	Sparse throughout its distribution through the savannas and known to breed in plantations where it selects large pale-barked *Eucalyptus* trees for nests. Confirmed from the White River and Mbombela pentads.
African Marsh-Harrier	*Circus ranivorus*	Vulnerable	Dependent on large (>100ha) permanent wetlands for breeding, roosting and feeding. This species may use smaller wetlands 1 to 2ha for occasional foraging arrays. Recorded from the Mbombela pentad.
African Finfoot	*Podica senegalensis*	Vulnerable	Streams and rivers with overhanging trees, shrub and reeds. Confirmed from the Mbombela section of the Crocodile River.

Lanner Falcon	*Falco biarmicus*	Near Threatened	Most frequent in open grassland, open or cleared woodland and agricultural areas. Breeding pairs favour habitats where cliffs are available for nesting and roosting sites. Recorded from all five pentads.
Peregrine Falcoln	*Falco peregrinus*	Near Threatened	Breeding pairs favour habitats where cliffs are available for nesting and roosting sites. Recorder from the White River and Nelspruit pentads.
Half-collared Kingfisher	*Alcedo semitorquata*	Near threatened	Fast-flowing streams with clear water and well-wooded banks. Occurs around dams (pers.obs.). Has recently been recorded in the White River and Mbombela pentads.
Broadtailed Warbler	*Schoenicola brevirostris*	Near Threatened	Tall, dense, rank grasslands typically in moist areas. Recorded by wetland specialist (Da Cruz, 2012) as well as within the White River alignment (D. McKenzie, 2015).

The savanna biome, and specifically 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.

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 Nelspruit-White River study area for foraging arrays. No recent records of these large raptor species during the current Second South African Bird Atlas Project (SABAP2). Apart from Red Data species, the Mbombela 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. The study area does contain important wetlands such as the channelled valley bottom wetlands adjacent to White River and several footslope and hillslope seepage wetlands in the Mbombela area as wwell as artificially created farm dams. These dams are important refuges for a variety of waterbirds, including species such as African Fish Eagle as well Black Stork. The dams and wetlands may be utilised on a temporary basis for foraging by Yellowbilled Stork and Marabou Storks. The palustrine wetlands also provide important habitat for the Broadtailed Warbler in the form of dense, rank grasslands adjacent to the valley bottom and hillslope seepage wetlands and dams. Several Broadtailed Warblers were observed by D. McKenzie during the walk-though of the White River alignment (ECOREX 2015). The smaller wetlands along the proposed P-166 alignment may be utilised by African Marsh-harriers for temporary foraging arrays but are however too small to provide suitable breeding habitat.

Rivers: The Crocodile River as well as the Crocodile River, Sandrivier, Blinkwater, Nelsrivier and floodplains are important habitats for birds. The 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 Crocodile River provides refuge for shy and skulking species such as the African Finfoot and possibly Whitebacked Night Heron. The eroded macro-channel banks of the Crocodile River could provide favourable nesting, foraging and dispersal habitat for the Half-Collared Kingfisher. Recent records are restricted to the valley bottom wetlands and artificially created dams within the White River area.

5.3 REPTILES

Most current knowledge of the reptiles of Mpumalanga is based on a 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 agricultural 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, sheetrocksand wooded hill-slopes 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 rocks and bark and replacing all surface objects after examining the ground beneath. Steiner 10x50 Binoculars were used to scan rocky outcrops and sheetrocks 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 roads along the proposed alignment, especially after rainfall, in order to record nocturnal species during the survey.

Although rarely subject to human pressure, rock outcrops and sheetrocks often shelter a specialist rupicolous lizard fauna. The granite rock outcrops and sheetrocks may be blasted during construction of road cuttings, or viewed as sources of in-fill during road construction. However, due to their isolated habitats and the difficulties of moving between them, specialist rock-living lizards are often highly endemic such as Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*), Barberton girdled lizard (*Smaug warreni barbertonensis*) and Lebombo girdled lizard (*Smaug warreni warreni*). Rock outcrops and sheetrocks should always be surveyed prior to developments to determine whether they harbour endemic species. Due to the habitat diversity, rock outcrops often form faunal hotspots, particularly as they are naturally protected from the historical impacts of

overgrazing and excessive fire regimes.

Figure16. A conglomerate of photographs displaying the reptile species observed along the proposed P-166 alignment. A: Striped Grass Snake (*Psammophylax tritaeneus*) was observed adjacent to the small seepage wetland in the Rocky Drift area, **B:** Serrated Hinged Terrapin (*Pelusios sinuatus*), **C:** Rock Monitor (*Varanus albigularis albigularis*) and **D:** Nile Monitor (*Varanus niloticus*) were observed in the Mbombela area adjacent to the Crocodile River.

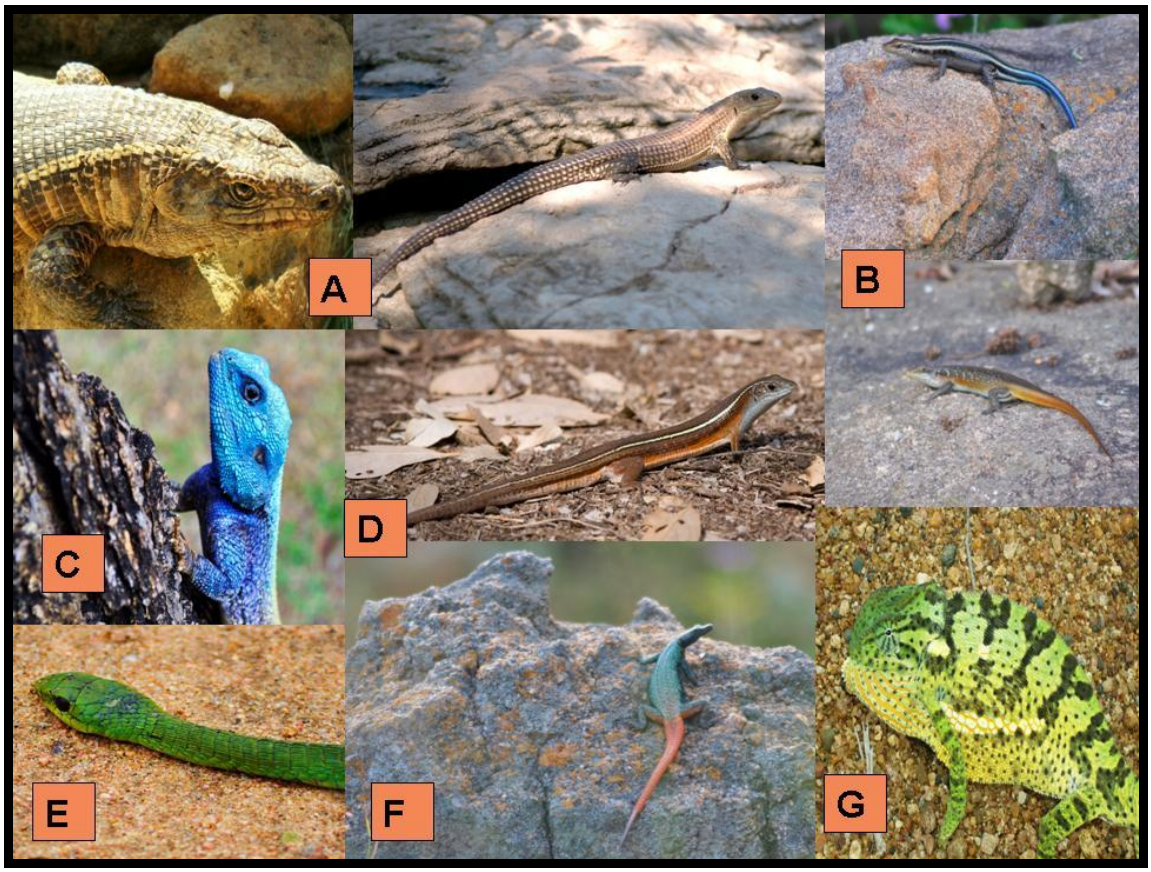


Figure17. A conglomerate of photographs displaying the reptile species observed along the proposed P-166 alignment. A: The rupicolous Giant Plated Lizard (*Gerrhosaurus validus*) was observed on the large granite rocksheets and outcrops as well as **B:** Five Lined or Rainbow Skinks (*Trachylepis margaritifer*) with the female (blue-tailed) on top and the (orange tailed) male below. **C:** The arboreal Male Southern Tree Agama (*Acanthocercus atricolis*) was observed on an *Acacia sieberiana* trunk in Mbombela. **D:** The Black-lined Plated Lizard (*Gerrhosaurus nigrolineatus*) was observed in the open bushveld. **E:** A road fatality of an adult male Boomslang (*Dispholidus typus*) observed on the R40 towards White River. **F:** A male Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*) displaying on a low-lying granite boulder. These strictly rupicolous lizards live in dense colonies under exfoliating granitic flakes and narrow rock crevices and are endemic to the Mbombela region of Mpumalanga Province. Small colonies of this species were located in both the Msholozi and Phumlani Alternative Routes in their preferred granite sheetrock habitat (McKenzie, 2015). **G:** A male Flap-neck Chameleon (*Chamaeleo dilepis*) displaying threatened posture with inflated throat. The chameleon was observed within the Mbombela area in the Halls property.

Table10. Reptile recorded during the field-survey and supplemented with previous surveys conducted in the White River-Nelspruit areas.

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Acanthocercus*	*atricollis*	*atricollis*	Southern Tree Agama	Least Concern (SARCA 2014)	
Agamidae	*Agama*	*aculeata*	*distanti*	Distant's Ground Agama	Least Concern (SARCA 2014)	Yes
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)	
Atractaspididae	*Aparallactus*	*capensis*		Black-headed Centipede-eater	Least Concern (SARCA 2014)	
Colubridae	*Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Least Concern (SARCA 2014)	
Colubridae	*Dispholidus*	*typus*	*typus*	Boomslang	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*semivariegatus*		Spotted Bush Snake	Least Concern (SARCA 2014)	
Colubridae	*Pseudaspis*	*cana*		Mole Snake	Least Concern (SARCA 2014)	
Cordylidae	*Platysaurus*	*intermedius*	*wilhelmi*	Wilhelm's Flat Lizard	Least Concern (SARCA 2014)	Yes
Elapidae	*Naja*	*mossambica*		Mozambique Spitting Cobra	Least Concern (SARCA 2014)	
Gekkonidae	*Hemidactylus*	*mabouia*		Common Tropical House Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Pachydactylus*	*affinis*		Transvaal Gecko	Least Concern (SARCA 2014)	Yes

Gerrhosauridae	*Gerrhosaurus*	*flavigularis*		Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*nigrolineatus*		Black-lined Plated Lizard	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*validus*	*validus*	Common Giant Plated Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Meroles*	*squamulosus*		Common Rough-scaled Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Nucras*	*ornata*		Ornate Sandveld Lizard	Least Concern (SARCA 2014)	
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*conjunctus*	Eastern Thread Snake	Not listed	
Pelomedusidae	*Pelusios*	*sinuatus*		Serrated Hinged Terrapin	Least Concern (SARCA 2014)	
Scincidae	*Afroablepharus*	*wahlbergii*		Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*capensis*		Cape Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*margaritifer*		Rainbow Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*punctatissima*		Speckled Rock Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*striata*		Striped Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*varia*		Variable Skink	Least Concern (SARCA 2014)	
Varanidae	*Varanus*	*albigularis*	*albigularis*	Rock Monitor	Least Concern (SARCA 2014)	
Varanidae	*Varanus*	*niloticus*		Water Monitor	Least Concern (SARCA 2014)	

Viperidae	*Causus*	*rhombeatus*		Rhombic Night Adder	Least Concern (SARCA 2014)	

Many of the reptile species recorded have wider distributions in South Africa and are eurytopic*. This includes the eight snake species recorded during the survey namely 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 Boomsland (*Dispholidus typus typus*) and Spotted Bush Snake (*Philothamnus semiveriegatus*). Three of snake species observed during the survey were of road fatalities.

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 sheetrocks. The scattered low-lying granite and quartzite outcrops and sheets 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).

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

HABITAT AVAIALBLE FOR SENSITIVE OR ENDANGERED SPECIES

Table6. Red listed reptile species recorded from the 2530BD, 2530CD, 2531BA QDGC's according to the South African Reptile Conservation Assessment (SARCA).

FAMILY	GENUS	SPECIES	COMMON NAME	RED LISTED CATEGORY SARCA 2014
Atractaspididae	*Homoroselaps*	*dorsalis*	Striped Harlequin Snake	Near Threatened
Cordylidae	*Chamaesaura*	*aenea*	Coppery Grass Lizard	Near Threatened
Cordylidae	*Chamaesaura*	*macrolepis*	Large-scaled Grass Lizard	Near Threatened
Cordylidae	*Platysaurus*	*intermedius* wilhelmi	Wilhelm's Flat Lizard	Least Concern*
Crocodylidae	*Crocodylus*	*niloticus*	Nile Crocodile	Vulnerable

* Listed as Vulnerbale (LottMBCP 2011)

Figure18. Nile Crocodiles occur within the Crocodile River system (photograph taken on Letaba River in KNP)

Nile Crocodile (*Crocodylus niloticus*)

The Nile Crocodile is a large reptile restricted to the north-eastern and eastern South Africa. It is found in most east flowing rivers north of the latitude 29°S. Seriously depleted over most of its former range with population widely scattered. It inhabits rivers in more tropical areas of South Africa. The Nile Crocodile is currently listed as Vulnerable (SARCA 2014). The Nile Crocodile has been recorded from the Nelspruit 2530BD QDGC within the reach of the Crocodile River. The indiscriminate killing and hunting for crocodile meat and skin has significantly reduced populations outside the protected reserves and larger river systems.

The Coppery Grass Lizard (*Chamaesaura aenea*)

These very unusual lizards have extremely reduced limbs (often littke more than spikes) and a very long tail (3-4 times longer than the SVL length). The body scales are rough, strongly keeled and arranged in regular rows. The elongate shape of grass lizards allows them to move freely in long grass through which they 'swim' with the speed and agility of snakes. The Coppery Grass Lizard is endemic to Southern Africa occurring on grass covered mountain slopes and plateaus. Extremely limited suitable habitat occurs within the proposed alignments due to the degradation of the majority of grasslands (overgrazing, frequent fires, grass harvesting activities). The Coppery Grass Lizard has been recorded from the 2530CD QDGC according to ReptiMAP (SARCA virtual museum).

Large-scaled Grass Lizard (*Chamaesaura macrolepis*)

The Large-scaled lacks forelimbs altogtehr and the hind limbs have only one digit each. The legs are spike-like and may be held perpendicular to the body and play no part in locomotion. Grass lizards do not appear to use holes in the ground as refuge habitats, although they do occasionally shelter under rocks is there is easy access. Grass fires are important conservation threat to Grass Lizard populations in several respects. Fires kill lizards that become trapped in pockets of grassland from which they cannot escape. Transformation of land by humans has exacerbated the negative effects of fire due to the increase in fire frequency, fragmentation of the grasslands and installation of barriers such as roads, walls and channels, over which the lizards cannot easily pass to escape the flams. Fires also change the structure of the grassland habitat making it more difficult for Grass Lizards to locomote. The removal of the grass cover is also likely to increase predation and reduce the abundance of food. After fires, Grass Lizards typically move into any unburnt patches that remain. It is probably for this reason that populations persist better in grasslands where there are rocky areas as the rocks probably afford some protection from fire and also serve as fire breaks, causing patches of grass to remain (Alexander & Marais 2007). The Large-scaled Grass Lizard has been recorded from the 2530BD QDGC according to ReptiMAP (SARCA virtual museum).

Striped Harlequin Snake (*Homoroselaps dorsalisis*)

Striped Harlequin Snake (*Homoroselaps dorsalis*), which was previously categorised as Rare in the out-dated Red Data List (Branch 1988) and is currently listed as Near-Threatened (NT) by the South African Reptile Conservation Assessment (SARCA 2014) and the IUCN (World Conservation Monitoring Centre, 1996). Striped Harlequin Snakes have been recorded from the 2530BD and 2531BA quarter degree grid squares (SARCA virtual museum). Prefers grassland and are endemic to the highveld of the Free State, Kwazulu-Natal, Swaziland, Limpopo and Gauteng. These snakes are very secretive and are only known from a few specimens. They burrow in loose soil and forage underground in tunnels and cracks, and are usually exposed in abandoned termitaria or under stones. They feed exclusively on thread snakes (*Leptotyphlops*) which they catch underground (Branch 1998). Limited moribund termite mounds were observed within the proposed P-166 road servitude. As a precautionary measure a suitably qualified herpetologist should examine the moribund termite mounds and loosely embedded rocks within the selected road servitude prior to vegetation and earth-moving activities. The termite mounds can be carefully excavated with a hand pick and recovered reptiles relocated in suitable habitat away from the alignments.

5.4 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 (2000-2012); data from the White River and Nelspruit areas collected for the South African Frog Atlas Project (SAFAP) (1999-2003) and published data, and the list provided in the Appendix (see Table 10) is therefore regarded as likely to be fairly comprehensive.) Thirty-three (38) frog species have been recorded for the combined locus of 2530BD, 2530 CD and 2531 BA.

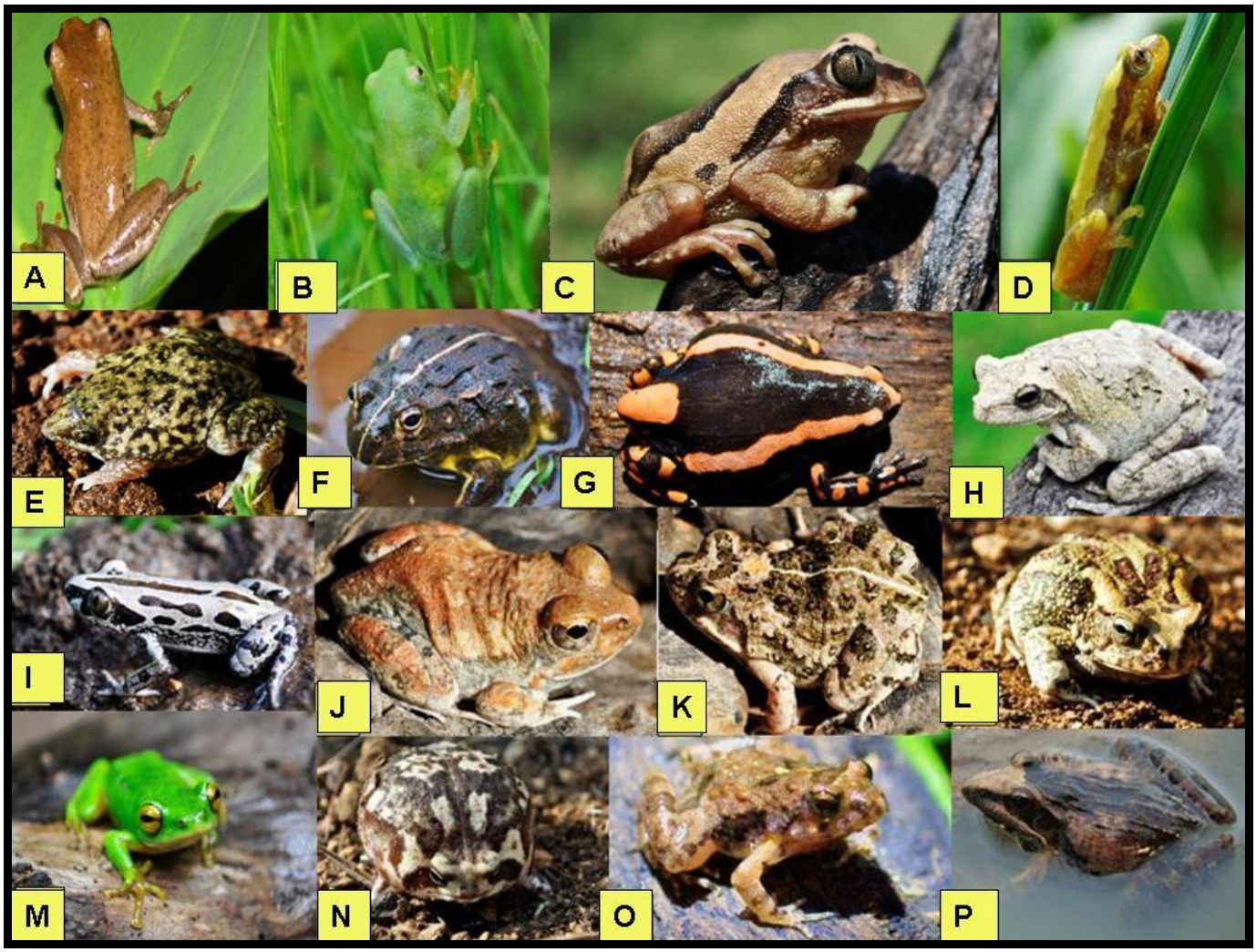


Figure19: A conglomerate of photographs of frog species recorded or likely to occur within the seasonal wetlands habitats and riverine habitats within and surround ding the P-166 alignments. **A:** Painted Reed Frog (*Hyperolius marmoratus marmoratus*) was observed calling within reed invaded margins of farms dams as well as along the perennial rivers **B:** Water Lily Frog (*Hyperolius pusillus*) was observed calling within dams as well as seasonal pools with floating vegetation including water-lilies (*Nymphae nouchali*), **C:** Brown-Backed Tree Frog (*Leptopelis mossambicus*) were observed calling within the bushveld vegetation units and riparian areas along the rivers juvenile colouration, **D:** Golden Leaf-Folding Frog (*Afrixalus aureus*) was observed adjacent to a seasonally inundated depressions in the Mbombela area; **E:** The Mottled Shovel-nosed Frog (*Hemisus marmoratus*) was recorded calling from a sdmall burrow adjacent to a small seasonally inundated pool **F:** African Bullfrog (*Pyxicephalus edulis*) have been previously recorded by the consultant in the Barberton and Nelspruit areas, **G:** Banded Rubber Frog (*Phrynomantis bifasciatus*) were observed calling in the bushveld vegetation unit, **H:** Southern Foam Nest Frog (*Chiromantis xerampelina*) nests were observed hanging over seasonal pools **I:** Bubbling Kassina (*Kassina senegalensis*) were observed calling from the hygrophilous sedge and grass dominated seasonally inundated seepage areas adjacent to the channelled valley bottom in White River., **J:**

Natal Sand Frog (*Tomopterna natalensis marmorata*) and **K:** Tremelo Sand Frog (*Tomopterna cryptotis*) were collected from the roads during the nocturnal surveys, **L:** Eastern Olive Toad (*Amietophrynus garmani*) as well as Guttural Toads (Amietophrynus gutturalis were recorded, **M:** Tinker Reed Frog (*Hyperolius tuberilinguis*) was observed calling from *Typha capensis* beds adjacent to the artificially created dams, **N:** Bushveld Rain Frog (*Breviceps adspersus*) were observed calling throughout the bushveld vegetation units, **O:** Dwarf Puddle Frog (*Phrynobatrachus mababiensis*) were observed calling from small pools situated within the granitic sheets and **P:** Plain Grass Frog (*Ptychadena anchietae*) from seasonally inundated seepage wetlands as well as seasonal pools.

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

No threatened frog species were recorded during the brief field survey or have been recorded during the South African Frog Atlas Project (SAFAP) within the 2530BD, 2530CD and 2531BA Quarter Degree Grid Cells (QDGC's) in which the proposed P-166 road link is situated. A local resident in the White River area has informed the consultant that at least two specimens of the red listed Shovel-nosed Frog (Hemisus guttatus) have been discovered in her swimming pool over the past two years (pers. comm. Mrs J De Villiers). The photographs of the frog and the latest specimen collected in February 2014 have been sent to Professor Louis Du Preez from the Amphibian Specialist Working Group at North-West University. The photographs and specimen have been confirmed by Professor Du Preez and the consultant to be Spotted Shovel-nosed Frogs (Hemsius guttatus).

Figure20. A collage of photographs of the Spotted Shovel-nosed Frog *(Hemisus guttatus*) collected from a swimming pool in the White River area. Photographs courtesy of Mrs J. De Villiers.

SPOTTEDSHOVEL-NOSED FROG (*HEMISUS GUTTATUS*)

Geographic Range:

This species, which is known only from South Africa, occurs in southern Mpumalanga, and central and eastern KwaZulu-Natal, south to Durban on the coast (EOO of 51 000 km^2 and AOO conservatively estimated to be 1%). The northernmost coastal record is from Hluhluwe. It ranges from sea level up to over 1 000 m a.s.l. on the summit of the Lebombo Mountains. It has not been recorded from Swaziland, but it presumably occurs in this country (Measey *et al.* 2011). The only record of this elusive species in Mpumalanga was from Piet Retief, collected in 1964 by Poynton (Jacobsen 1989). This record was confirmed in November 2000 when individuals of this species were observed at two localities near Piet Retief (Theron and Braack 2001). The specimens collected from Mrs J. De Villiers' swimming pool are the first for the White River area and are approximately 180km north of the previous records.

Population:

Breeding congregations of this species appear to be relatively small and widely dispersed. This species is considered to be severely fragmented as no subpopulation has >50% of individuals and >50% of sub-populations are considered non-viable(Measey *et al.* 2011).

Habitat and Ecology:

It inhabits grassland and savanna. It breeds in seasonal pans, swampy areas, and in pools near rivers. It nests in burrows in wet soil by temporary water and tadpoles move to water to develop.

Major Threats:

The main threats include habitat loss due to afforestation, sugar cane cultivation, urbanisation and invasive alien plants lowering the water table (Measey *et al.* 2011).

Conservation Actions:

The highest priority for conservation research of this species is to assess its ability to disperse. Understanding the impact of perceived threats and population size and trends is also required. This species occurs in the iSimangaliso Wetlands Park, the Hluhluwe-Imfolozi Game Reserve, and other protected areas (Bonamanzi, Twin Streams/Mtunzini) (Measey *et al.* 2011).

Listed as **Vulnerable** (B2 a, b (ii,iii,iv) because its AOO is estimated to be 510 km^2, its distribution is severely fragmented, and there is continuing decline in its area of occupation and the extent and quality of its habitat. The estimate of the area of occupation provided is conservative in nature; if additional surveys suggest it is more circumscribed, then a higher threat category should be considered (Measey *et al.* 2011). More intensive surveys undertaken over extended periods are required in order to ascertain the current conservation status of Spotted Shovel-nosed Frogs (Hemisus guttatus) in the White River area. The original P-166 alignment bisects the seepage wetlands of the channelled valley bottom wetland which forms part of the White River Nature Reserve/Bird Sanctuary. An alternative alignment has been proposed to the north of the original alignment and is preferred from a faunal perspective.

5.5 FAUNAL CONCLUSION

Four faunal species of conservation-important were located within the P-166 road alignments and are presented in more detail below:

Mottled Shovel-nosed Frog (*Hemisus guttatus*)
This species, which is known only from South Africa, occurs in southern Mpumalanga, and central and eastern KwaZulu-Natal, south to Durban on the coast (EOO of 51 000 km2 and AOO conservatively estimated to be 1%). The northernmost coastal record is from Hluhluwe. It ranges from sea level up to over 1 000 m a.s.l. on the summit of the Lebombo Mountains. It has not been recorded from Swaziland, but it presumably occurs in this country (Measey et al. 2011). The only record of this elusive species in Mpumalanga was from Piet Retief, collected in 1964 by Poynton (Jacobsen 1989). This record was confirmed in November 2000 when individuals of this species were observed at two localities near Piet Retief (Theron and Braack 2001).

A local resident in the White River area has informed the consultant that at least two specimens of the red listed Shovel-nosed Frog (*Hemisus guttatus*) have been discovered in her swimming pool over the past two years (C. Cook pers. comm. Mrs J De Villiers). The photographs of the frog and the latest specimen collected in February 2014 have been sent to Professor Louis Du Preez from the Amphibian Specialist Working Group at North-West University. The photographs and specimen have been confirmed by Professor Du Preez and the consultant to be Spotted Shovel-nosed Frogs (*Hemsius guttatus*).

Wilhelm's Flat Lizard (*Platysaurus intermedius wilhelmi*)
This range-restricted subspecies of the Common Flat Lizard is not nationally assessed as being of conservation concern but the genetics of this group are currently under review and it is likely that this species will be elevated to species level (Whiting, M. J. in Bates, *et al*., 2014). It is currently assessed as provincially Vulnerable. Small colonies of this species were located in both the Msholozi and Phumlani Alternative Routes in their preferred granite sheetrock habitat as well as adjacent to the Rocky Drift alignment.

Broad-tailed Warbler (*Schoenicola brevirostris*)
The Broad-tailed Warbler is widespread in the Afrotropics but occupies a reasonably small AOO (66 200km^2) and its habitat (tall, moist grassland) is under threat from burning, overgrazing, livestock trampling and agriculture (Barnes, 2000). Several birds of this Near-Threatened classified species were confirmed along the White River Route (McKenzie, 2015).

Side-striped Jackal (*Canis adustus*)

This small carnivore has a restricted distribution in South Africa, limited to the extreme eastern sour bushveld of KwaZulu-Natal, Mpumalanga and Limpopo. It is listed as Near-Threatened due to the small AOO in South Africa (Friedman and Daily, 2004). Tracks of a single individual were observed in natural vegetation near the southern section of the Phumlani Alternative Route (McKenzie, 2015).

6. ROUTE EVALUATION

White River Route

Due to the presence of a significant number of *Aloe simii* (Critically Endangered) and *Aloe kniphofioides* (Vulnerable), the White River Route has the highest number of and most significant biodiversity conflicts. This route contained 115 individual *Aloe simii* plants, in addition to a small colony of *c.* 10 *Aloe kniphofioides* adjacent to the proposed route. *Aloe simii* is also protected nationally under NEMBA ToPS. The White River Route also yielded 5038 individual protected plants. Approximately half of the White River Route is classified as **CBA: Irreplaceable** in the MBSP (see Figure above). The construction of a road through an Irreplaceable Critical Biodiversity Area would also conflict significantly with the land-use guidelines given in Lotter et al. (2014) for CBAs. The selection of this route would also conflict with the 200m buffer proposed by Raimondo *et al.* (2009) for species of conservation concern. Approximately 1600 m of this proposed route will cross this buffer zone. According to the MTPA (M. Lötter *pers. comm*. D. McKenzie) the appropriate conservation measures for *Aloe simii* are *in situ* conservation where plants are allowed to remain on site and untouched. The Near-threatened Broad-tailed Warbler was also recorded at a few localities along this route (McKenzie, 2015).

The 'Declining' River Pumkin *Gunnera perpensa* was observed within the seaosnal wet zones of the valley bottom wetland. The 'Vulnerable' Spotted Shovel-nosed Frog (*Hemisus guttatus*) was collected by a local resident adjacent to the White River Route. This is the **least preferred alignment** and is **not supported** by the faunal and vegetation consultants due to the potential irreversible negative impacts on the hydrological patters of the remaining seepage and valley bottom wetland that would severely impact on the plant species composition and ecosystem functioning, resulting in further habitat destruction and fragmentation within this highly sensitive ecosystem. The Critically Endangered *Aloe simmii* must be conserved 'in-situ' with the proposed 200m 'no-development' buffer zone around the colonies.

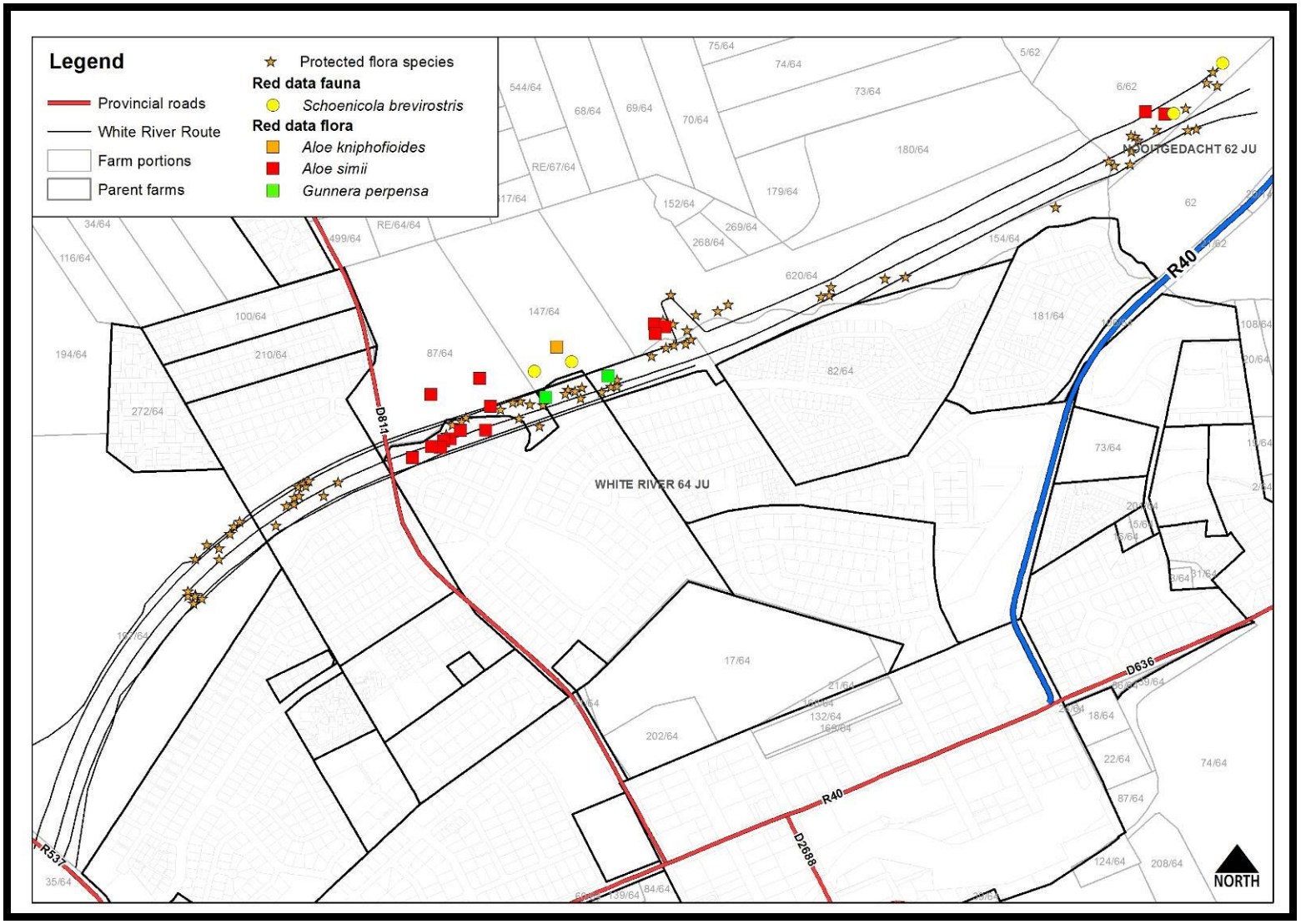


Figure21. Map showing the localities of all conservation-important flora and fauna along the White River Route (McKenzie, 2015).

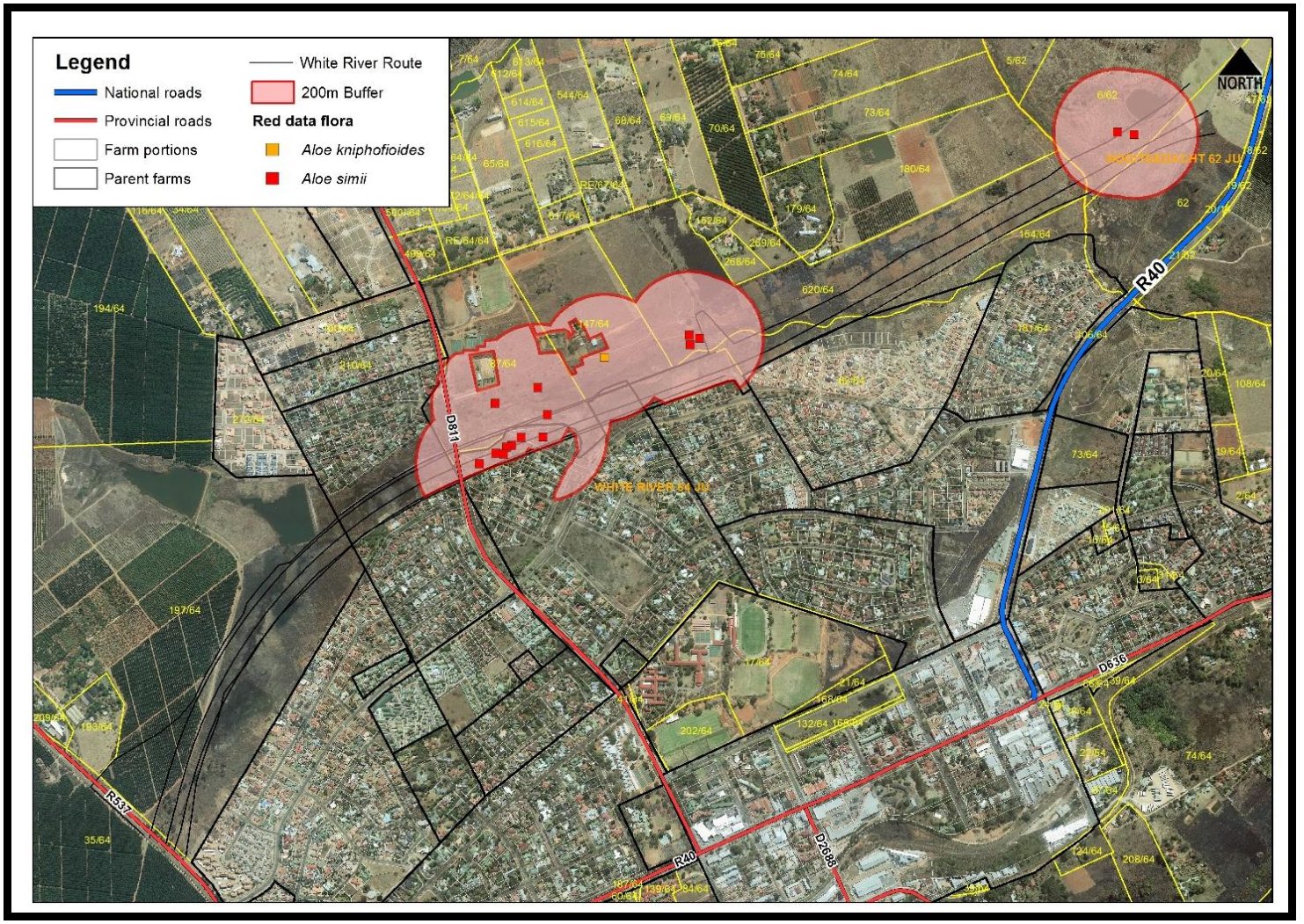


Figure22. Map showing the localities of *Aloe simii*and *Aloe kniphofioides*plants as well as the recommended 200 m no development buffer proposed for those two species

White River Alternative Route

The White River Alternative Route, with no species of conservation concern confirmed, has the least biodiversity conflicts in the vicinity of White River and is considered the preferred route from a biodiversity conservation and ecological perspective. Only two species of protected plants numbering 181 plants in total were found along this route, namely *Gladiolus dalenii* and *Eulophia streptopetala,* and neither qualifies for the provision of a protective conservation buffer. Permits would have to be obtained from the MTPA to destroy or translocate any protected plants along this Route. The White River Alternative Route covers mostly Heavy or Moderately Modified Areas although some portions cross narrow sections of **CBA: Irreplaceable**. These stretches were surveyed and no Threatened species were located (MCKenzie 2015).

Msholozi Route

This proposed route west of Rocky Drift produced four localities where the provincially Vulnerable Wilhelm's Flat Lizard was found as well as two "Declining" plant species: *Eucomis autumnalis* subsp. c*lavata* and *Crinum macowanii.* High numbers (2094) of protected plant species were also recorded along this route. The Msholozi Route is classified as having either Heavy or Moderately Modified or Other Natural Areas in the MBSP (McKenzie, 2015).

Phumlani Alternative Route

Two plant species listed as Declining were confirmed along the Phumlani Alternative Route: *Eucomis autumnalis* subsp. *clavata* and *Crinum macowanii.* One Near-threatened mammal species (Side-striped Jackal) and one provincially Vulnerable reptile (Wilhelm's Flat Lizard) were also confirmed. Although many protected plants species were recorded along this route (1350), the total numbers are significantly lower than that found along the Msholozi Route, and the Phumlani Alternative Route is therefore recommended to be developed, with some mitigation although the same measures could be applied to both routes. These measures include plant relocation, permit application to destroy plants and alien plant control. The Phumlani Alternative Route is also classified as having either Heavy or Moderately Modified or Other Natural Areas in the MBSP (McKenzie, 2015). From an ecological perspective the Phumlani alternative is the preferred alternative as it bisects large transformed vegetation units as well as running adjacent to an existing dirt road as well as immediately to the west of a large settlement. The high levels ofanthropogenic disturbances associated with the informal settlement including overgrazing of livestock, wood harvesting, collection of medicinal plants, hunting and poaching as well as increased fire regimes results in further habitat degradation.

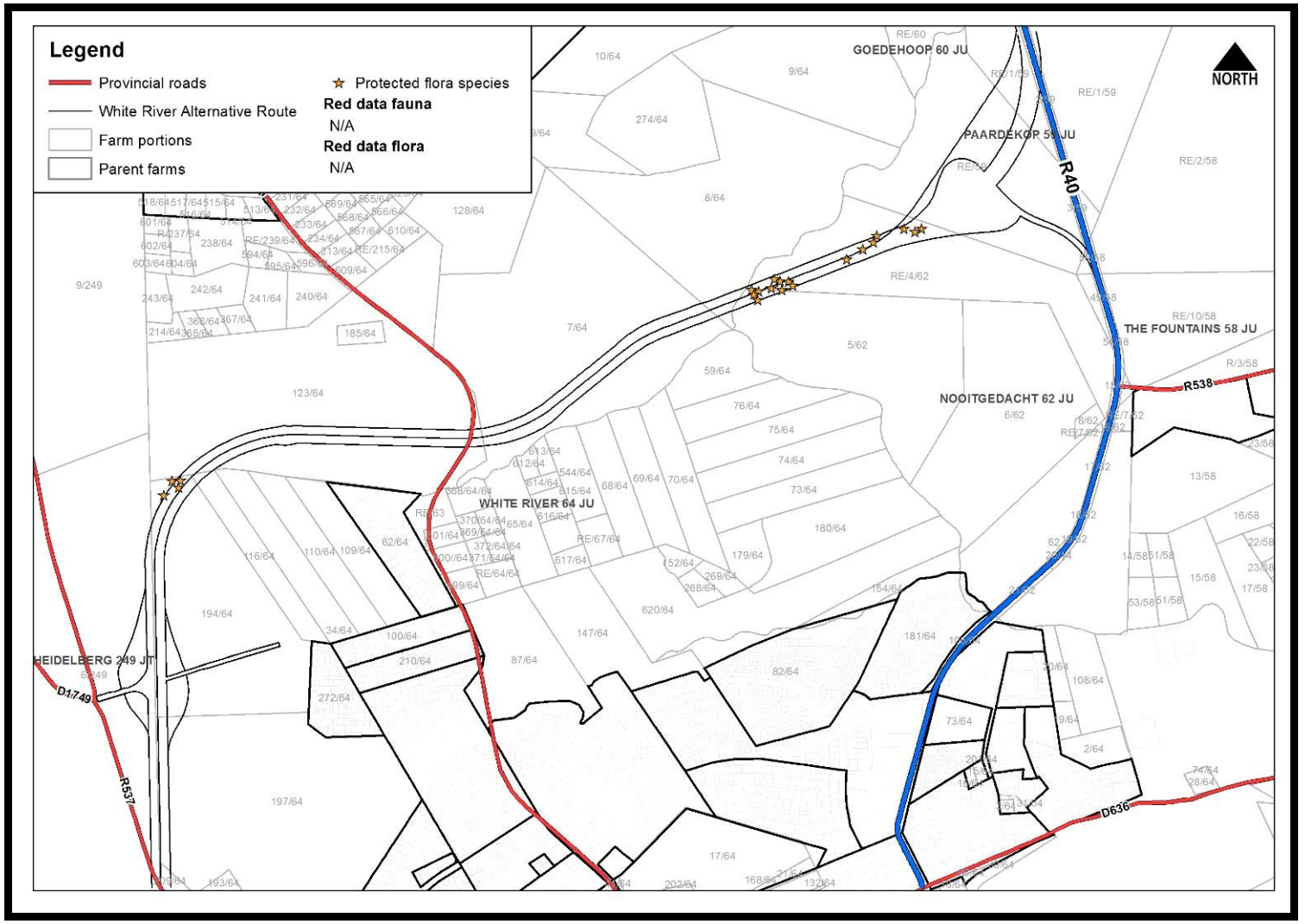


Figure23. Map showing the localities of all conservation-important flora and fauna along the White River Alternative Route (McKenzie, 2015)

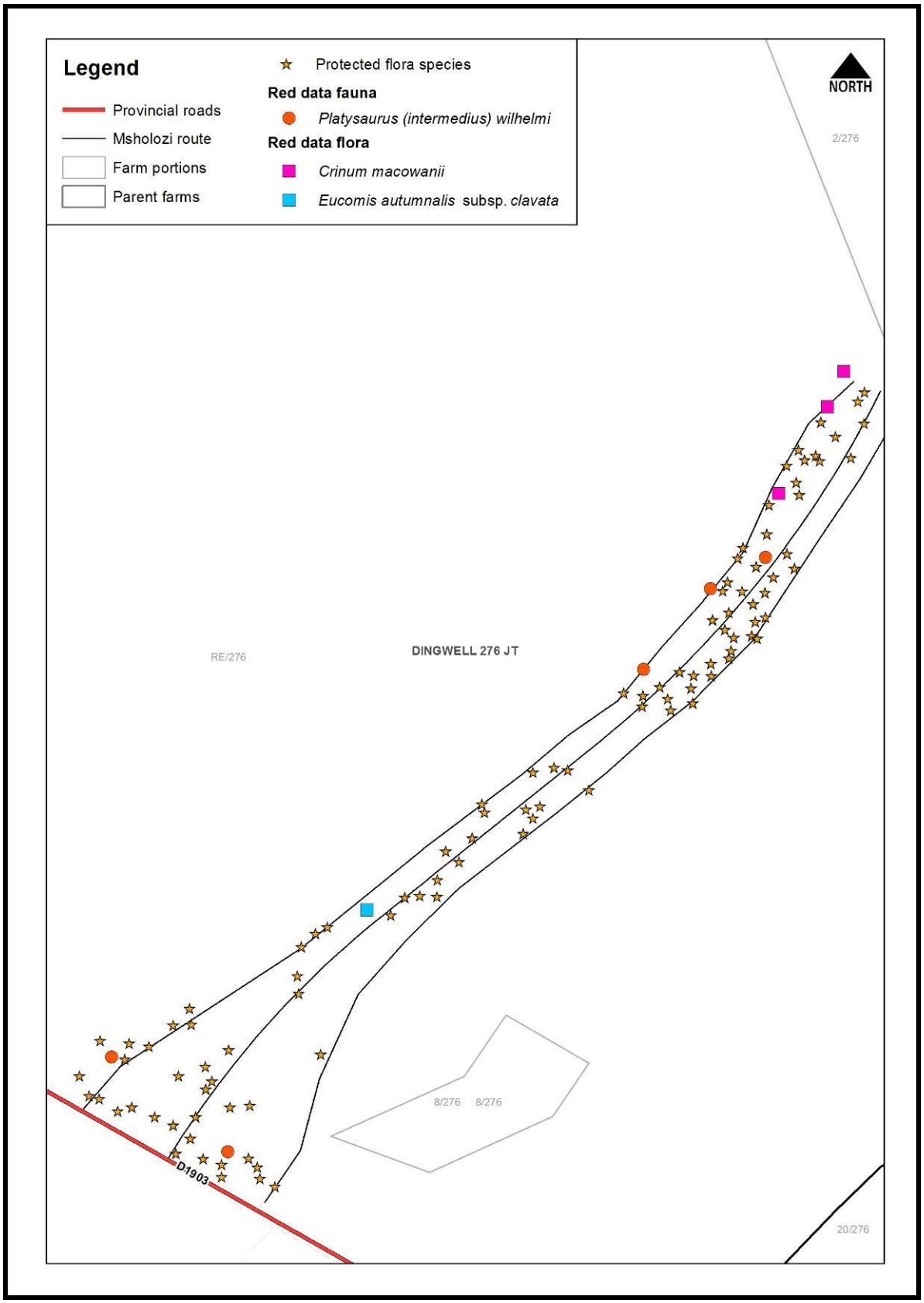


Figure24. Map showing the localities of all conservation-important flora and fauna along the Msholozi Route

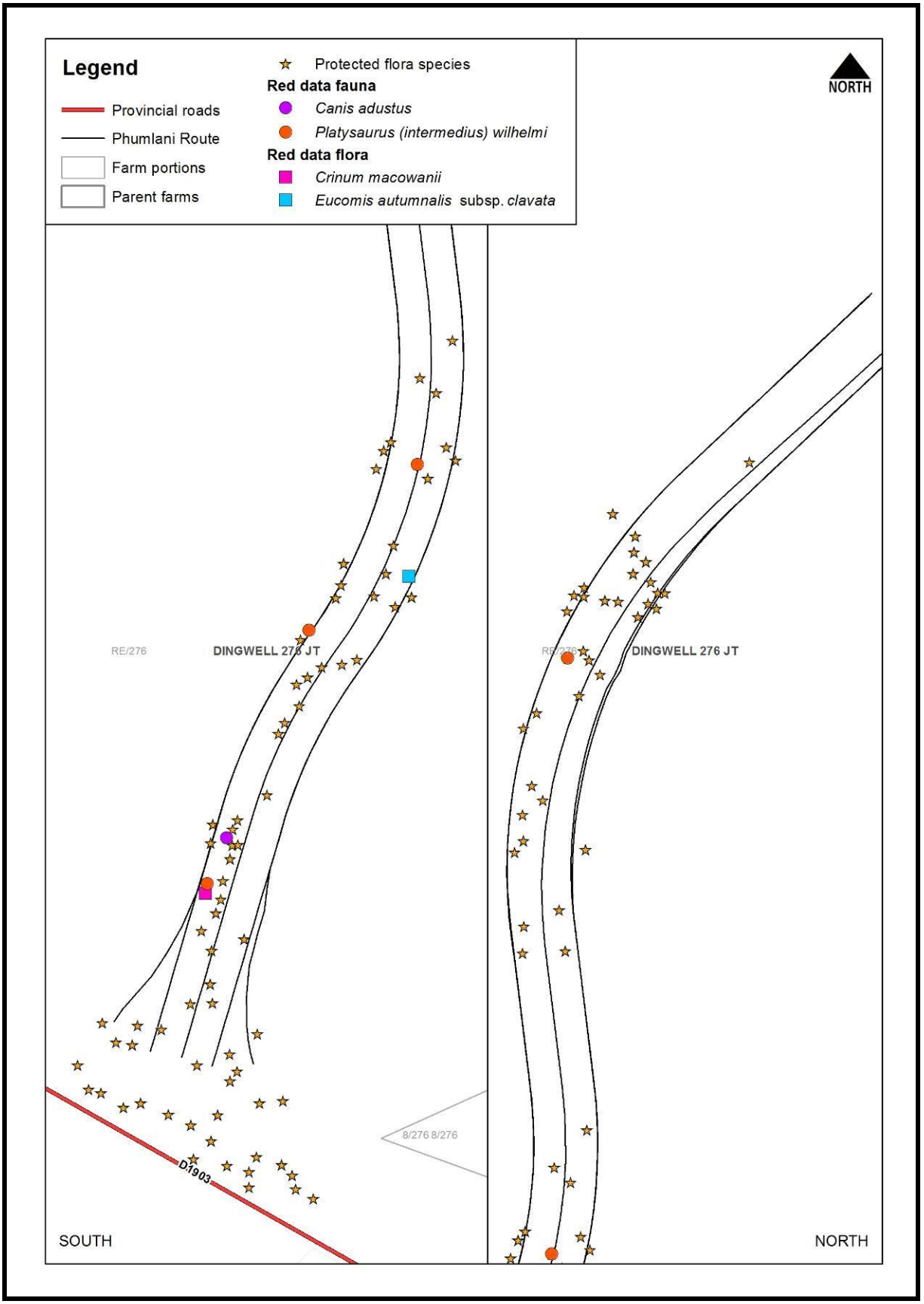


Figure25. Map showing the localities of all conservation-important flora and fauna along the Phumlani Alternative Route

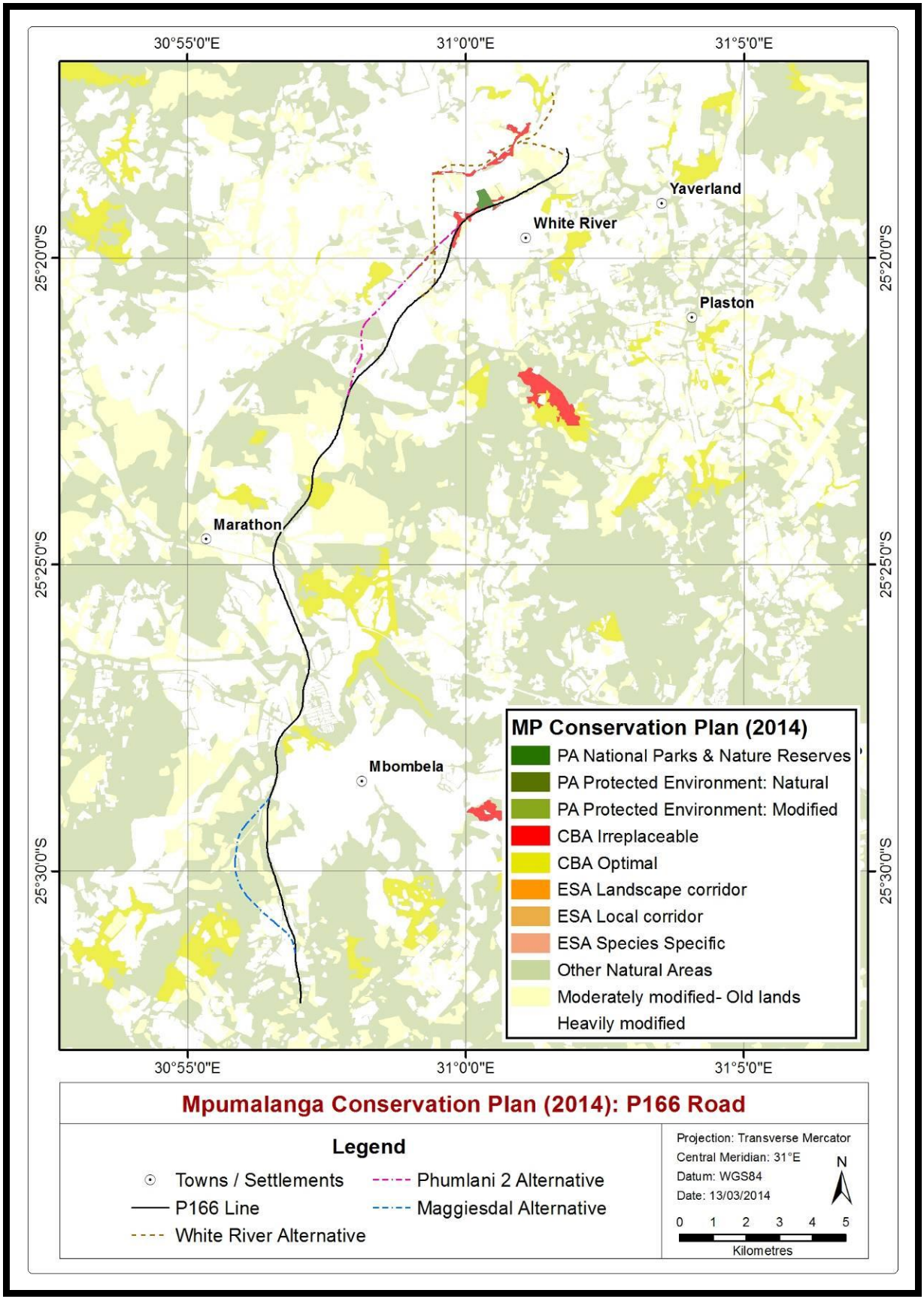


Figure26. The proposed P-166 road alignments overlaid onto the Mpumalanga Conservation Plan (2014)

7. SENSITIVITY MAPPING

The vegetation of the study area comprises two vegetation types namely the **Legogote Sour Bushveld (SVI 9)** and the **Pretoriuskop Sour Bushveld (SVI 10)** (Mucina & Rutherford 2006). The largest part of the proposed P-166 road will pass through the Legogote Sour Bushveld (SVI 9) which is considered a **Vulnerable** vegetation type. The Pretoriuskop Sour Bushveld (SVI 10) vegetation type is not threatened with large areas conserved in the Kruger National Park. This region is economically important in terms of wood production agriculture and especially tourism. Various red data and endemic species have been recorded in the area while invader plants are also a concern.The Legogote Sour Bushveld (SVI 9) is poorly conserved with only 2% statutorily conserved, while 40% of the Pretoriuskop Sour Bushveld (SVI 10) is conserved in the Kruger National Park (Mucina & Rutherford 2006).

The proposed P-166 road is located within areas where various forms of land use occur. Large sections are totally transformed due to commercial forest plantations while others were used to establish various settlements. Soil erosion is regarded low to medium with veld degradation evident in grazed and cultivated areas. In terms of alien plants degradation of large patches of land is evident as a result of alien plants replacing natural species of the area.

According to the Mpumlanga Conservation Plan (MCP 2014) (see Figure 26 above) the proposed P-166 alignment bisects a section of optimal habitat (CBA Optimal) comprising of a channelled valley bottom wetland adjacent to the Nels Rivier to the north of Marathon. The White River P-166 alignment runs parallel bisecting the remnant patches of seasonally inundated seepage wetlands adjacent to a broad channelled valley bottom wetland which forms part of the White River Rotary Bird Sanctuary. The alternative runs to the north and bisects sections of an adjacent valley bottom system. Both these valley bottom wetland systems are classified as IRREPLACEABLE areas according to the MCP. These are critical areas of the Province from a biodiversity point of view, outside of the protected area network. Some IRREPLACEABLE sites may already be managed carefully and sustainably by well-informed owners with appropriate resources, but there is currently no compelling legal or public pressure for this to be so. Ideally, Conservation Management (Land-Use Type 1) should apply to all IRREPLACEABLE areas (Ferrar *et al.* 2007). All these areas have been listed as High sensitivity and the original alignment is not supported by the consultants due to the potential negative impacts including further habitat destruction and transformation, alteration of the hydrological patterns of the channelled valley bottom which will impact negatively on remaining vegetation and fauna; including red listed plants (*Aloe simmii, Gunnera perspensa*) and animals Spotted Shovel-nosed Froh (*Hemisus guttatus*) and Broad-tailed Warbler (*Schoenicola brevirostra*) which have been confirmed from the area.

Wetland area (Unit 1) is located in various sections along the proposed route especially within the valley bottoms close to the town of White River. These palustrine wetland areas vary from being moderately to significantly impact upon by anthropogenic activities such such as destruction of the hillslope seepage wetlands for expanding residential developments, planting of crops on a smallscale, sand harvesting and alien vegetation invasion. This has the effect of disturbance to the natural vegetation and ecosystem with water being artificially channelled in some areas and the natural hygrophilous vegetation removed. This has however not degraded the total ecosystem and their water carrying/buffering function is still considered high with suiatble habitats for a variety of plant and animal species present. The channelled valley bottom wetland in the White River Rotary Bird Sanctuary provides critical habitat for the 'Critically Endangered' *Aloe simii*, the red listed 'declining' *Gunnera perpensa* as well as a red listed bird namely the Broadtailed Warbhler and frog species namely the Spotted Shovel-nose Frog (*Hemsisus guttatus*). Wetlands are considered sensitive ecosystems that are constantly under threat due to human development. They not only act as water reservoirs, but also purify water, buffer an area against floods and provides habitat for various insect and aquatic organisms. Ill-planned human actions in these ecosystems could easily lead to total ecosystem degradation and a loss in biodiversity. Although this unit is somewhat disturbed from a vegetation point of view it still has a high ecosystem functioning and are therefore considered to have a **high conservation value** (Figure 25).

The vegetation of **Unit 2 (Sour Bushveld)** has a high species richness with mostly climax species present. The area is mostly natural with some areas degraded due to human actions such as dumping, topsoil removal etc. In spite of this these rocky areas are characteristic of the Legogote Sour Bushveld (SVI 9) as described by Mucina & Rutherford (2006). The rocky outcrops provide suitable habitats for various rupicolous plants and animals (especially reptiles) with the open grassy and woodland patches adding to the species diversity. The sour bushveld provides important habitat for the red listed 'Declining' *Eucomis autumnalis* subsp. *calvicornis* and *Crinum macowanii* as well as 'NFA protected' *Pterocarpus angolensis* and *Sclerocarya birrea* ssp. *caffra*. The sour bushveld provides important habitat for several threatened faunal species and the granite rockshhets and outcrops offer suitable habitat for the Vulnerable Wilhelm's Flat Lizard (*Platysaurus intermedius wilhelmi*). This unit has from a plant ecological and ecosystem functioning point of view **high conservation value** (Figure 25).

South Africa is an arid country and its water resources are limited. **River systems (Unit 3)** provide water for irrigation, potable water and fish stocks thereby supporting millions of livelihoods throughout the country. These systems also provide nutrient rich soil where palatable plants grow for animals, while many of the river banks and valley bottoms are used for agricultural purposes. River systems also are home to extremely diverse aquatic animal communities (benthic macroinvertenrates, fish) and provide suitable habitat for various bird and animal species that inhabit the river banks and corridors.

The Crocodile River is a slow flowing river with mainly bedrock (dolerite intrusions and basaltic lava) or sandy pools; it has an average width of 45 m, and a low gradient. The area below 250 m altitude falls within the typical Bushveld with types of *Acacia, Combretum, Sclerocarya, Terminalia* as dominant trees. The Lowveld area has developed rapidly and agricultural activities have greatly increased. These developments abstract large volumes of water from the river, resulting in a decline of the flow especially during the dry season. Extensive reed (*Phragmites mauritianus*) banks dominate the riparian zone of this river. The Crocodile River is from an ecological point of view one of the most important rivers in South Africa. This is due to the broad range of riverine habitats, ranging from cold mountain streams in the Drakensberg to slow flowing temperate waters where the river meanders through the Lowveld. As a result of this, the Crocodile River is also one of the most biological diverse systems in the country, with at least 49 fish species (Roux et al., 1999).

These river systems are therefore regarded as sensitive cosystems and although they are degraded in some places they have a high ecosystem functioning. It is therefore important that these systems are managed in a responsible way so as to ensure that they maintain their ecosystem functioning and biophysical composition and status. The rivers in the study area provide important habitat for the red listed ‘declining’ *Crinum macowanii* as well as the several threatened faunal species including African Finfoot, and Half-collared Kingfisher. Thus these areas are regarded as having a **high conservation value** (Figure 25)**.**

Vegetation **unit 4 (Bushveld)** has a relatively low species richness. The area comprises open woodland (typical savannah) to closed woodland on the higher-lying rocky hills with large granite boulders and sheetrocks in some areas. Due to the impact of humans (roads, houses, grazing, small-scale agriculture) large sections are degraded but also fragmented. The granitic outcrops and sheetrocks offer suitable habitat for several rupicolous plant and tree species. The large granitic outcrops and sheetrocks provide critical habitat for several endemic reptile species and have a **medium to high conservation** value and ecosystem functioning (Figure 25).

The vegetation of the **afforested plantations and developed areas (Unit 5)** is totally transformed. These areas will not naturally recover and have a **low conservation value** and **ecosystem functioning** (Figure 25).

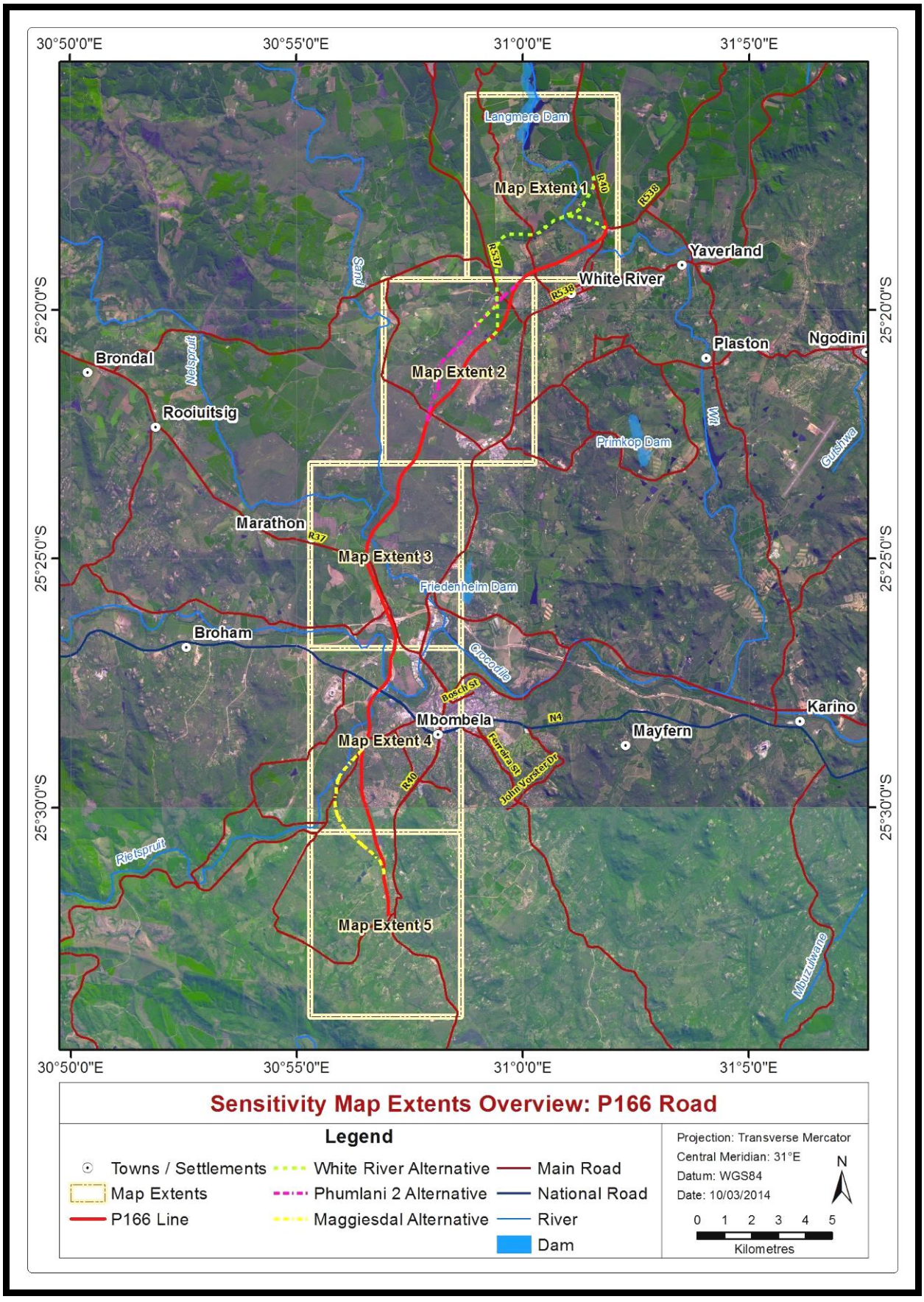


Figure27a. Overview of extents proposed P-166 road Sensitivity Map

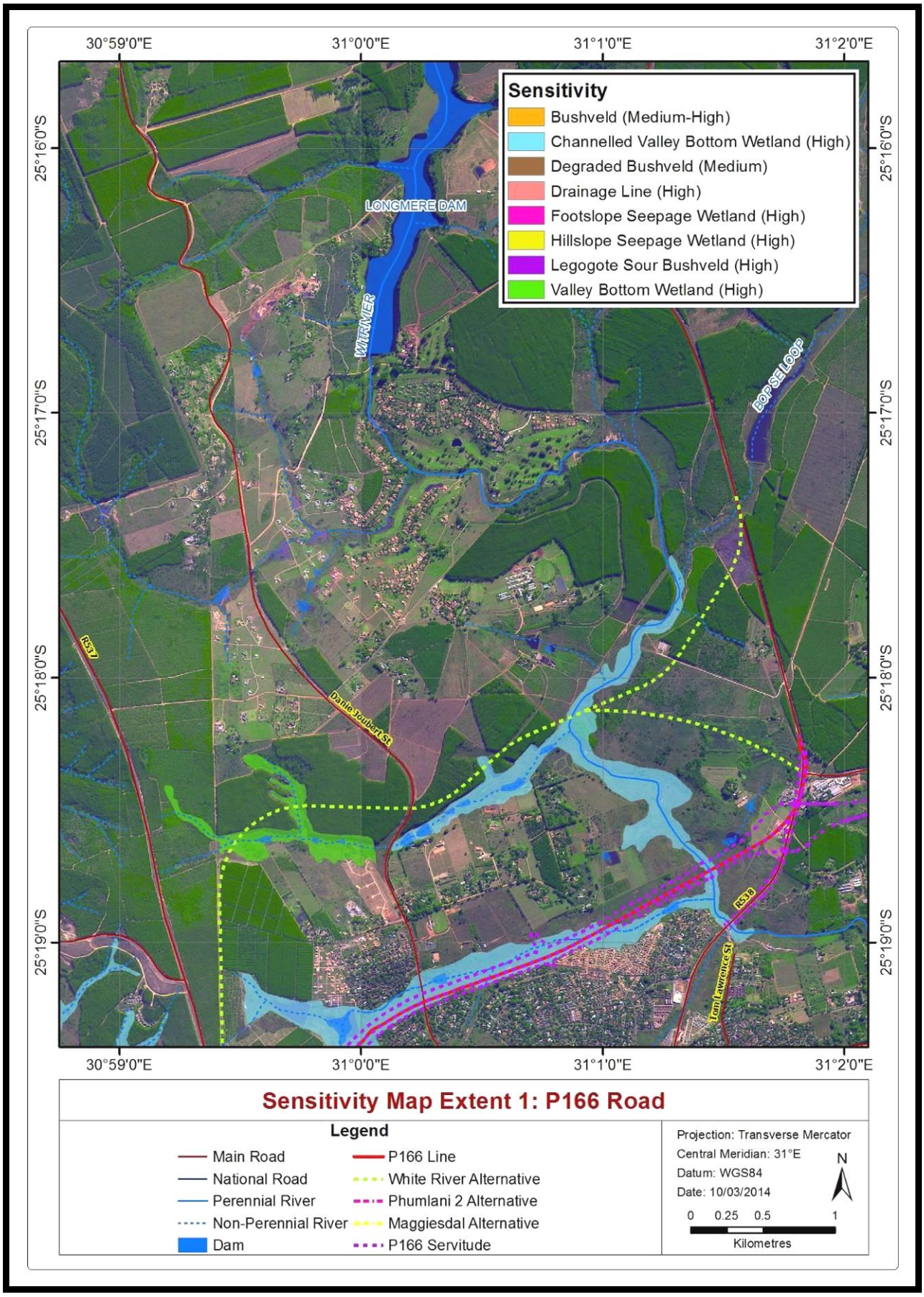


Figure27b. Sensitivity Map for the Extent 1 of the P-166 road.

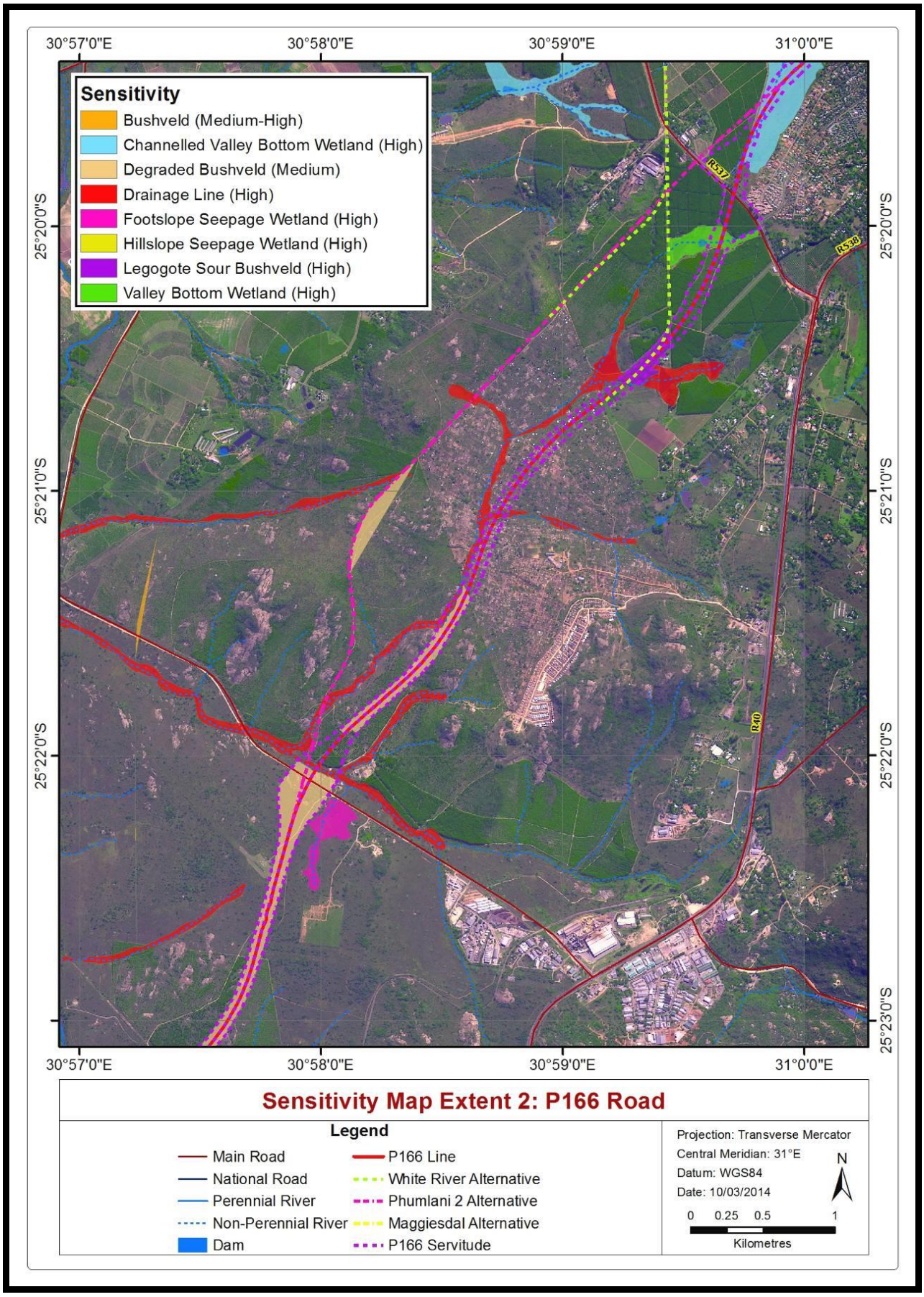


Figure27c. Sensitivity Map for the Extent 2 of the P-166 road.

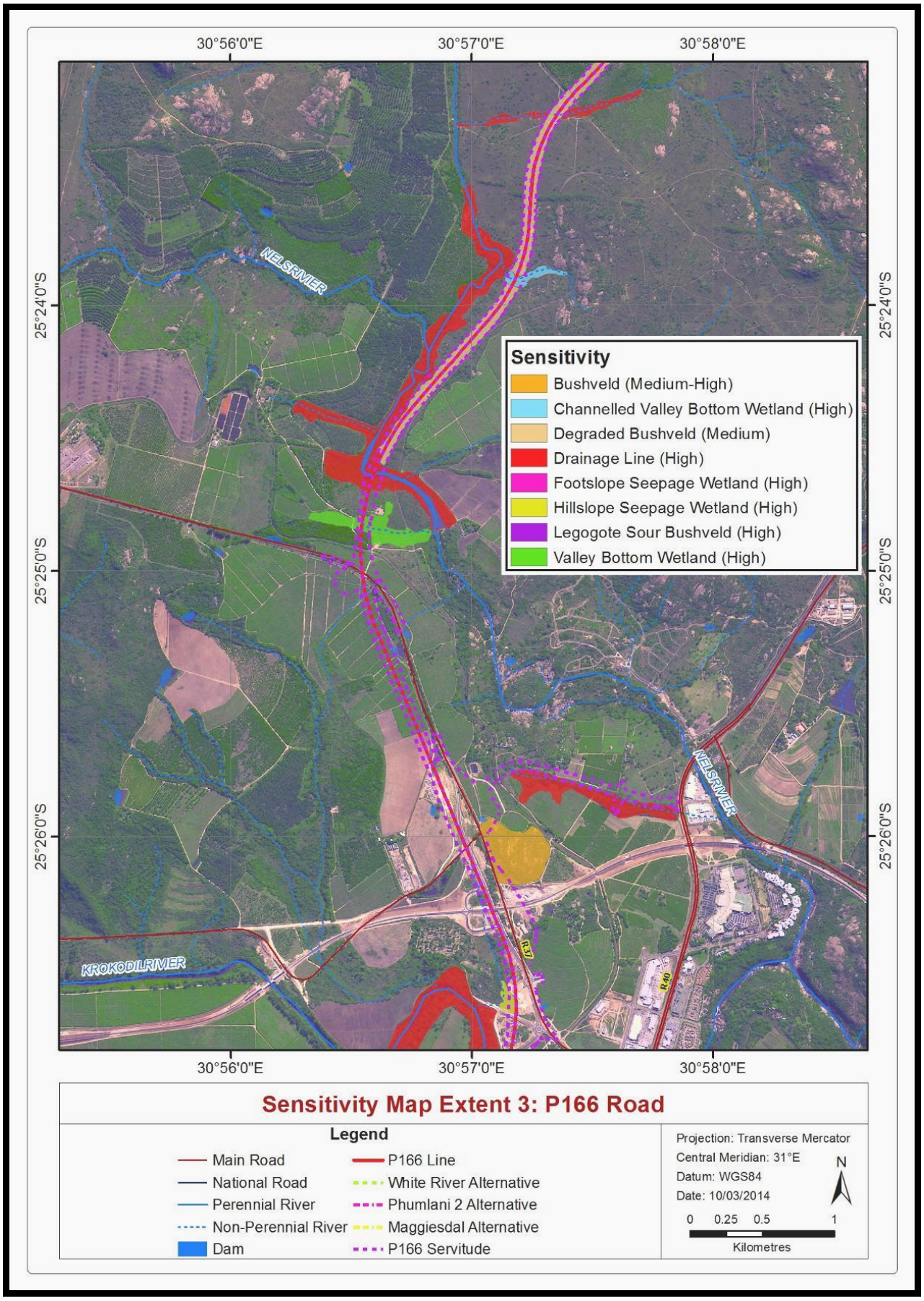


Figure27c. Sensitivity Map for the Extent 3 of the P-166 road.

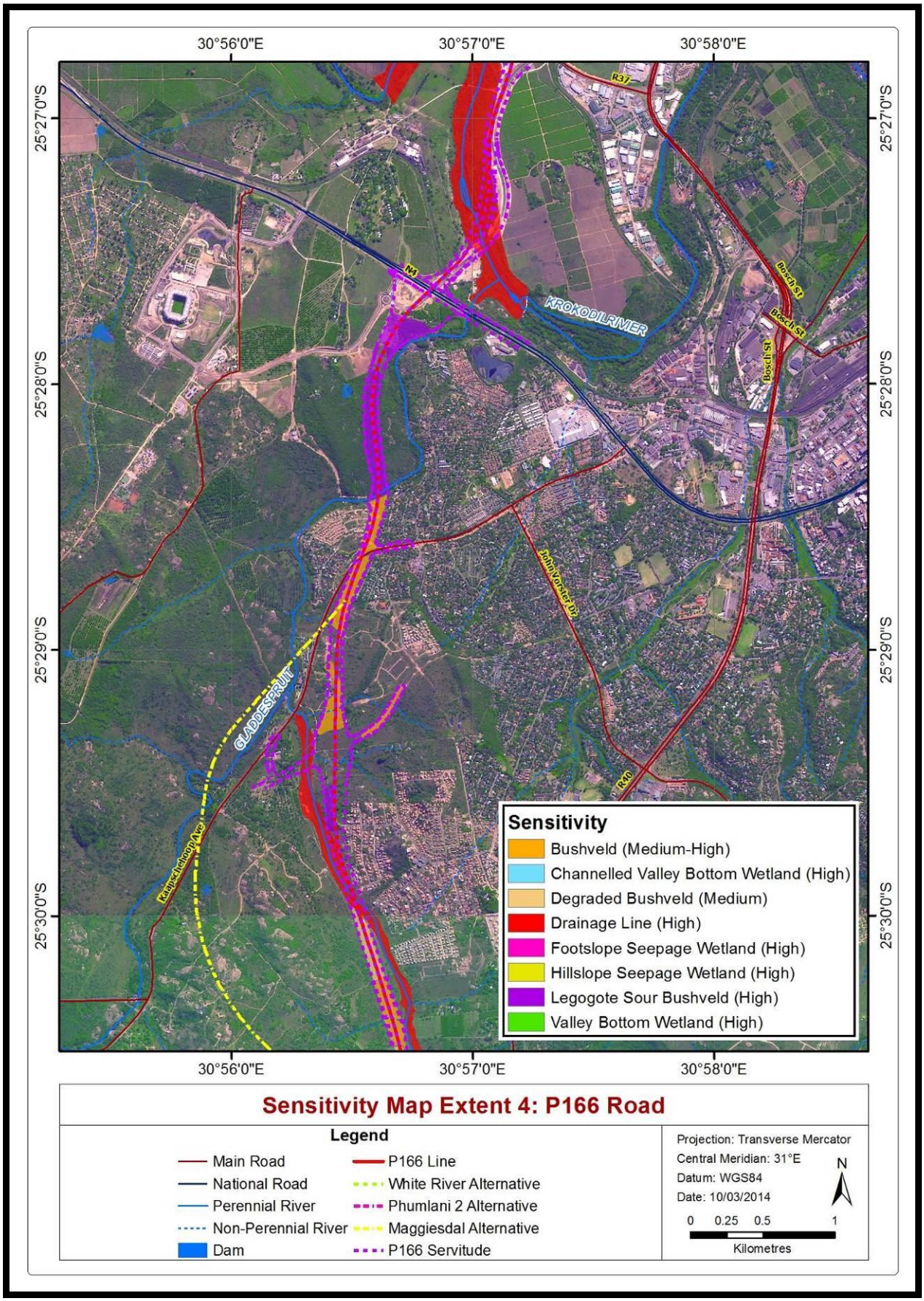


Figure27d. Sensitivity Map for the Extent 4 of the P-166 road.

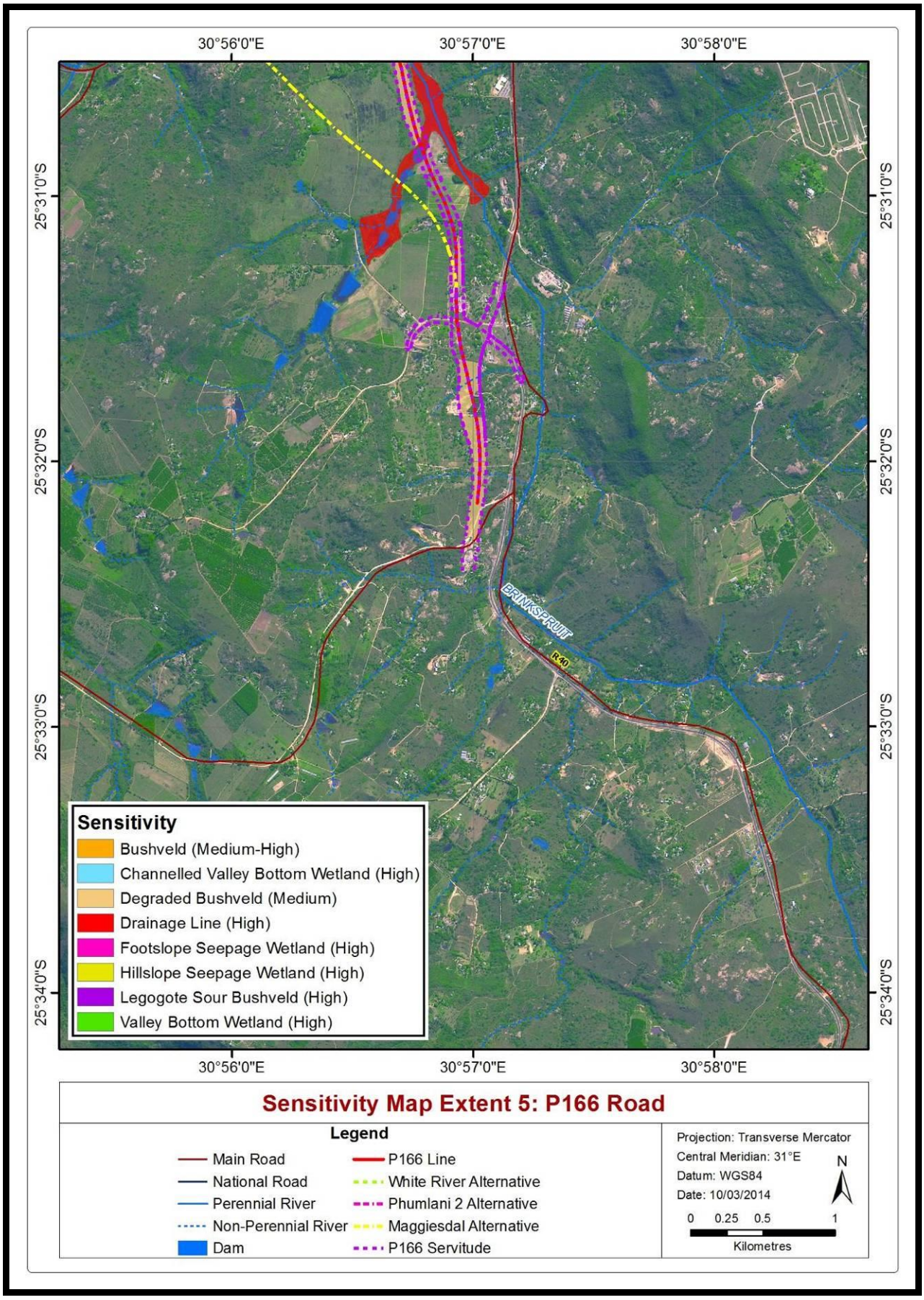


Figure27e. Sensitivity Map for the Extent 1 of the P-166 road.

Table11. The impact rating criteria used for determining potential impacts of the P-166

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!**

Table12. Summary table of the potential impacts and ratings for the P-166 road.

Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed alignments.	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Destruction of suitable habitat for red listed plants and animals.	Likely to Very likely (50 – 89%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Increased levels of road fatalities of dispersing animals.	Very likely (70 – 89%)	Very frequent (a few times a week, to daily)	Local Footprint / site	Long (lifespan of development (i.e. all of operation))	Low – natural processes slightly affected	High-High consequence, probably / definite, **mitigation is essential**
Erosion and sediment control from the cleared alignment and road reserves.	Very likely (70 – 89%)	Frequent (a few times a month) especially during construction phase	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Short (few months, or less than a phase in total) to medium term (until soil adjacent to the road has been stabilised with vegetation)	Low – natural processes slightly affected	Medium to high-Medium to high consequence, probably to very probable, **mitigation is necessary**
Increase in fire frequency within remaining grassland/bushveld vegetation units adjacent to road.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years).	Local	Short (few days to a few months, less than a phase)	Medium – natural processes continue but in a modified manner	Medium to high-Medium to high consequence, probably to very probable, **mitigation is necessary**

Table13. Summary table of the potential impacts and ratings for the White River P-166 route.

Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed alignments.	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Destruction of suitable habitat for red listed plants and and animals	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Increased levels of road fatalities of dispersing animals.	Very likely (70 – 89%)	Very frequent (a few times a week, to daily)	Local Footprint / site	Long (lifespan of development (i.e. all of operation))	Low – natural processes slightly affected	High-High consequence, probably / definite, **mitigation is essential**
Erosion and sediment control from the cleared alignment and road reserves.	Very likely (70 – 89%)	Frequent (a few times a month) especially during construction phase	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Short (few months, or less than a phase in total) to medium term (until soil adjacent to the road has been stabilised with vegetation)	Low – natural processes slightly affected	Medium to high-Medium to high consequence, probably to very probable, **mitigation is necessary**
Increase in fire frequency within remaining grassland/bushveld vegetation units adjacent to road.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years).	Local	Short (few days to a few months, less than a phase)	Medium – natural processes continue but in a modified manner	Medium to high consequence, probably to very probable, **mitigation is necessary**

Table14. Summary table of the potential impacts and ratings for the White River alternative route.

Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed alignments.	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Destruction of suitable habitat for red listed plants and and animals	Inprobable (<24% of occuring)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	Medium to high consequence, probably to very probable, **mitigation is necessary**
Increased levels of road fatalities of dispersing animals.	Very likely (70 – 89%)	Very frequent (a few times a week, to daily)	Local Footprint / site	Long (lifespan of development (i.e. all of operation))	Low – natural processes slightly affected	High-High consequence, probably / definite, **mitigation is essential**
Erosion and sediment control from the cleared alignment and road reserves.	Very likely (70 – 89%)	Frequent (a few times a month) especially during construction phase	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Short (few months, or less than a phase in total) to medium term (until soil adjacent to the road has been stabilised with vegetation)	Low – natural processes slightly affected	Medium to high consequence, probably to very probable, **mitigation is necessary**
Increase in fire frequency within remaining grassland/bushveld vegetation units adjacent to road.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years).	Local	Short (few days to a few months, less than a phase)	Medium – natural processes continue but in a modified manner	Medium to high consequence, probably to very probable, **mitigation is necessary**

Table15. Summary table of the potential impacts and ratings for the Msholozi route.

Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed alignments.	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Destruction of suitable habitat for red listed plants and and animals	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Increased levels of road fatalities of dispersing animals.	Very likely (70 – 89%)	Very frequent (a few times a week, to daily)	Local Footprint / site	Long (lifespan of development (i.e. all of operation))	Low – natural processes slightly affected	High-High consequence, probably / definite, **mitigation is essential**
Erosion and sediment control from the cleared alignment and road reserves.	Very likely (70 – 89%)	Frequent (a few times a month) especially during construction phase	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Short (few months, or less than a phase in total) to medium term (until soil adjacent to the road has been stabilised with vegetation)	Low – natural processes slightly affected	Medium to high consequence, probably to very probable, **mitigation is necessary**
Increase in fire frequency within remaining grassland/bushveld vegetation units adjacent to road.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years).	Local	Short (few days to a few months, less than a phase)	Medium – natural processes continue but in a modified manner	Medium to high consequence, probably to very probable, **mitigation is necessary**

Table16. Summary table of the potential impacts and ratings for the Phumlani route.

Nature of Impact	Probability	Frequency	Extent	Duration	Intensity	Significance
Habitat destruction with transformation of natural vegetation and habitats within the proposed alignments.	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Destruction of suitable habitat for red listed plants and and animals	Definite (90-100%)	During Construction Phase	Local Footprint / site	Permanent	Medium – natural processes continue but in a modified manner	High-High consequence, probably / definite, **mitigation is essential**
Increased levels of road fatalities of dispersing animals.	Very likely (70 – 89%)	Very frequent (a few times a week, to daily)	Local Footprint / site	Long (lifespan of development (i.e. all of operation))	Low – natural processes slightly affected	High-High consequence, probably / definite, **mitigation is essential**
Erosion and sediment control from the cleared alignment and road reserves.	Very likely (70 – 89%)	Frequent (a few times a month) especially during construction phase	Local Footprint / site, but eroded soil could be washed onto other ecosystems	Short (few months, or less than a phase in total) to medium term (until soil adjacent to the road has been stabilised with vegetation)	Low – natural processes slightly affected	Medium to high consequence, probably to very probable, **mitigation is necessary**
Increase in fire frequency within remaining grassland/bushveld vegetation units adjacent to road.	Likely (50 – 69%)	Unusual to occasional (once or twice every 5 years).	Local	Short (few days to a few months, less than a phase)	Medium – natural processes continue but in a modified manner	Medium to high consequence, probably to very probable, **mitigation is necessary**

8. GENERIC DESCRIPTION OF POTENTIAL IMPACTS OF PROPOSED P-166 ROAD ON ASSOCIATED FAUNA AND FLORA AS WELL AS PROPOSED MITIGATORY MEASURES

The proposed P-166 road and associated increased vehicular traffic may impact on the terrestrial fauna in various ways. The major impacts occurring during the construction phase involve the loss and fragmentation of habitats, with a consequent loss of biodiversity, some ecosystem functioning and possibly loss of remnant faunal species or of plant species of conservation concern. This may result from direct land clearance, or occur indirectly via loss or changes in habitats due to consequent changes in drainage patterns, increased fire risk, or secondary impacts associated with socio-economic factors resulting from changes in surrounding land use. During the operational life of the road, small accumulative impacts would also occur, including ongoing road mortalities, increased disturbance (noise and light), dust generation, air pollution, chemical contamination from petroleum and rubber products, increased litter, changes in the incidence of fire (more frequent), and the introduction of a corridor for alien vegetation. All of these factors may impact the surrounding fauna and ecological processes in different ways.

8.1 HABITAT DESTRUCTION AND ASSOCIATED DISTURBANCES TO REMAINING FAUNAL SPECIES

During the construction phase of the proposed P-166 road, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of the road servitudes. As approximately 50% of the preferred alignment occurs within existing road servitude as well as in transformed habitats (old agricultural lands) extremely limited vegetation clearance will be required during the construction and operational phase of the project. Vegetation clearance will be impacted on within the 50% of the alignment within sensitive bushveld, riverine and palustrine wetland habitats. These activities will have an impact on the associated fauna especially ground living and fossorial species occurring along or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. The proposed impact will be of a **definite high; short-long term impact** on remaining natural vegetation and associated faunal species within the P1-66 road reserve and immediate adjacent areas.

MITIGATION AND RECOMMENDATIONS

The following general recommendations are made to minimise the impacts of proposed road construction on the immediate environment and remaining fauna:

- Close site supervision must be maintained during construction. A suitably qualified (minimum BSC. Hons.) Environmental Control Officer (ECO) must be appointed for the project.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the road servitude and access to the undeveloped areas, especially the surrounding rocky granite hills and woodlands, plaustrine wetlands and Crocodile River must be strictly regulated ("no-go" areas during construction as well as operational activities).
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) and surface water in the area. Mobile toilets must be provided in order to minimize un-authorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the road servitude to prevent further invasion.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and plants and the importance of their conservation.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

Figure28. Black Button Spiders were observed under loosely embedded rocks on the lower slopes of the woody hill adjacent to Mbombela.

SCORPIONS AND SPIDERS

- Several poisonous spiders occur around the site including the Black Button Spider (*Lactrodectus indistincus*). One of the most dangerous spiders in Southern Africa with a neurotoxic venom.
- Several species of scorpions are recorded from the area including *Pseudolychas pegleri*, *Uroplected triangulifer*, *Uroplectes formosus, Opistacanthus vallidus, Opistothalmus macer, Opistothalmus karrooensis, Opistothalmus capensis, Opistothalmus pictus*.
- These scorpions construct burrows or scrapes under rocks as well as found under loose bark, wood piles and other surface debris.
- The majority of these scorpions possess a painful sting they are not of medical importance except *Parubuthus granulatus* which is South Africa's most venomous scorpion species.
- Care should be taken when removing stumps, logs or rock material.
- Any scorpions encountered on the site should be left alone and allowed free access away from the activity or safely removed from the area.
- No scorpions should be intentionally killed. Standard precautions or safety measures includes wearing sturdy leather boots and gloves in the field and close inspection of sleeping areas and bedding, clothes, shoes etc. for any scorpions.
- Stings from mildly venomous scorpions cause localised pain and swelling, with little systematic reaction. The affected limb should be immobilized and an ice pack should be applied, if possible, to the site of the sting. The site of the sting should be cleaned and never cut open.

- Venom sprayed in the eyes (certain *Parabuthus* species are able to spray venom) produces an intense burning sensation and may result in temporary blindness if the eyes are not washed out thoroughly with clean water or some other neutral liquid such as milk

BABOON SPIDERS

Figure29. Several Common Yellow-Banded Baboon Spider (*Harpactira tigrina*) were observed under loosely embedded rocks within the wooded hillslopes adjacent to Mbombela.

- During the construction phase care must be taken not to destroy any trap-door or baboon spider burrows. Prior to excavations a thorough inspection of the cleared areas must be undertaken to determine the presences of any baboon spider burrows, loosely embedded rocks or stumps in the proposed cleared areas. Several species of Baboon and Trapdoor species have been recorded in the area including African Corklid Trapdoor Spiders (*Stasimopus spp*.) Wafer-Lid Trapdoor Spiders (*Ancyloptrypa spp*.), Sheetweb Mygalomorph *Allothele australis*, Front-eyed Trapdoor Spiders (*Ctenolophus spp., Idiops spp.*), Banded Legged Trapdoor Spider (*Poecicilomigas abrahami*), African Tree Trapdoor Spiders (*Moggridgea spp.*), Wishbone Trapdoor Spiders (*Lepthercus dregei*, *Spiroctenus fossorius*), Common Yellow-Banded Baboon Spider (*Harpactira tigrina*).

Conservation

- Of the mygalomorphs, it is mainly the larger Baboon Spiders that are in great demand as pets and are consequently regarded as commercially threatened by the International Union for Conservation of International Trade in Endangered Species (CITES) (De Wet & Schoonbee 1991). The genera *Ceratogyrus, Harpactira* and *Pterinochilus* were added to schedule V11 of the Transvaal Provincial Nature Conservation Ordinance of 1983 as Protected Invertebrate Animals.

SNAKES

- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances.
- Several venomous snake species occur along the proposed route including Boomslang (*Dispholidus typus*), Rinkhals (*Haemachatus haemachatus*), Common or Rhombic Night Adder (*Causus rhombeatus*), Puff Adder (*Bitis arietans*).
- General avoidance of snakes if the best policy if encountered. Snakes should not be harmed or killed and allowed free movement away from the area.
- Safety precaution measure must be implemented especially during the vegetation clearance phase which could result in encounters with several venomous snake species.
- Appropriate foot wear (sturdy leather boots) should be worn in the field.
- Several large termite mounds *Trinervitermes spp.* were observed opposite the proposed road alignment. Termite mounds offer important refuges for numerous frog, lizard and snake species.
- If any termite mounds have to be destroyed a qualified herpetologist must be present in case any blind snakes, or the red data Yellow-bellied house Snake (Rare) or Striped Harlequin Snake is unearthed. Although these species have not been recorded in the grid square they have been recorded in adjacent grid squares.

8.2 VEGETATION/FLORA

All indigenous trees and plants occurring outside the proposed road servitude shall be left undisturbed and permits will be required for the removal of the protected tree species *Sclerrocarya birrea* subsp. *caffra* and *Pterocarpus angolensis*. 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. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species.

Management objective

- Minimal disturbance to vegetation where such vegetation does not interfere with construction and the road servitude
- No unnecessary destruction to surrounding vegetation especially in the adjacent natural areas situated in close proximity to the road servitude.

Measurable targets

- Adequate protection of remaining indigenous plant or tree species, especially large trees
- No litigation due to removal of vegetation (protected plant and tree species) without the necessary permits

MITIGATION AND RECOMMENDATIONS

- According to the Red List of South African Plants, a buffer of 200 m is recommended around a “taxon of conservation concern”, in this case *Aloe simii* and *A. kniphofioides*, both confirmed to occur on or adjacent to the White River Route. This is to “mitigate deleterious edge effects. This would apply specifically to. In addition, the open space system must be sufficient to conserve pollinators”. This buffer effectively excludes the entire central section of the proposed route.

- Plant relocations can be made to either to adjacent habitat or to the Lowveld National Botanical Gardens. For provincially protected plants, a permit from the MTPA is required to do this. It is strongly advised that this be done in conjunction with a botanist/ horticulturalist to ensure a higher success rate.

- Regular inspections should be performed on the translocated plants in order to gauge the success of the exercise. This information should be relayed to the MTPA.

- Where herbicides are used to clear vegetation, selective and biodegradable herbicides registered for the specific species should be applied to individual plants only. General spraying and the use of non-selective herbicides (e.g. Roundup, Mamba etc.) should be prohibited at all times.

- All alien vegetation should be eradicated within the P-166 road servitude over a five-year period. Invasive species (*Acacia mearnsii, Agave americana, Opuntia ficus-indica, Sesbania punicea, Eucalyptus sp., Solanum mauritianum*) should be given the highest priority. 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. It is imperative that the construction and operational activities are restricted to the road reserve. This impact is anticipated to be **localised, of a long-term nature and of medium significance**, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation or tree clearance adjacent to the road reserve).

8.3 VEGETATION CLEARANCE

Management objective

- Minimise damage to surrounding vegetation
- Minimise damage to topsoil
- Successful rehabilitation of barren areas

Measurable targets

- No damage to indigenous vegetation outside the road servitude
- No loss of topsoil
- No visible erosion three months after completion of the contract
- All disturbed areas successfully rehabilitated three months after completion of the contract

MITIGATION AND RECOMMENDATIONS

- Vegetation clearing of the P-166 road servitude must be kept to a minimum. Several large indigenous and protected tree species occur along the proposed alignment. Any trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level

to prevent scalping. Any vegetation cleared shall be removed or flattened and not be pushed to form an embankment.

- Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion. This is especially relevant adjacent to the Crocodile River as well as palustrine wetlands. The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications.

- All alien vegetation in the road servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides. 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.

It is recommended that a contractor for vegetation clearing should comply with the following parameters:

- The contractor must have the necessary knowledge to be able to identify indigenous and protected tree species (*Sclerrocarya birrea, Pterocarpus angolensis*), red listed (*Aloe simiii*, *Aloe kniphoides, Eucomis autumalis* subsp, *clavata, Crinum macowanii, Gunnera perpensa*) as well as indigenous species not interfering with the road servitude.

- The contractor must also be able to identify declared weeds and alien species that must be totally eradicated according to the Conservation of Agricultural Resources Act (Act 43 of 1983).
- The contractor must be in possession of or appoint a person with a valid herbicide applicators license.

8.4 INCREASED ROAD FATALITIES

The proposed new P-166 road will most-likely result in a **medium-high, short-long duration negative impact** due to increase in numbers of road fatalities of dispersing faunal species. The road alignments adjacent to the palustrine wetlands are rivers could potentially result in increased fatalities of faunal species moving towards and away from these areas. Where the P-166 road traverses a wetland, measures are required to ensure that the road has minimal effect on the hydrological or flow of water through the wetland and river, e.g. by using a high level clear-span bridges or box culverts rather than pipes. The installation of culverts and bridges over the riverine and wetland crossings. Traditionally culverts are only installed with consideration for their hydraulic capacity, and little thought has been given to the needs of fauna passage or migration. The installation of a culvert alters the hydraulic conditions of the stream at that location, and may also create upstream passage or dispersal problems for fauna, both within the culvert itself and at the inlet and outlet. A second major problem can be the elevation of the culvert outlet. An outlet with the invert above the natural stream level, particularly if it is positioned above the water surface is often an insurmountable obstacle for smaller animal species such as fish, frogs, reptiles and smaller mammals. This situation may result from either the way in which the culvert was initially installed or from subsequent erosion below it. In some circumstances, this may be a desired result to prevent the migration of certain species to upper catchment areas. Badly designed and poorly installed culverts/pipes can be impassable to riverine fauna. Increased water velocities combined with shallow water depth, “stepped” culvert entrances and smooth uniform surfaces all create barriers to fauna migration.

Culverting results in the loss of natural in-stream and bank-side habitats through direct removal and loss of daylight. The culverting of watercourses leads to fragmentation and loss of wildlife corridors in agricultural environments. These corridors and habitats can be important for mammals, bird, reptile and amphibian species and fish, along with other biodiversity interests such as vegetation. Culverted sections may create or exacerbate downstream or upstream bank and bed erosion as well as sediment deposition, as a result of altered water velocities and disruption to the natural transport of sediment. This in turn drives demand for further hard engineering responses (e.g. gabion baskets, concrete banks) which may create additional erosion and deposition problems, and the need to carry out sediment removal. Culverts are prone to blockage by debris, both natural wood and litter, leading to localised flooding during periods of high river flow.

Badly designed or undersized culverts also form restrictions to high flows causing upstream flooding. Once installed, if flood flows increase due to climate change or upstream development, it is very difficult to change the amount of water that a culvert can carry and therefore avoid flooding.

Disturbance to any wetlands or riverine habitats during construction should be minimized. A plan for the immediate rehabilitation of damage caused to wetlands and rivers and riparian habitats should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMP and a record book should be maintained on site to monitor and report on the implementation of the plan.

MITIGATION AND RECOMMENDATIONS

- Appropriate road design and traffic control measures are recommended to reduce air pollution and animal mortality.
- All stormwater structures should be designed so as to block amphibian and reptile access to the road surface.
- A comprehensive surface runoff and stormwater management plan should be compiled, indicating how all surface runoff generated as a result of the road development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / stormwater and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.
- Where road traverses a streams or rivers, an underpass should provide for the movement of aquatic as well as terrestrial species through the inclusion of appropriate buffer zones within the underpass. A minimum of a 30m buffer from them outer edge of the riparian zones.
- Sealing of surfaces under a bridge or gabion construction should be avoided. All underpasses should be dressed with a layer of sand (minimum 10cm), should be a minimum of 1.5m high and 1.0m wide so as to facilitate maintenance access and should be provided with small grates in the road surface to allow light penetration into the underpass. Underpasses should be accessible to maintenance staff and should be cleared of accumulated material at least at the start of each rainy season.
- A barrier (either prefab concrete wall or galvanized fencing that extends at least 40cm above the ground and at least 30cm below the ground) that will physically block animals from accessing the road surface should be constructed for a distance of 200 m on either side of all aquatic/wetland and terrestrial underpasses.

- Holes within the barriers/fence should be routinely filled in and areas directly adjacent to the barrier should be kept free of vegetation
- Where roads are associated with suitable habitat for larger mammals or Spotted Eagle Owls, precautionary road signs should be erected (in accordance with applicable legislation) warning motorists to slow down on account of owls or bushbuck and road margins should be regularly mowed to a distance of 5m from the hard edge of the road and/or regularly burned to prevent the accumulation of grass cover that could provide refuge for small mammals. Where a road-related mortality problem is encountered with other priority species, similar measures may be required.
- Where roads are associated with powerlines and telephone lines (these provide an attraction for species that hunt from perches), road margins should be mowed and/or burned regularly. Owl hunting perches could also be established away from the road.

8.5 EROSION AND SEDIMENT CONTROL

The sandy soils within the P-166 road servitude have a **medium to high** erodibility and risk of erosion**.** Appropriate mitigatory measures for controlling sediment input into the rivers and palustrine wetlands will be required during the construction phase.

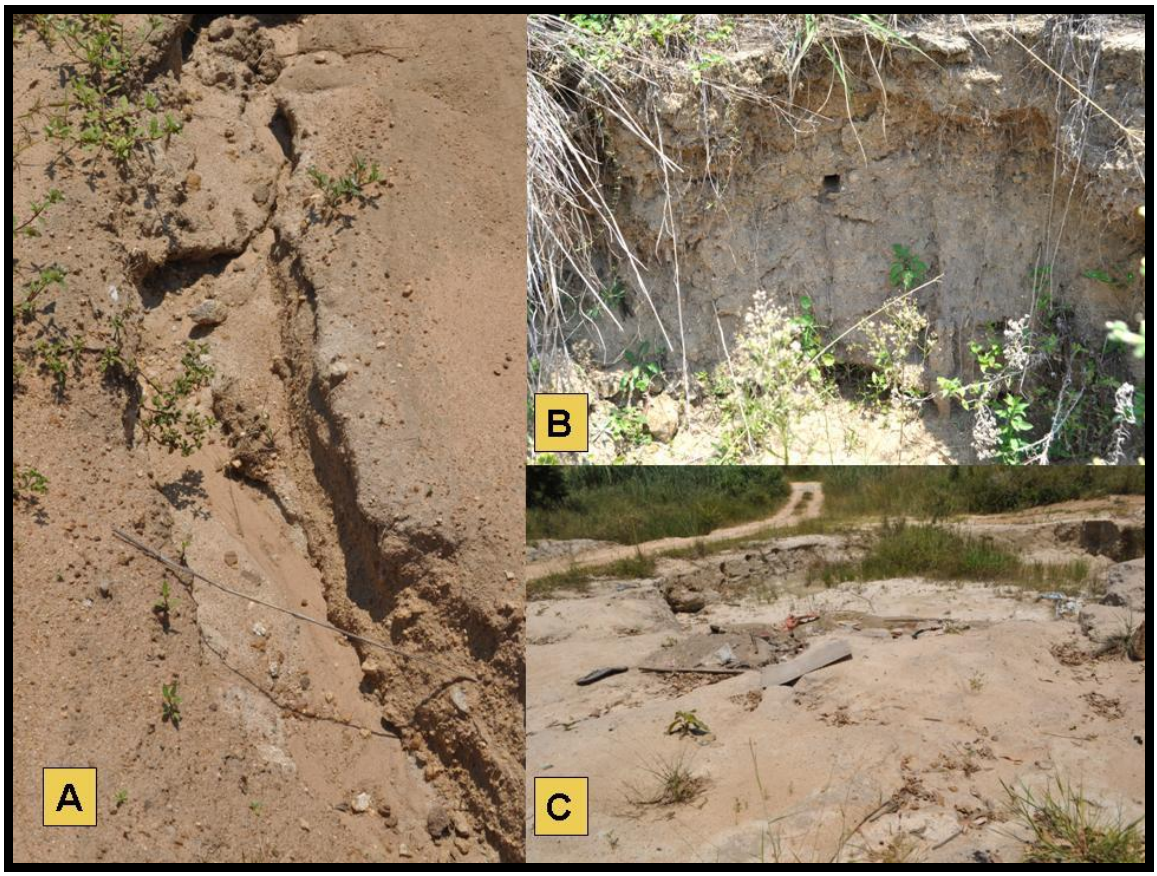


Figure30. A collage of photographs displaying the soil erosion observed along the

proposed P-166 road alignments. A: Extensive rill, B: bank and C: surface erosion occurs in the area, especially within disturbed or cleared areas. The shallow soils situated on the granitic plinthic B horizon are highly erodable.

MITIGATION AND RECOMMENDATIONS

- Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent further soil erosion.
- Re-seeding shall be done on disturbed areas especially adjacent to any natural bushveld habitat, riverine or wetland crossing
- In accordance with the Conservation of Agricultural Resources Act, No 43 of 1983, slopes in excess of 2% must be contoured and slopes in excess of 12% must be terraced.
- Contour banks shall be spaced according to the original or surrounding topography/slope. The type of soil shall also be taken into consideration.
- Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted, and the areas restored to a proper condition.
- The Contractor shall ensure that cleared areas are effectively stabilised to prevent and control erosion. The method of stabilization shall be determined in consultation with the consultant. Consideration and provision shall be made for the following methods:
- Mulch or chip cover
- Straw stabilizing (at the rate of one bale/m² and rotated into the top 100mm of the completed earthworks)
- Watering
- Planting / sodding
- Hand seeding/ sowing
- Hydroseeding
- Soil binders and anti erosion compounds
- Mechanical cover or packing structures
- Gabions & reno mattresses
- Geofabric
- Hessian cover

- Exposed slopes and/or destabilised areas should be landscaped to blend in with the surrounding areas if possible.

8.6 FIRE FREQUENCY

The frequent burning of the vegetation will have a high impact on remaining vegetation and associated faunal species. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks. Fires have an extremely negative impact on the threatened Grass Lizards (Coppery and Large-scaled).

Management objective

- Minimise risk of veld fires
- Minimise damage to grazing
- Prevent runaway fires

Measurable targets

- No veld fires started by the Contractor's work force
- No claims from Landowners for damages due to veld fires
- No litigation

MITIGATION AND RECOMMENDATIONS

- **No open fires shall be allowed on site** under any circumstance. The Contractor shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months.
- Precautionary signs should be erected indicating no open fires.
- During the operational phase the road verges should be regularly maintained with the removal of alien invasive vegetation as well as cutting of the fank grassland vegetation within the road verges.
- Firebreaks may need to be established between the road reserve and afforested plantations as well as natural open grassland/bushveld areas.

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10. APPENDICES

Table17. List of red data and endemic species recorded from the 2530BD, 2530CD and 2531 BA QDGC's. Red listed species recorded during the brief field surveys within the proposed P-166 road servitudes are indicated in red.

FAMILY	SPECIES	THREAT STATUS
AMARYLLIDACEAE	*Clivia caulescens*	NT
AMARYLLIDACEAE	*Crinum macowanii* Baker	Declining
AMARYLLIDACEAE	*Crinum stuhlmannii Baker*	Declining
AMARYLLIDACEAE	*Cyrtanthus eucallus* R.A.Dyer	VU
APIACEAE	*Alepidea peduncularis* A.Rich.	DDT
APOCYNACEAE	*Brachystelma campanulatum* N.E.Br.	NT
AQUIFOLIACEAE	*Ilex mitis* (L.) Radlk. var. *mitis*	Declining
ASPHODELACEAE	*Aloe chortolirioides A.Berger var. chortolirioides*	VU
ASPHODELACEAE	*Aloe kniphofioides* Baker	VU
ASPHODELACEAE	*Aloe simii* Pole-Evans	CR
ASTERACEAE	*Helichrysum homilochrysum* S.Moore	Rare
CELASTRACEAE	*Elaeodendron croceum* (Thunb.) DC.	Declining
CORNACEAE	*Curtisia dentata* (Burm.f.) C.A.Sm.	NT
CRASSULACEAE	*Kalanchoe alticola* Compton	DDD
CRASSULACEAE	*Kalanchoe longiflora Schltr. ex J.M.Wood*	VU
FABACEAE	Pearsonia hirsuta Germish.	VU
GUNNERACEAE	*Gunnera perpensa* L.	Declining
HYACINTHACEAE	*Drimia altissima (L.f.) Ker Gawl*	Declining
HYACINTHACEAE	*Eucomis autumnalis*	Declining
HYACINTHACEAE	*Merwilla plumbea* (Lindl.) Speta	NT
HYPOXIDACEAE	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Av?-Lall.	Declining
MYRSINACEAE	*Rapanea melanophloeos* (L.) Mez	Declining
ORCHIDACEAE	*Ansellia africana* Lindl.	Declining
ORCHIDACEAE	*Disa extinctoria Rchb.f.*	NT
ORCHIDACEAE	*Platycoryne mediocris* Summerh.	EN*
ORCHIDACEAE	*Schizochilus cecilii* Rolfe subsp. *culveri* (Schltr.) H.P.Linder	Rare
PASSIFLORACEAE	*Adenia gummifera* (Harv.) Harms var. *gummifera*	Declining
PROTEACEAE	*Faurea macnaughtonii* E.Phillips	Rare
PROTEACEAE	*Leucospermum gerrardii* Stapf	NT
PROTEACEAE	*Protea parvula* Beard	NT
ZAMIACEAE	*Encephalartos humilis* I.Verd.	VU

ZAMIACEAE	*Encephalartos laevifolius* Stapf & Burtt Davy	CR
ZAMIACEAE	*Encephalartos lanatus* Stapf & Burtt Davy	VU

Table18. Mammal species recorded from the 2530BD, 2530CD and 2531 BA QDGC's according to MammalMAP. Species in red are red listed.

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Bovidae	*Aepyceros*	*melampus*		Impala	Least Concern	0
Bovidae	*Kobus*	*ellipsiprymnus*	*ellipsiprymnus*	Waterbuck	Least Concern	0
Bovidae	*Oreotragus*	*oreotragus*		Klipspringer	Least Concern	0
Bovidae	*Raphicerus*	*campestris*		Steenbok	Least Concern	0
Bovidae	*Tragelaphus*	*scriptus*		Bushbuck	Least Concern	0
Bovidae	*Tragelaphus*	*strepsiceros*		Kudu	Least Concern	0
Canidae	***Lycaon***	***pictus***		**African Wild Dog**	**Endangered**	**0**
Cercopithecidae	*Cercopithecus*	*aethiops*	*pygerythrus*	Vervet Monkey	Least Concern	0
Cercopithecidae	*Papio*	*ursinus*		Chacma Baboon	Least Concern	0
Elephantidae	*Loxodonta*	*africana*		African Elephant	Least Concern	0
Felidae	*Felis*	*silvestris*		African Wild Cat	Least Concern	0
Felidae	***Panthera***	***leo***		**Lion**	**Vulnerable**	**0**
Felidae	*Panthera*	*pardus*		Leopard	Least Concern	0
Giraffidae	*Giraffa*	*camelopardalis*	*giraffa*	Giraffe	Least Concern	0
Hippopotamidae	*Hippopotamus*	*amphibius*		Hippopotamus	Least Concern	0
Hyaenidae	***Crocuta***	***crocuta***		**Spotted Hyaena**	**Near Threatened**	**0**
Orycteropodidae	*Orycteropus*	*afer*		Aardvark	Least Concern	0
Suidae	*Phacochoerus*	*africanus*		Warthog	Least Concern	0

*observed during brief field survey (October 2012)

Table19. List of 38 frog species found for the combined locus = 2530BD, 2530CD, 2531BA according to FrogMAP (SAFAP data). Species in green ere observed during current survey.

Family	Genus	Species	Common name	Red list category	Atlas region endemic
Arthroleptidae	*Leptopelis*	*mossambicus*	Brownbacked Tree Frog	Least Concern	0
Brevicepitidae	*Breviceps*	*adspersus*	Bushveld Rain Frog	Least Concern	0
Brevicepitidae	*Breviceps*	*mossambicus*	Mozambique Rain Frog	Least Concern	0
Bufonidae	*Amietophrynus*	*garmani*	Olive Toad	Least Concern	0
Bufonidae	*Amietophrynus*	*gutturalis*	Guttural Toad	Least Concern	0
Bufonidae	*Amietophrynus*	*maculatus*	Flatbacked Toad	Least Concern	0
Bufonidae	*Amietophrynus*	*rangeri*	Raucous Toad	Least Concern	0
Bufonidae	*Poyntonophrynus*	*fenoulheti*	Northern Pygmy Toad	Least Concern	0
Bufonidae	*Schismaderma*	*carens*	Red Toad	Least Concern	0
Heleophrynidae	*Hadromophryne*	*natalensis*	Natal Ghost Frog	Least Concern	0
Hemisotidae	*Hemisus*	*marmoratus*	Mottled Shovenosed Frog	Least Concern	0
Hyperoliidae	*Afrixalus*	*aureus*	Golden Leaf-folding Frog	Least Concern	0
Hyperoliidae	*Hyperolius*	*marmoratus*	Painted Reed Frog	Least Concern	0
Hyperoliidae	*Hyperolius*	*pusillus*	Water Lily Frog	Least Concern	0
Hyperoliidae	*Hyperolius*	*semidiscus*	Yellowstriped Reed Frog	Least Concern	0
Hyperoliidae	*Hyperolius*	*tuberilinguis*	Tinker Reed Frog	Least Concern	0
Hyperoliidae	*Kassina*	*senegalensis*	Bubbling Kassina	Least Concern	0
Hyperoliidae	*Semnodactylus*	*wealii*	Rattling Frog	Least Concern	0
Microhylidae	*Phrynomantis*	*bifasciatus*	Banded Rubber Frog	Least Concern	0
Phrynobatrachidae	*Phrynobatrachus*	*mababiensis*	Dwarf Puddle Frog	Least Concern	0
Phrynobatrachidae	*Phrynobatrachus*	*natalensis*	Snoring Puddle Frog	Least Concern	0
Pipidae	*Xenopus*	*laevis*	Common Platanna	Least Concern	0
Pipidae	*Xenopus*	*muelleri*	Tropical Platanna	Least Concern	0
Ptychadenidae	*Hildebrandtia*	*ornata*	Ornate Frog	Least Concern	0
Ptychadenidae	*Ptychadena*	*anchietae*	Plain Grass Frog	Least	0

				Concern	
Ptychadenidae	*Ptychadena*	*mossambica*	Broadbanded Grass Frog	Least Concern	0
Ptychadenidae	*Ptychadena*	*oxyrhynchus*	Sharpnosed Grass Frog	Least Concern	0
Ptychadenidae	*Ptychadena*	*porosissima*	Striped Grass Frog	Least Concern	0
Pyxicephalidae	*Amietia*	*angolensis*	Common or Angola River Frog	Least Concern	0
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common Caco	Least Concern	0
Pyxicephalidae	*Cacosternum*	*nanum*	Bronze Caco	Least Concern	0
Pyxicephalidae	*Cacosternum*	*parvum*	Mountain Caco	Least Concern	0
Pyxicephalidae	*Pyxicephalus*	*edulis*	African Bull Frog	Least Concern	0
Pyxicephalidae	*Strongylopus*	*fasciatus*	Striped Stream Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*cryptotis*	Tremelo Sand Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*marmorata*	Russetbacked Sand Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*natalensis*	Natal Sand Frog	Least Concern	0
Rhacophoridae	*Chiromantis*	*xerampelina*	Southern Foam Nest Frog	Least Concern	0

Table20. Reptile (104) species found for the combined locus = 2530BD, 2530CD, 2531BA Southern African Reptile Conservation Assessment (SARCA). Species in green were recorded during current survey.

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Acanthocercus*	*atricollis*	*atricollis*	Southern Tree Agama	Least Concern (SARCA 2014)	
Agamidae	*Agama*	*aculeata*	*distanti*	Distant's Ground Agama	Least Concern (SARCA 2014)	Yes
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)	
Amphisbaenidae	*Zygaspis*	*vandami*	*vandami*	Van Dam's Dwarf Worm Lizard	Not listed	
Atractaspididae	*Amblyodipsas*	*concolor*		Natal Purple-glossed Snake	Least Concern (SARCA 2014)	Yes
Atractaspididae	*Amblyodipsas*	*polylepis*	*polylepis*	Common Purple-glossed Snake	Least Concern (SARCA 2014)	
Atractaspididae	*Aparallactus*	*capensis*		Black-headed Centipede-eater	Least Concern (SARCA 2014)	
Atractaspididae	*Atractaspis*	*bibronii*		Bibron's Stiletto Snake	Least Concern (SARCA 2014)	
Atractaspididae	***Homoroselaps***	***dorsalis***		**Striped Harlequin Snake**	**Near Threatened (SARCA 2014)**	**Yes**
Atractaspididae	*Homoroselaps*	*lacteus*		Spotted Harlequin Snake	Least Concern (SARCA 2014)	Yes
Boidae	*Python*	*natalensis*		Southern African Python	Least Concern (SARCA 2014)	
Chamaeleonidae	*Bradypodion*	*transvaalense*		Wolkberg Dwarf Chameleon	Least Concern (SARCA 2014)	Yes
Chamaeleonidae	*Chamaeleo*	*dilepis*	*dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA	

					2014)	
Colubridae	*Amplorhinus*	*multimaculatus*		Many-spotted Snake	Least Concern (SARCA 2014)	
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)	
Colubridae	*Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Least Concern (SARCA 2014)	
Colubridae	*Dasypeltis*	*inornata*		Southern Brown Egg-eater	Least Concern (SARCA 2014)	Yes
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern (SARCA 2014)	
Colubridae	*Dipsadoboa*	*aulica*		Marbled Tree Snake	Least Concern (SARCA 2014)	
Colubridae	*Dispholidus*	*typus*	*typus*	Boomslang	Least Concern (SARCA 2014)	
Colubridae	*Duberria*	*lutrix*	*lutrix*	South African Slug-eater	Least Concern (SARCA 2014)	Yes
Colubridae	*Gonionotophis*	*capensis*	*capensis*	Common File Snake	Least Concern (SARCA 2014)	
Colubridae	*Gonionotophis*	*nyassae*		Black File Snake	Least Concern (SARCA 2014)	
Colubridae	*Hemirhagerrhis*	*nototaenia*		Eastern Bark Snake	Least Concern (SARCA 2014)	
Colubridae	*Inyoka*	*swazicus*		Swazi Rock Snake	Least Concern (SARCA 2014)	Yes
Colubridae	*Lamprophis*	*guttatus*		Spotted House Snake	Least Concern (SARCA 2014)	
Colubridae	*Lycodonomorphus*	*laevissimus*		Dusky-bellied Water Snake	Least Concern (SARCA 2014)	Yes
Colubridae	*Lycodonomorphus*	*rufulus*		Brown Water	Least	

				Snake	Concern (SARCA 2014)	
Colubridae	*Lycophidion*	*capense*	*capense*	Cape Wolf Snake	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*hoplogaster*		South Eastern Green Snake	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*natalensis*	*occidentalis*	Western Natal Green Snake	Least Concern (SARCA 2014)	Yes
Colubridae	*Philothamnus*	*semivariegatus*		Spotted Bush Snake	Least Concern (SARCA 2014)	
Colubridae	*Prosymna*	*bivittata*		Two-striped Shovel-snout	Least Concern (SARCA 2014)	
Colubridae	*Prosymna*	*stuhlmannii*		East African Shovel-snout	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*angolensis*		Dwarf Sand Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*brevirostris*		Short-snouted Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*mossambicus*		Olive Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*subtaeniatus*		Western Yellow-bellied Sand Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophylax*	*rhombeatus*	*rhombeatus*	Spotted Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophylax*	*tritaeniatus*		Striped Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Pseudaspis*	*cana*		Mole Snake	Least Concern (SARCA	

					2014)	
Colubridae	*Rhamphiophis*	*rostratus*		Rufous Beaked Snake	Least Concern (SARCA 2014)	
Colubridae	*Telescopus*	*semiannulatus*	*semiannulatus*	Eastern Tiger Snake	Least Concern (SARCA 2014)	
Colubridae	*Thelotornis*	*capensis*	*capensis*	Southern Twig Snake	Least Concern (SARCA 2014)	
Cordylidae	***Chamaesaura***	***aenea***		**Coppery Grass Lizard**	**Near Threatened (SARCA 2014)**	**Yes**
Cordylidae	*Chamaesaura*	*anguina*	*anguina*	Cape Grass Lizard	Least Concern (SARCA 2014)	Yes
Cordylidae	***Chamaesaura***	***macrolepis***		**Large-scaled Grass Lizard**	**Near Threatened (SARCA 2014)**	
Cordylidae	*Cordylus*	*jonesii*		Jones' Girdled Lizard	Least Concern (SARCA 2014)	
Cordylidae	*Cordylus*	*vittifer*		Common Girdled Lizard	Least Concern (SARCA 2014)	
Cordylidae	*Platysaurus*	*intermedius*	*wilhelmi*	Wilhelm's Flat Lizard	Least Concern (SARCA 2014)	Yes
Cordylidae	*Pseudocordylus*	*melanotus*	*melanotus*	Common Crag Lizard	Least Concern (SARCA 2014)	Yes
Cordylidae	*Pseudocordylus*	*microlepidotus*	*subsp. ?*	Cape Crag Lizard (subsp. ?)	Not listed	
Cordylidae	*Smaug*	*warreni*	*barbertonensis*	Baberton Girdled Lizard	Least Concern (SARCA 2014)	Yes
Crocodylidae	***Crocodylus***	***niloticus***		**Nile Crocodile**	**Vulnerable (SARCA 2014)**	
Elapidae	*Aspidelaps*	*scutatus*	*intermedius*	Intermediate Shield Cobra	Least Concern (SARCA 2014)	Yes
Elapidae	*Dendroaspis*	*polylepis*		Black Mamba	Least Concern (SARCA	

					2014)	
Elapidae	*Elapsoidea*	*boulengeri*		Boulenger's Garter Snake	Least Concern (SARCA 2014)	
Elapidae	*Hemachatus*	*haemachatus*		Rinkhals	Least Concern (SARCA 2014)	
Elapidae	*Naja*	*annulifera*		Snouted Cobra	Least Concern (SARCA 2014)	
Elapidae	*Naja*	*mossambica*		Mozambique Spitting Cobra	Least Concern (SARCA 2014)	
Gekkonidae	*Chondrodactylus*	*turneri*		Turner's Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Hemidactylus*	*mabouia*		Common Tropical House Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Homopholis*	*wahlbergii*		Wahlberg's Velvet Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Lygodactylus*	*ocellatus*		Spotted Dwarf Gecko	Not listed	
Gekkonidae	*Lygodactylus*	*ocellatus*	*ocellatus*	Spotted Dwarf Gecko	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Pachydactylus*	*affinis*		Transvaal Gecko	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Pachydactylus*	*vansoni*		Van Son's Gecko	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*flavigularis*		Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*major*	*major*	Rough-scaled Plated Lizard	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*nigrolineatus*		Black-lined Plated Lizard	Least Concern (SARCA	

					2014)	
Gerrhosauridae	*Gerrhosaurus*	*validus*	*subsp. ?*	Giant Plated Lizard (subsp. ?)	Not listed	
Gerrhosauridae	*Gerrhosaurus*	*validus*	*validus*	Common Giant Plated Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Heliobolus*	*lugubris*		Bushveld Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Meroles*	*squamulosus*		Common Rough-scaled Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Nucras*	*ornata*		Ornate Sandveld Lizard	Least Concern (SARCA 2014)	
Leptotyphlopidae	*Leptotyphlops*	*distanti*		Distant's Thread Snake	Least Concern (SARCA 2014)	
Leptotyphlopidae	*Leptotyphlops*	*incognitus*		Incognito Thread Snake	Least Concern (SARCA 2014)	
Leptotyphlopidae	*Leptotyphlops*	*jacobseni*		Jacobsen's Thread Snake	Least Concern (SARCA 2014)	Yes
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*conjunctus*	Eastern Thread Snake	Not listed	
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*scutifrons*	Peters' Thread Snake	Not listed	
Leptotyphlopidae	*Myriopholis*	*longicauda*		Long-tailed Thread Snake	Least Concern (SARCA 2014)	
Pelomedusidae	*Pelomedusa*	*subrufa*		Marsh Terrapin	Least Concern (SARCA 2014)	
Pelomedusidae	*Pelusios*	*sinuatus*		Serrated Hinged Terrapin	Least Concern (SARCA 2014)	
Scincidae	*Acontias*	*plumbeus*		Giant Legless Skink	Least Concern (SARCA 2014)	
Scincidae	*Afroablepharus*	*wahlbergii*		Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)	
Scincidae	*Mochlus*	*sundevallii*	*sundevallii*	Sundevall's Writhing Skink	Least Concern	

					(SARCA 2014)	
Scincidae	*Scelotes*	*bidigittatus*		Lowveld Dwarf Burrowing Skink	Least Concern (SARCA 2014)	Yes
Scincidae	*Scelotes*	*mirus*		Montane Dwarf Burrowing Skink	Least Concern (SARCA 2014)	Yes
Scincidae	*Scelotes*	*mossambicus*		Mozambique Dwarf Burrowing Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*capensis*		Cape Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*margaritifer*		Rainbow Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*punctatissima*		Speckled Rock Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*striata*		Striped Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*varia*		Variable Skink	Least Concern (SARCA 2014)	
Testudinidae	*Stigmochelys*	*pardalis*		Leopard Tortoise	Least Concern (SARCA 2014)	
Typhlopidae	*Afrotyphlops*	*bibronii*		Bibron's Blind Snake	Least Concern (SARCA 2014)	
Typhlopidae	*Megatyphlops*	*schlegelii*		Schlegel's Beaked Blind Snake	Least Concern (SARCA 2014)	
Varanidae	*Varanus*	*albigularis*	*albigularis*	Rock Monitor	Least Concern (SARCA 2014)	
Varanidae	*Varanus*	*niloticus*		Water Monitor	Least Concern (SARCA 2014)	
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)	

Viperidae	*Causus*	*defilippii*		Snouted Night Adder	Least Concern (SARCA 2014)	
Viperidae	*Causus*	*rhombeatus*		Rhombic Night Adder	Least Concern (SARCA 2014)	