

The Precautionary Principle is applied throughout this investigation.

### **Red Data Flora Assessment**

Baseline data for the ¼ degree grid ((2327DC; 2327DD; 2328CC; 2427BA; 2427BB; 2428AA) in which the study area is situated were obtained from the SANBI database and was compared to the Interim Red Data List of South African Plant Species (Threatened Species Programme, 2004) to compile a list of Red Data flora species that could potentially occur within the study area.

A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data flora species. Therefore, particular emphasis is placed on the identification of habitat deemed suitable for the potential presence of Red Data plant species by associating available habitat to known habitat types of Red Data flora species. The verification of the presence or absence of these species from the study area are not perceived as part of this investigation as a result of project limitations.

### **Faunal Sensitivity**

Determining the full faunal component of a study area during a short time scale of a few field trips can be highly limiting. Therefore, the different habitats within the study area and nearby surrounding areas were scrutinised for attributes that are deemed to be suitable for high diversity of fauna, as well as for Red Data species. Special consideration was given to habitats of pristine condition and high sensitivity.

Areas of faunal sensitivity were calculated by considering the following parameters:

- Habitat status – the status or ecological condition of the habitat. A high level of habitat degradation will often reduce the likelihood of the presence of Red Data species.
- Habitat linkage – Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area



- Potential presence of Red Data species – Areas that exhibit characteristics that are suitable for the potential presence of Red Data species area considered sensitive.

### **Red Data Fauna Assessment**

Literature was reviewed and relevant experts contacted to determine which Red Data fauna species are present, or likely to be present, in the study area.

A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data fauna species. Particular emphasis was therefore placed on the identification of habitat deemed suitable for the potential presence of Red Data fauna species by associating available habitat to known habitat types of Red Data species. The verification of the presence or absence of these species from the study area is not perceived as part of this investigation as a result of project limitations.

### **Biodiversity Impact Evaluation**

The impact evaluation takes into account the nature, scale and duration of the effects on the environment and whether such effects are positive (beneficial) or negative (detrimental).

A rating/point system is applied to the potential impact on the affected environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each issue the following criteria are used and points awarded as shown:

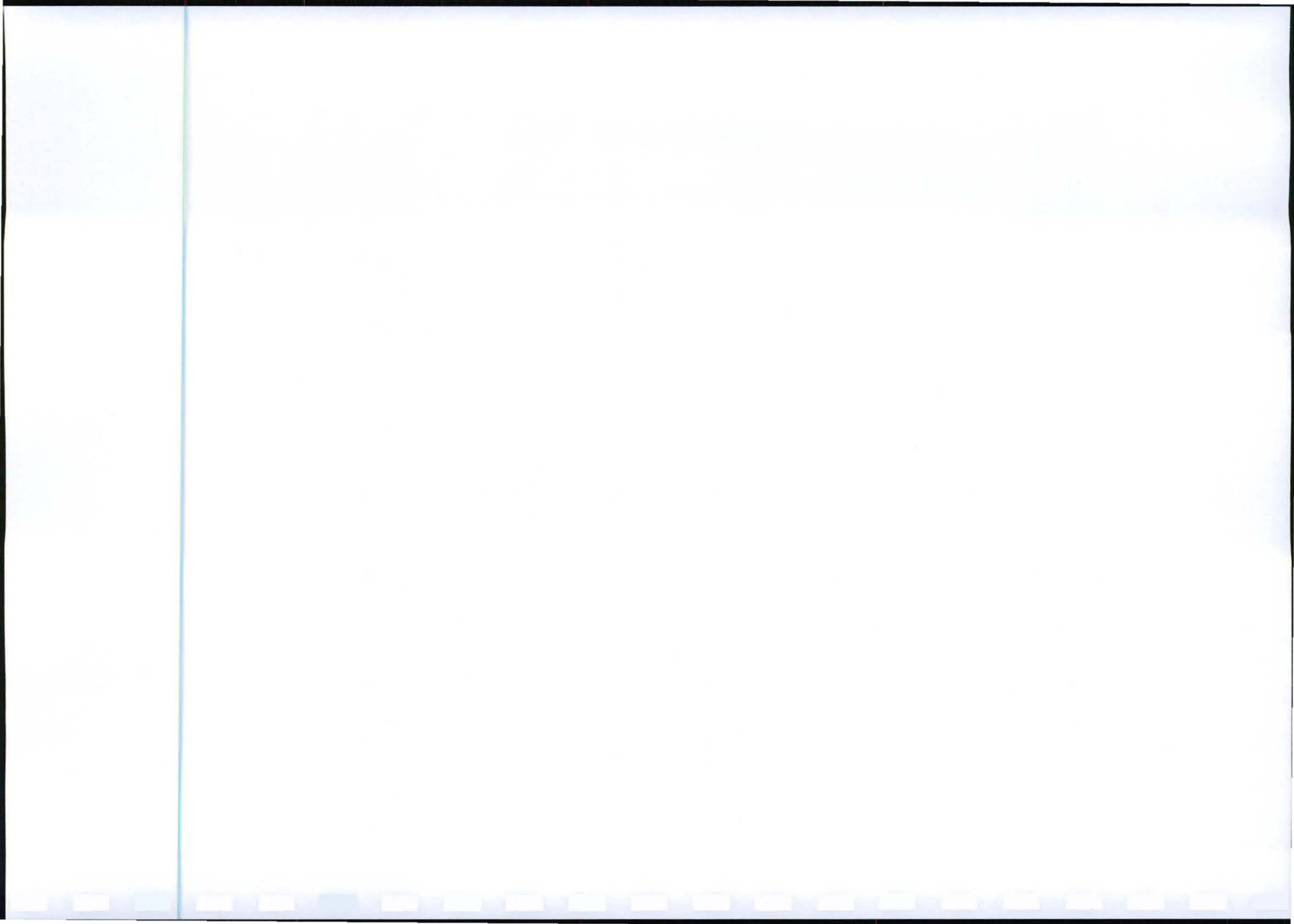
- Extent: National - 4; Regional – 3; Local – 2; Site – 1.
- Duration: Permanent – 4; Long term – 3; Medium term – 2; Short term – 1.
- Intensity: Very high – 4; High – 3; Moderate – 2; Low – 1.
- Probability of Occurrence: Definite – 4; Highly probable – 3; Possible – 2; Impossible – 1.

### **Criteria for the classification of an impact**

#### **Nature**

A brief description of the environmental aspect being impacted upon by a particular action or activity is presented.





### Extent (Scale)

Considering the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact.

- Site: Within the construction site
- Local: Within a radius of 2 km of the construction site
- Regional: Provincial (and parts of neighbouring provinces)
- National: The whole of South Africa

### Duration

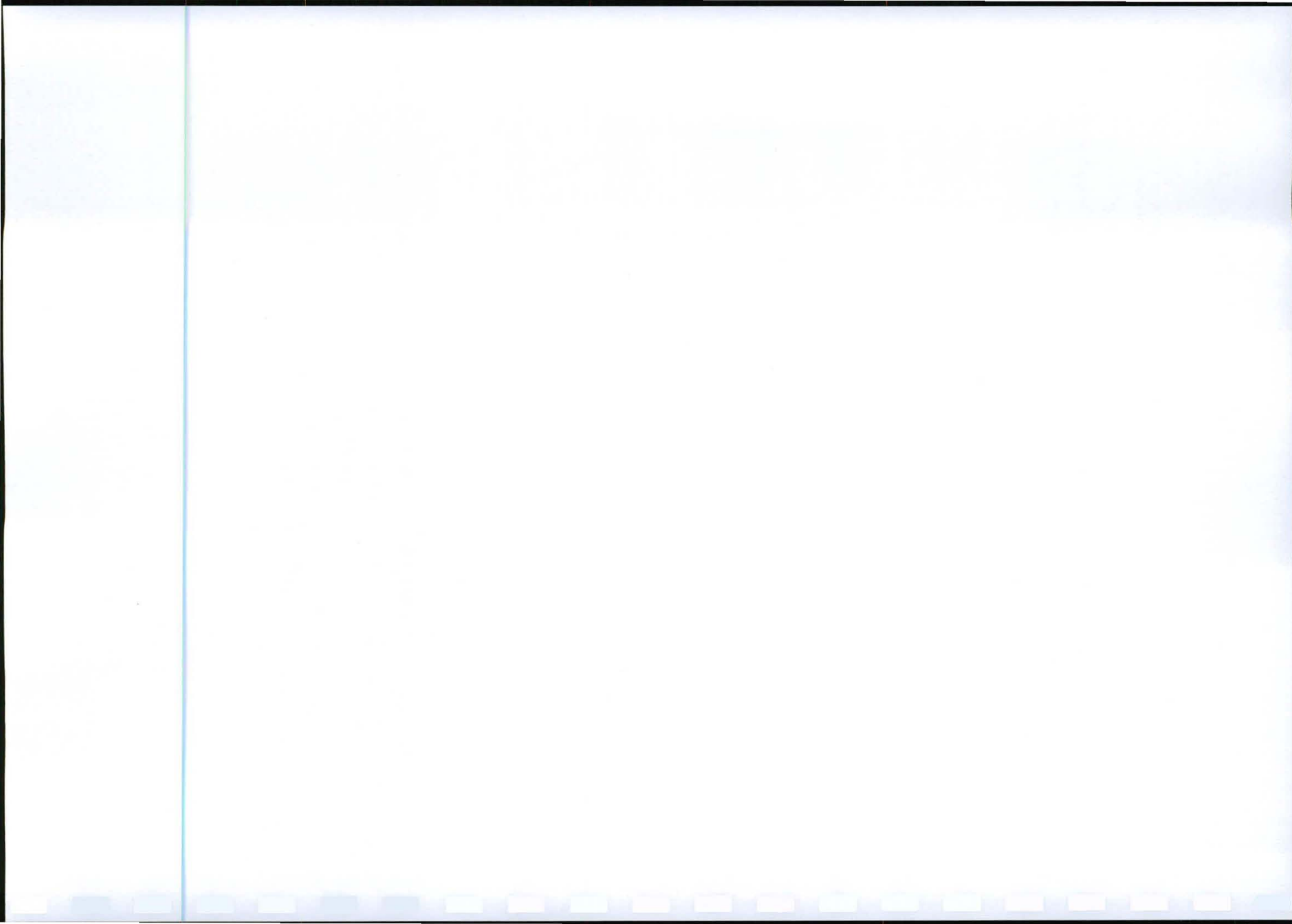
Indicates what the lifetime of the impact will be.

- Short-term: The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase.
- Medium-term: The impact will last for the period of the construction phase, where after it will be entirely negated.
- Long-term: The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

### Intensity

Describes whether an impact is destructive or benign.

- Low: Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
- Medium: Effected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way.



- High: Natural, cultural and social functions and processes are altered to extent that they temporarily cease.
- Very high: Natural, cultural and social functions and processes are altered to extent that they permanently cease.

#### Probability

Describes the likelihood of an impact actually occurring.

- Improbable: Likelihood of the impact materialising is very low.
- Possible: The impact may occur.
- Highly probable: Most likely that the impact will occur.
- Definite: Impact will certainly occur.

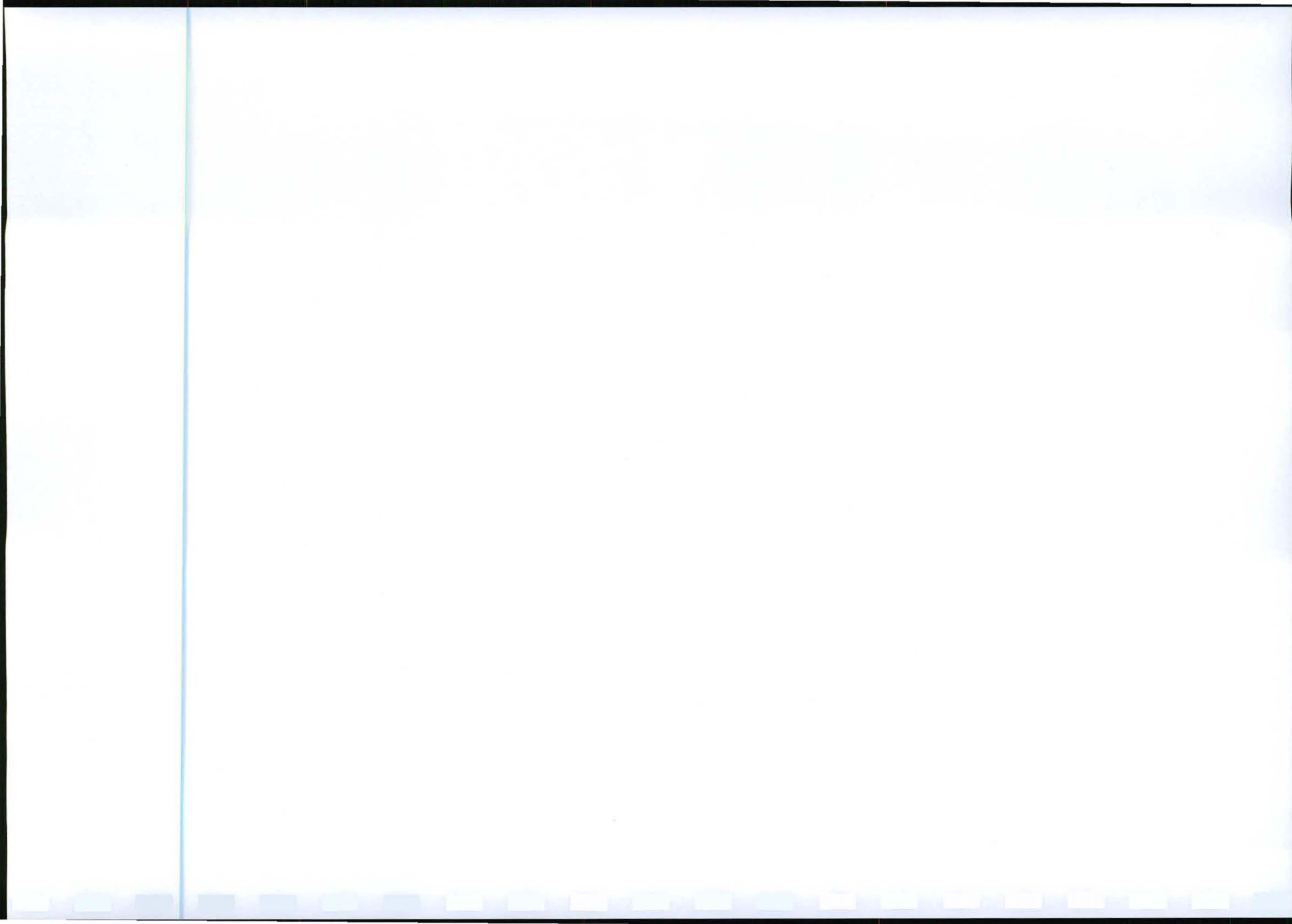
#### Significance

Significance is determined through a synthesis of impact characteristics. It is an indication of the importance of the impact in terms of both the physical extent and the time scale and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Using the scoring from the previous section, the significance of impacts is rated as follows:

- Low impact: 4-7 points. No permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
- Medium impact: 8-10 points. Mitigation is possible with additional design and construction inputs.
- High impact: 11-13 points. The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
- Very high impact: 14-16 points. The design of the site may be affected. Intensive remediation as needed during construction and/or operational





phases. Any activity, which results in a "very high impact", is likely to be a fatal flaw.

#### **Status**

Denotes the perceived effect of the impact on the affected area.

- Positive (+): Beneficial impact.
- Negative (-): Harmful or adverse impact.
- Neutral Impact (0): Neither beneficial nor adverse.

It is important to note that the status of an impact is assigned based on the *status quo*. Therefore not all negative impacts are equally significant. The suitability and feasibility of all proposed mitigation measures will be included in the assessment of significant impacts. This will be achieved through the comparison of the significance of the impact before and after the proposed mitigation measure is implemented.

## **5. BIOPHYSICAL ENVIRONMENT**

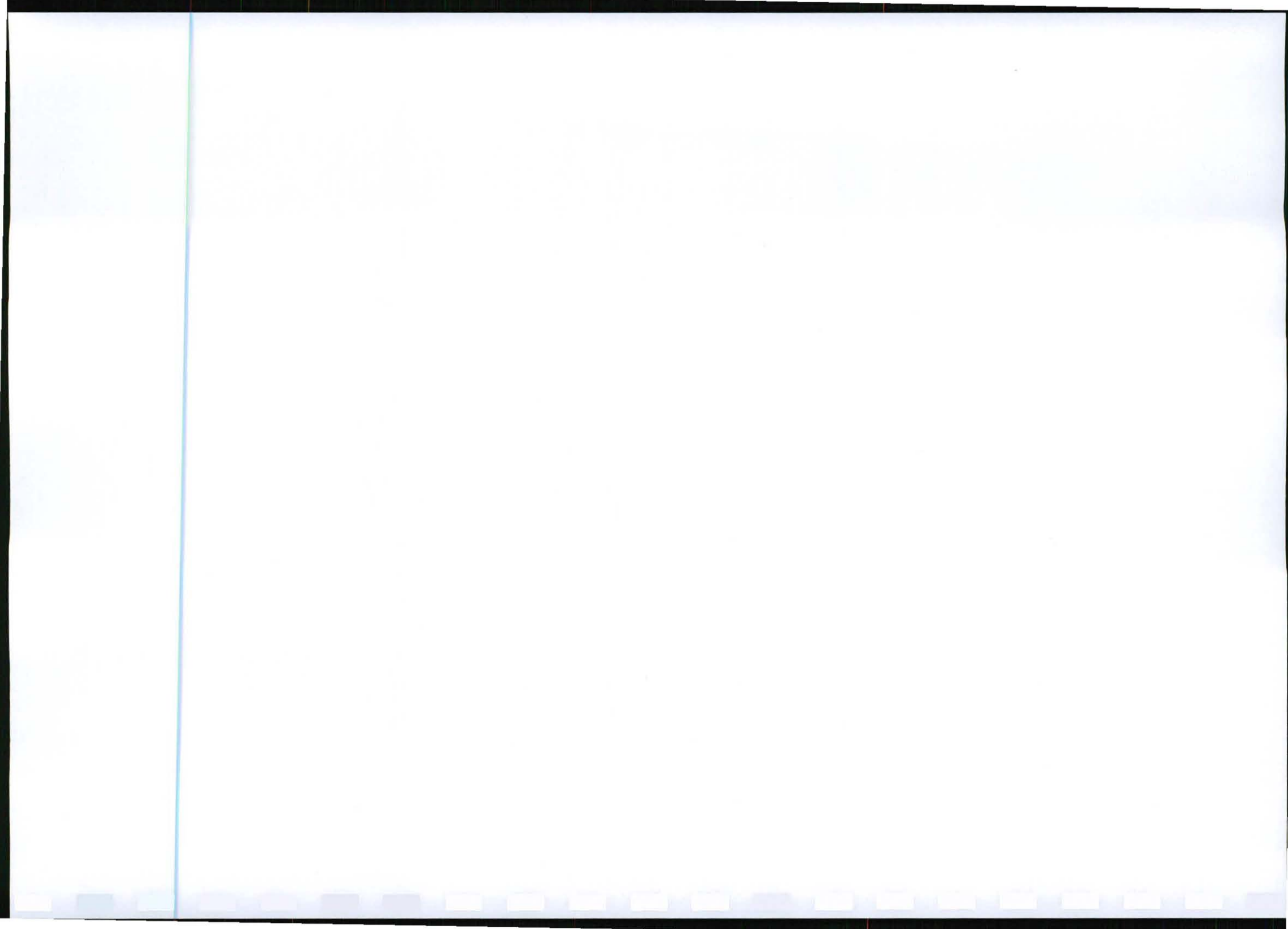
#### **Location**

The study area is situated in the Limpopo Province, close to the small towns of Vaalwater, Matlabas and Elmeston. With Lephalale (Ellisras) further to the north. The area is south of Lephalale, north of Vaalwater and north of the Waterberg mountain range. It is within the area south and east of the Mokolo Dam and Mokolo Dam Nature Reserve (Hans Strijdom Dam and Hans Strijdom Nature Reserve). The study area runs roughly in a east-west direction.

#### **GPS Coordinates of the study area**

The points shown (A-H) correspond to strategic points as highlighted on Map 2.

- Bulge River Substation site (Point A)  
S24<sup>0</sup>07.060'; E27<sup>0</sup>40.154'
- Bulge River shop and petrol station  
S24<sup>0</sup>07.457'; E27<sup>0</sup>41.405'
- River crossing at Malmaniers River  
S24<sup>0</sup>07.864'; E27<sup>0</sup>42.920'
- Road junction (Point B)



- S24<sup>0</sup>08.975'; E27<sup>0</sup>46.411'
- River crossing at Mokolo River  
S24<sup>0</sup>06.819'; E27<sup>0</sup>48.136'
- Site of Camel thorn trees (Protected trees)  
S24<sup>0</sup>06.822'; E27<sup>0</sup>48.301'
- Point where line alternatives deviate from each other (Point C)  
S24<sup>0</sup>06.137'; E27<sup>0</sup>57.752'
- Road junction (Point G)  
S24<sup>0</sup>06.096'; E27<sup>0</sup>59.857'
- Line alternative going north turns sharply east near road junction (Point D)  
S24<sup>0</sup>02.599'; E27<sup>0</sup> 59.175'
- Road junction near point D where line alternatives follow same route  
S24<sup>0</sup> 02.625'; E27<sup>0</sup> 59.385'
- Point at which line alternatives deviate (Point E)  
S24<sup>0</sup> 03.021'; E28<sup>0</sup> 05.317'
- Road junction and turning point of line alternative (Point H)  
S24<sup>0</sup> 03.755'; E28<sup>0</sup> 06.960'
- River crossing at Poer se loop (taken on the sand road)  
S24<sup>0</sup> 03.388'; E28<sup>0</sup> 07.651'
- Dorset Substation (Point F)  
S24<sup>0</sup> 03.860'; E28<sup>0</sup> 09.604'

## **Geology**

### **Geology of the region**

Sandstone and mudstone of the Matlabas Subgroup and sandstone, subordinate conglomerate, siltstone and shale of the Kransberg Subgroup (Both Mokolian Waterberg Group) are found in the north. Archaean granite and gneiss of the Swazian Erathem and granite of the Lebowe Granite Suite (Bushveld Igneous Complex) are found in the west and south-east of the region, respectively. This is the typical geology of the Western Sandy Bushveld vegetation type.

The southern and eastern parts of the Central Sandy Bushveld veldtype are predominantly underlain by granite of the Lebowe Granite Suite, with some





granophyre of the Rашoop Granophyre Suite. Both are part of the Bushveld Complex, Vaalian. The sedimentary rocks of the Waterberg mountains or Waterberg Group (Mokolian Erathem) to the south of the study area, are an important part of the geology of the region. Specifically the sandstone, conglomerate and siltstone of the Vaalwater Formation<sup>1</sup>.

The Waterberg Mountain Bushveld is present in the region. The geology of this veldtype is predominantly sandstone, subordinate conglomerate, siltstone and shale of the Kransberg Subgroup. As well as medium- to coarse-grained sandstone, conglomerate, trachytic lava and quartz porphyry of the Swaershoek Formation (Nylstroom Subgroup). Both subgroups are of the Mokolian Waterberg Group<sup>5</sup>.

### **Geology of the study area**

Coarse, sandy soils, which are typically shallow, overlay granite, quartzite or shale. Sandstone, conglomerate and siltstone also form an important part of the geology of the study area. Shales, along with coarse-grained sandstone, conglomerate, trachytic lava and quartz porphyry are present in parts of the study area where it enters the Waterberg Mountain vegetation unit.

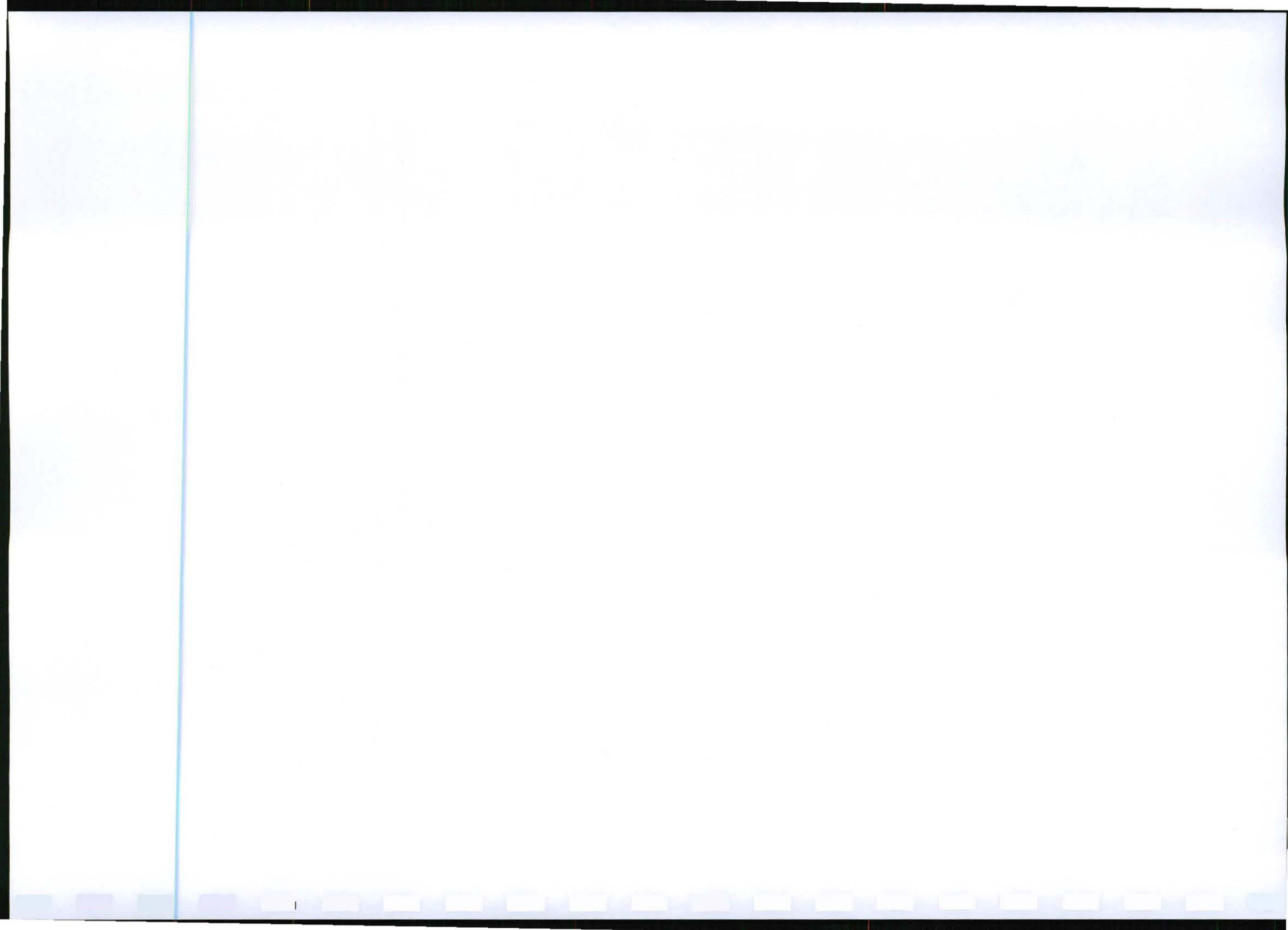
### **Soils**

#### **Soils of the region**

The soils are freely draining of the plinthic, catena, eutrophic and red-yellow apedal types. Certain areas contain high base status Hutton and Clovelly soils with some Glenrosa and Mispha soil forms. Several areas of the Western Sandy Bushveld tend to have less sandy soils than those of the Central Sandy Bushveld.

Within the Central Sandy Bushveld vegetation type the soils are typically well drained. Hutton or Clovelly soils are present. Often with a catenary (U-shape or bowl-shaped) sequence of Hutton at the top to Clovelly on the lower slopes. Shallow, skeletal Glenrosa soils are also found in the region.

The soils of the Waterberg Mountain Bushveld region are typically dystrophic, acidic sandy, loamy to gravelly soils. Of the Glenrosa and Mispah Forms<sup>1,5</sup>.



### Soils specific to the study area

The soils of the study area are mostly coarse, sandy soils that are shallow in some places and deep in others. They are typically well-drained and red to yellowish in colour. There are areas of loamier soils, which are ideal for numerous agricultural crops. In general, the clay content of the soils in the study area is low to very low. Areas of rockiness occur. Areas of acidic soils from the Waterberg Mountain Bushveld which can be sandy, loamy or gravelly also occur in the study area. However, they are not as widespread as those of the soils from the Sandy Bushveld vegetation units.

### Land capability

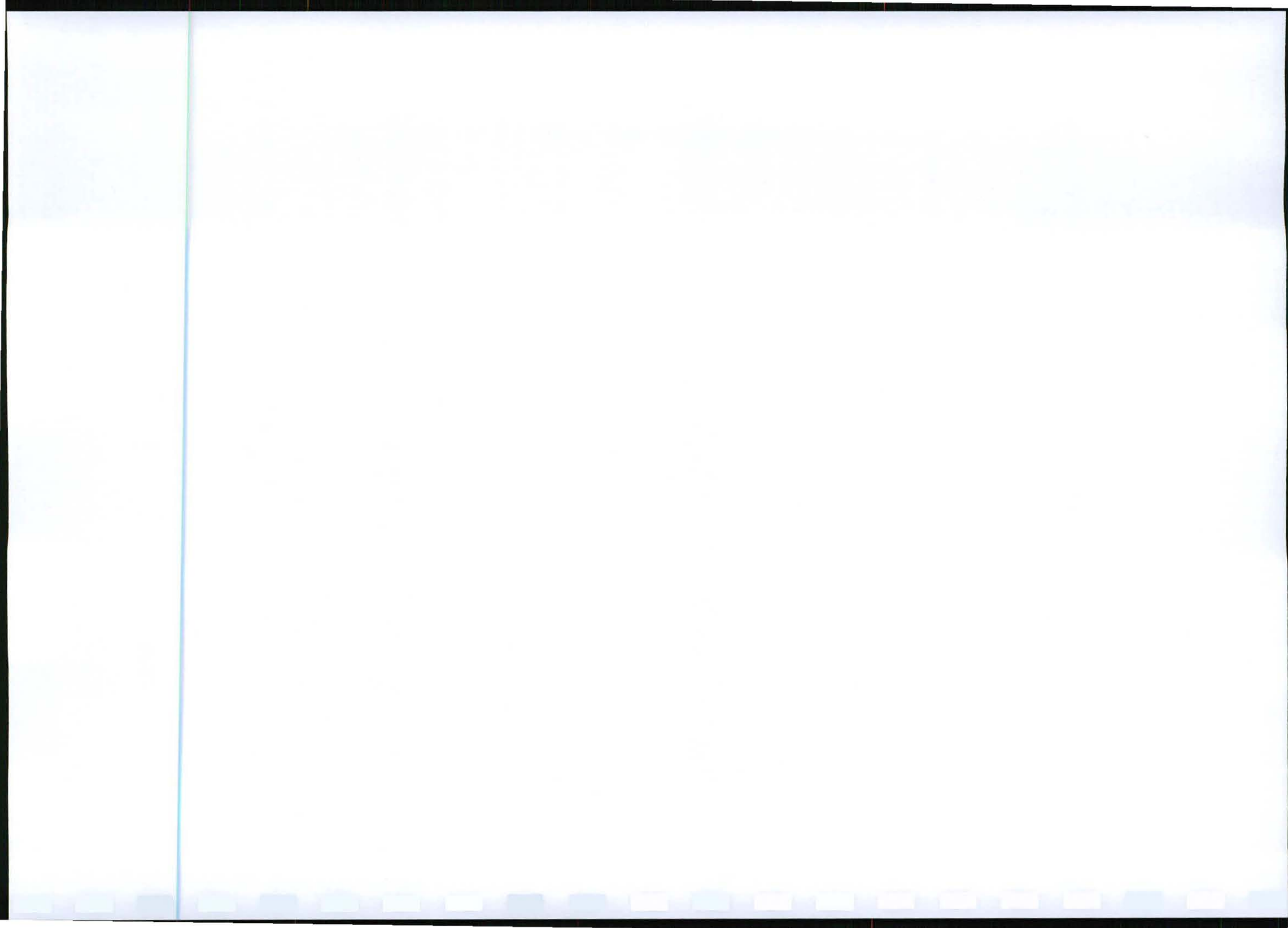
#### General land capability of the region

Basic criteria have been used to determine the land capability of the region and are summarised below in Table 1.

**Table 1: Land capability criteria**

Land Capability	Criteria
Arable Land	<p>It does not qualify as wetland.</p> <p>The soil is readily permeable to a depth of 750 mm.</p> <p>Has a pH value of between 4.0 and 8.5.</p> <p>Has a low salinity content.</p> <p>Has less than 10% by volume rocks or pedocrete fragments larger than 100 mm in the upper 750 mm.</p> <p>Has a slope (in per cent) and erodibility factor (K) such that their product is &lt;2.0.</p> <p>Occurs under a climate of crop yields that are at least equal to the current national average for these crops.</p>
Grazing Land	<p>It does not qualify as wetland or arable land.</p> <p>Has soil or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50% by volume of rocks or pedocrete fragments larger than 100 mm diameter.</p> <p>Supports, or is capable of supporting a stand of native or introduced grass</p>





	species or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.
Wilderness Land	Land, which does not qualify as wetland, arable land or grazing land. As described in the COM guidelines for the rehabilitation of strip mines, however not involving the replacement of any soil material. Involves suitable vegetation cover in accordance with industry norms and standards to prevent wind and water erosion. Land not necessarily suitable for grazing or other agricultural use.

The land capabilities of the immediate surrounding areas within which the proposed servitudes fall are fairly limited. Most of the sandy soils are too shallow or nutrient-poor for high-yield crop production. Certain areas with heavier soils are suited for arable land. However, due to the dry winter periods irrigation would be necessary. The climate is generally favourable for year-round production of crops in open-field cultivation.

The veld carrying capacity is relatively low although many sweet grasses are present. Cattle farming does occur in the area but suitably large areas for grazing are needed. The suitability for grazing land is there but needs to be carefully managed.

The general land capability is highly suited to wilderness land. This is already a major form of land use in the region with numerous nature reserves, a biosphere reserve, private game farms and lodges. Including the Marakele National Park.

## **Land Use**

### **General land use of the region**

The lands in the region or surrounding areas are used for agriculture such as the cultivation of maize (mielies) and sunflower and for grazing of cattle. There are also a number of settlements and townships in the region although small in comparison to other major metropolitan areas in the country and Limpopo Province. Mining is a significant and potentially dominant land use activity in the greater region. Especially closer towards Lephalale (Ellisras). Other uses include infrastructure such as roads.



An important land use in the region is that of wildlife areas. These areas include statutory nature reserves, dam and numerous private game reserves or lodges. As well as the Waterberg Biosphere Reserve.

#### **Specific land use within the study area**

Most of the land within the study area is private game reserves. Within these areas are a number of old, cultivated lands, which have been rehabilitated or left to return to bushveld. The region is therefore predominantly unspoilt, natural bushveld. There are however, a few human settlements (shops, farm houses, etc.) in the study area, as well as lands presently under cultivation.

#### **Topography**

##### **General topography of the region**

The general topography of the surrounding bushveld region is flat to low undulating plains. With the vegetation varying from tall open woodland to low woodland. These low, undulating areas are sometimes between mountains such as the Waterberg range, or those surrounding the Mokolo Dam. The Savanna Biome (in which the surrounding region and study areas fall) does not typically occur at high altitudes and is found mostly below 1500m. Small areas extend to 1800m on parts of the Highveld mainly along the southern most edges of the Central Bushveld<sup>6,7</sup>.

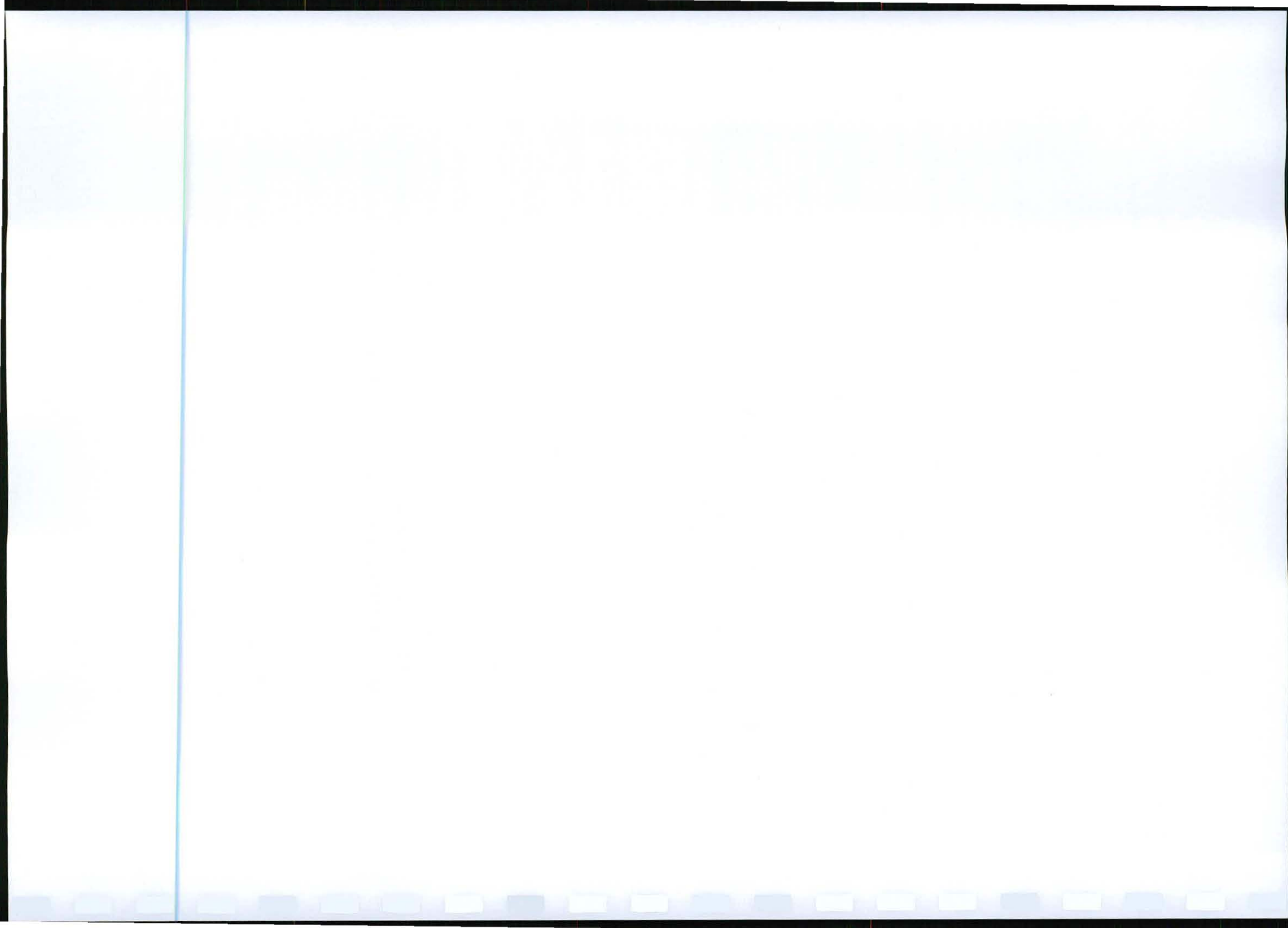
The topography within the mountainous areas of the Mokolo Dam region and the Waterberg itself can be rugged with the varying vegetation and rockiness.

##### **Topography of the study area**

The proposed alternative routes for the powerline are dominated by relatively flat to low undulating plains of mixed bushveld. The general gradient along the corridors is low (typically 1-2%), with steeper gradients (3-4%) sometimes been encountered, such as in the vicinity of the Mokolo River. Rocky outcrops (koppies) are rare in the study area.

A few small drainage lines cut across the demarcated servitudes. These are only active during the summer rainfall period. Four small to medium sized rivers are found





in the study area. Namely, the Bulge, Malmanies, Mokolo and Poer-se-loop. There are no wetlands within the demarcated servitudes or in the immediate proximity of the servitudes.

#### **Surface water within the study area**

There are four perennial to semi-perennial rivers / streams within the powerline corridors of the study area. There are also no wetlands present within the servitudes or in the areas immediately neighbouring the servitudes. The area comprises of flat to low undulating plains with a general sloping gradient from south to north. There are a few seasonal drainage routes that run across and through the servitudes. During the summer rainy season these are intermittently active. Due to the sandiness and drainage properties of the soils in the area, as well as the lack of high rainfall, there are no permanent or semi-permanent wetlands.

The drainage routes (or lines) are not seen as being of any threat to the powerline, but they should be kept in mind during construction and care should be taken to avoid them. Concrete foot supports should not be placed directly in or on the banks of these drainage furrows. Neither drainage nor erosion are seen to be significant threats as long as the proper mitigating measures are implemented. There were no signs of erosion along the investigated routes.

#### **Climate**

##### **General climate of the region**

The region falls within the summer rainfall areas of South Africa. The Savanna Biome is characterised by lower altitudes (mostly below 1500m) and temperatures are therefore higher than those of the adjacent Grassland Biome. The winters are typically very dry. The winter temperatures are mostly moderate to cool with little occurrence of frost. The climate is usually hot and dry from mid August to October, with a hot, wet season from November to April. Mean Average Precipitation (MAP) ranges from 500-700mm. Mean monthly maximum and minimum temperatures for Goedehoop (in the northern part of the Central Sandy Bushveld) are 35,5°C (November) and -3,1°C (June), respectively. The MAP for the Western Sandy Bushveld varies from 450mm to 650mm, making it generally slightly drier than the



Central Sandy Bushveld. Mean monthly maximum and minimum temperatures for Thabazimbi are 36°C (February) and -3,7°C (June), respectively<sup>6,8</sup>.

The MAP in the Waterberg mountains and associated veldtype varies from 500mm (in the lower lying areas) to around 750mm (at higher altitudes). Frost may occur frequently during the winter months in these mountainous areas<sup>1</sup>.

**Table 2: Climatic figures from selected weather stations**

STATIONS	TEMPERATURES (°C)		PRECIPITATION (mm)	RELATIVE HUMIDITY (%)	
	Maximum	Minimum	Annual Average	Maximum	Minimum
Lephalale	29,1	11,9	606,3	-	-
Thabazimbi	28,0	11,9	413,1	-	-
Vaalwater	26,5	11,1	601,9	82,1	28,3

## **Flora of the region**

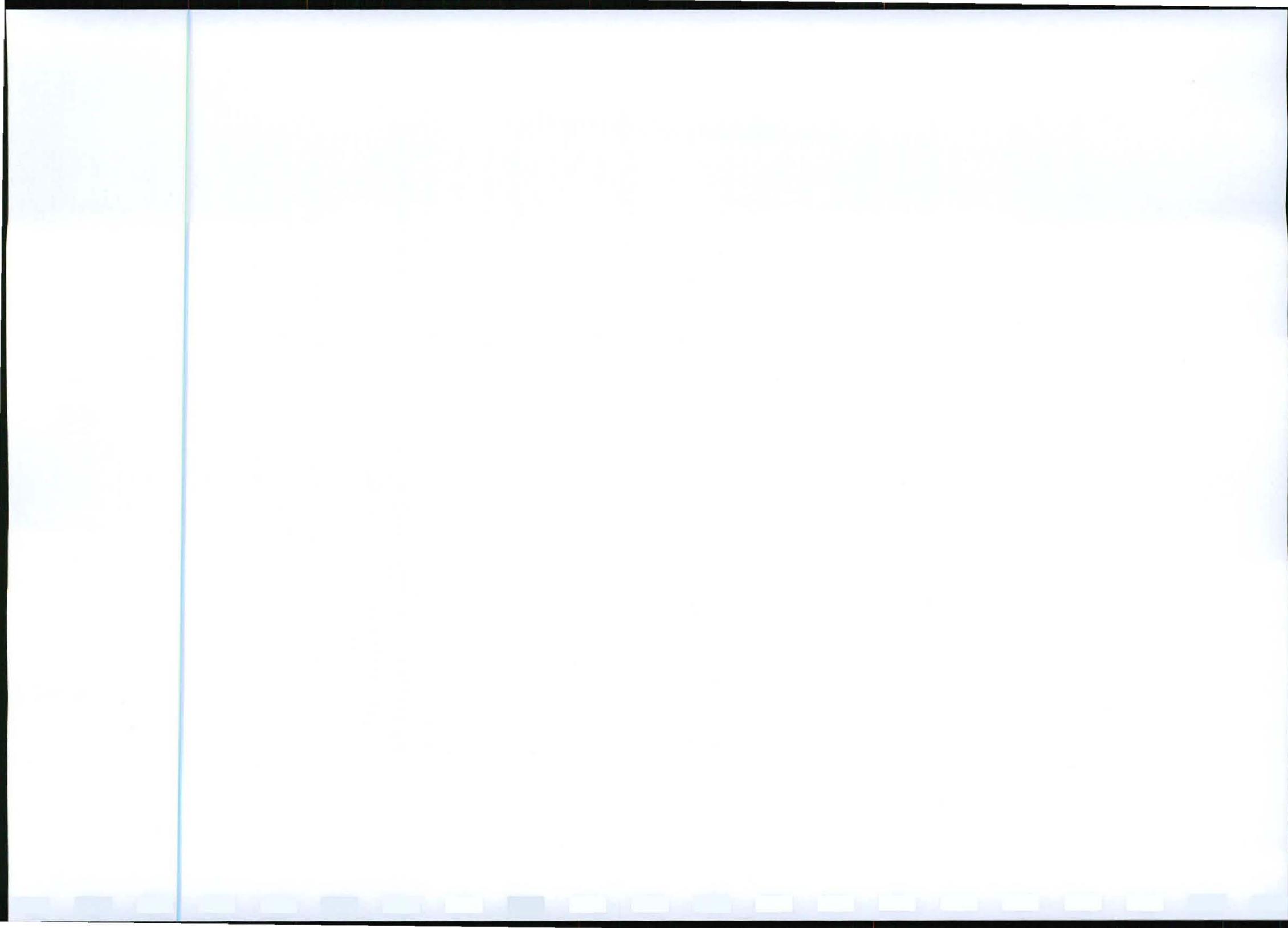
### **Biome**

Nearly all of the Limpopo Province (95%+) falls within the Savannah Biome with its associated Bushveld vegetation. There are a few scant areas that are part of the Grassland Biome very much due to their high elevations and associated higher rainfalls.

The Savannah Biome is the largest biome in South Africa and covers approximately 33% of South Africa<sup>1,2</sup>. It is characterised by a grassy ground layer, with a distinct upper layer of woody plants. The environmental factors shaping the biome are complex. Rainfall varies from 235mm to 1 000mm per annum and frost occurs in regions of the biome, anything from 0 days to 120 days per year. Almost every major soil type and geological type are found within this biome.

Summer rainfalls assist in keeping the grasses dominant, along with grazing and fairly frequent veldfires running through the region. For this reason the biome has probably been shaped over long periods of time. As can be expected, most plant





species present are able to survive fires, usually with less than 10% of all plants been destroyed.

### **Floral Regions**

Except for a small area in the extreme south-west of the Limpopo Province, the entire province falls within the Sudano-Zambesian Floral Region. This floral region incorporates the grasslands and savannas (bushveld) of the north and north-east of South Africa and is the southern extent of the vast Sudano-Zambesian Floral Region. This is the largest floral region on the African continent and includes most of sub-Saharan Africa, with the exceptions of the tropical forests of West and Central Africa. This region has a rich and diverse flora with a not-surprisingly equally rich and diverse fauna<sup>9</sup>.

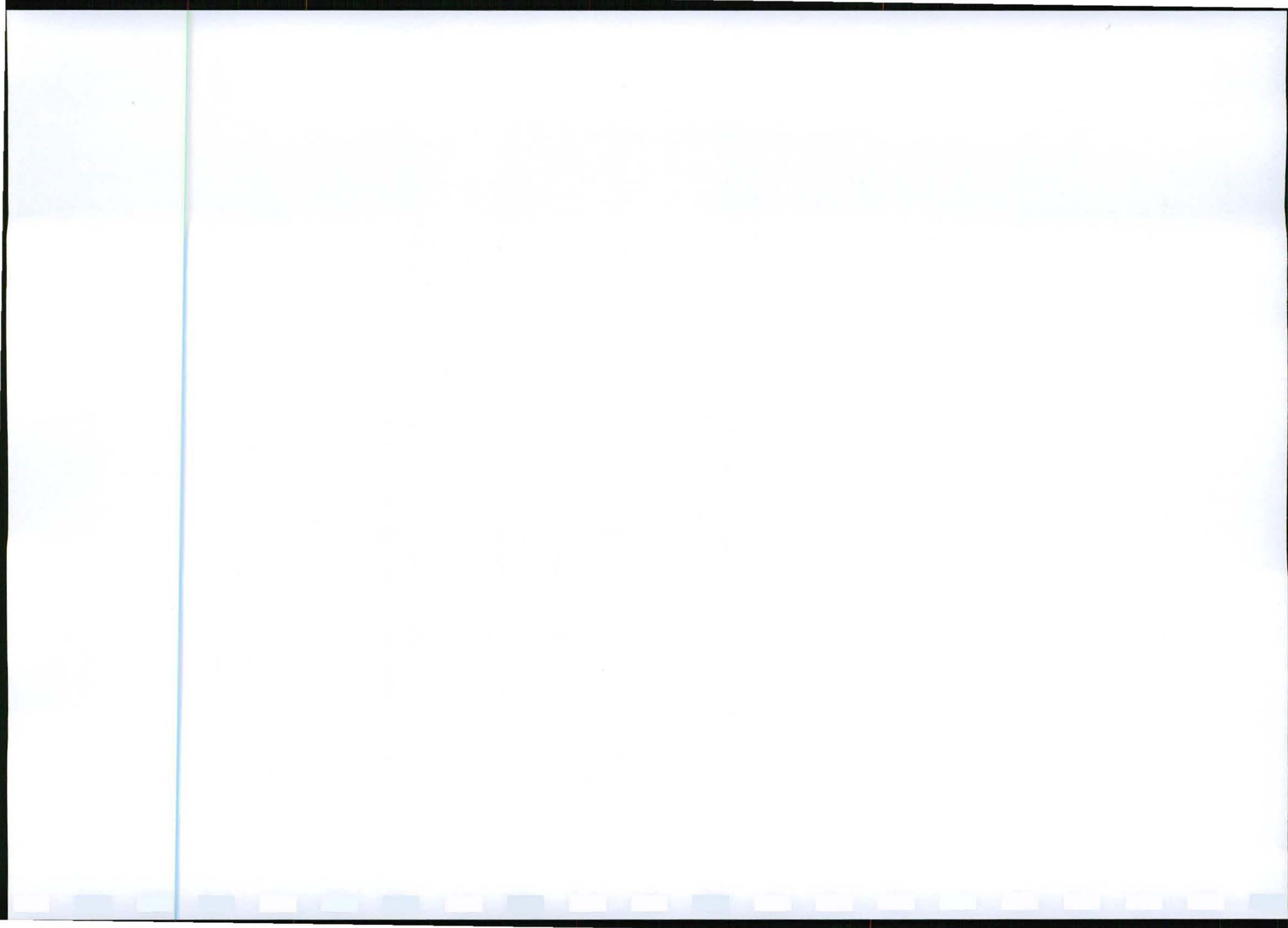
### **General vegetation of the region**

The vegetation of the general region falls within the Savanna Biome and more specifically within the vegetation types (veld types) known as Central Sandy Bushveld, Western Sandy Bushveld, Waterberg Mountain Bushveld and Limpopo Sweet Bushveld. Recently researchers have adapted the vegetation maps of Low and Rebelo (published by the National Botanical Institute in 1996) to create ecozones. Under this classification system the vegetation of the region is within the ecozones known as Central Mountains (which consists mainly of the Waterberg Mountains) and Mixed Bushveld.

There are numerous classification and naming systems used for vegetation types. It is the preference of the researches to use the latest and more detailed system of Mucina and Rutherford. However, two other very important classification works are those of Acocks and Low & Rebelo and their veldtype names into which the above mentioned Mucina & Rutherford names fall are shown in the table below:

**Table 3: Comparison of veldtype names**

<b>Mucina &amp; Rutherford (2006)</b>	<b>Acocks (1953)</b>	<b>Low &amp; Rebelo (1996)</b>
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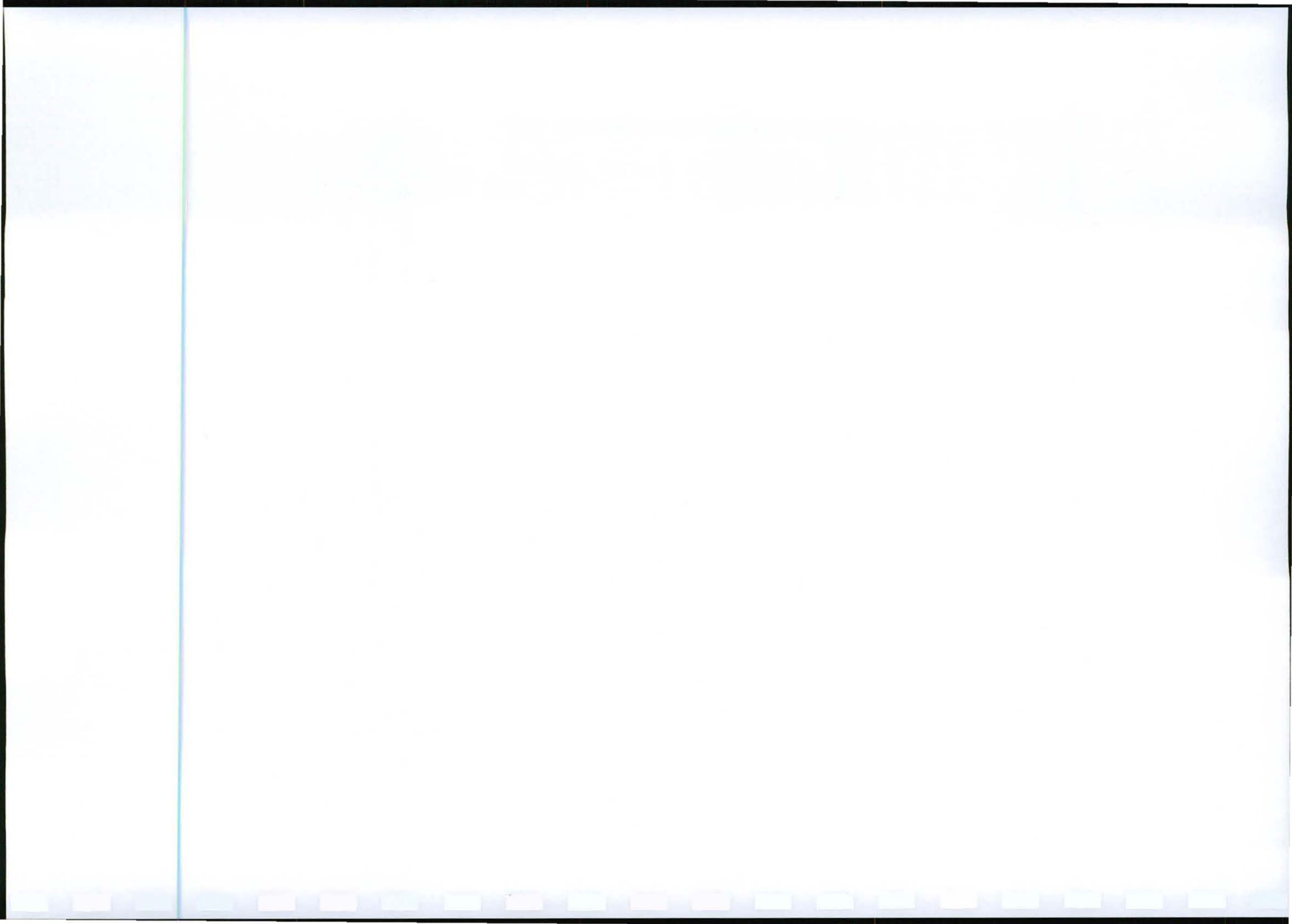
Central Sandy Bushveld	Mixed Bushveld (44%) Sourish Mixed Bushveld (32%)	Mixed Bushveld (73%)
Western Sandy Bushveld	Mixed Bushveld (58%)	Mixed Bushveld (75%)
Waterberg Mountain Bushveld	Sour Bushveld (73%)	Waterberg Moist Mountain Bushveld (83%)
Limpopo Sweet Bushveld	Arid Sweet Bushveld (74%)	Sweet Bushveld (65%)

The vegetation and landscape features of Central Sandy Bushveld are of low undulating areas and sandy plains. Sometimes between mountains as in the case of the greater study area. These areas predominantly support tall *Terminalia sericea* (Silver Clusterleaf) and *Burkea africana* (Burkea; Red Syringa) woodland on deep sandy soils; and low, broad-leaved *Combretum* (Bushwillow) woodland on shallow rocky or gravelly soils. Species of *Acacia* (thorn trees), *Ziziphus* (Buffalo thorn) and *Euclea* (Guarri) are found on flats and lower slopes on eutrophic sands and certain less sandy soils.

The vegetation and landscape features of Western Sandy Bushveld vary from tall, open woodland to low woodland. With broad-leaved as well as microphyllous (small, compound leaves) trees prominent. The dominant species include *Acacia erubescens* (Blue thorn, Blue acacia) on flat areas; *Combretum apiculatum* (Red bushwillow) on shallow soils of gravelly upland sites and *Terminalia sericea* (Silver clusterleaf) on deep sands. The landscape is typically flat or slightly undulating plains<sup>1,10</sup>.

The landscape features associated with Waterberg Mountain Bushveld is that of rugged mountains with vegetation changing from *Faurea saligna* – *Protea caffra* Bushveld (on higher slopes) to broad-leaved deciduous bushveld dominated by *Diplorhynchus condylocarpon* (on rocky mid- and footslopes); to *Burkea africana* – *Terminalia sericea* savanna (in the lower-lying valleys and on deeper sands of the plateaus). The grass layer can be moderately or well-developed.





The Limpopo Sweet Bushveld features undulating or irregular plains, traversed by several tributaries of the Limpopo River. The vegetation is short, open woodland, but in disturbed areas almost impenetrable thickets occur, dominated by *Acacia* species and *Dichrostachys cinerea* (Sicklebush)<sup>1,2</sup>.

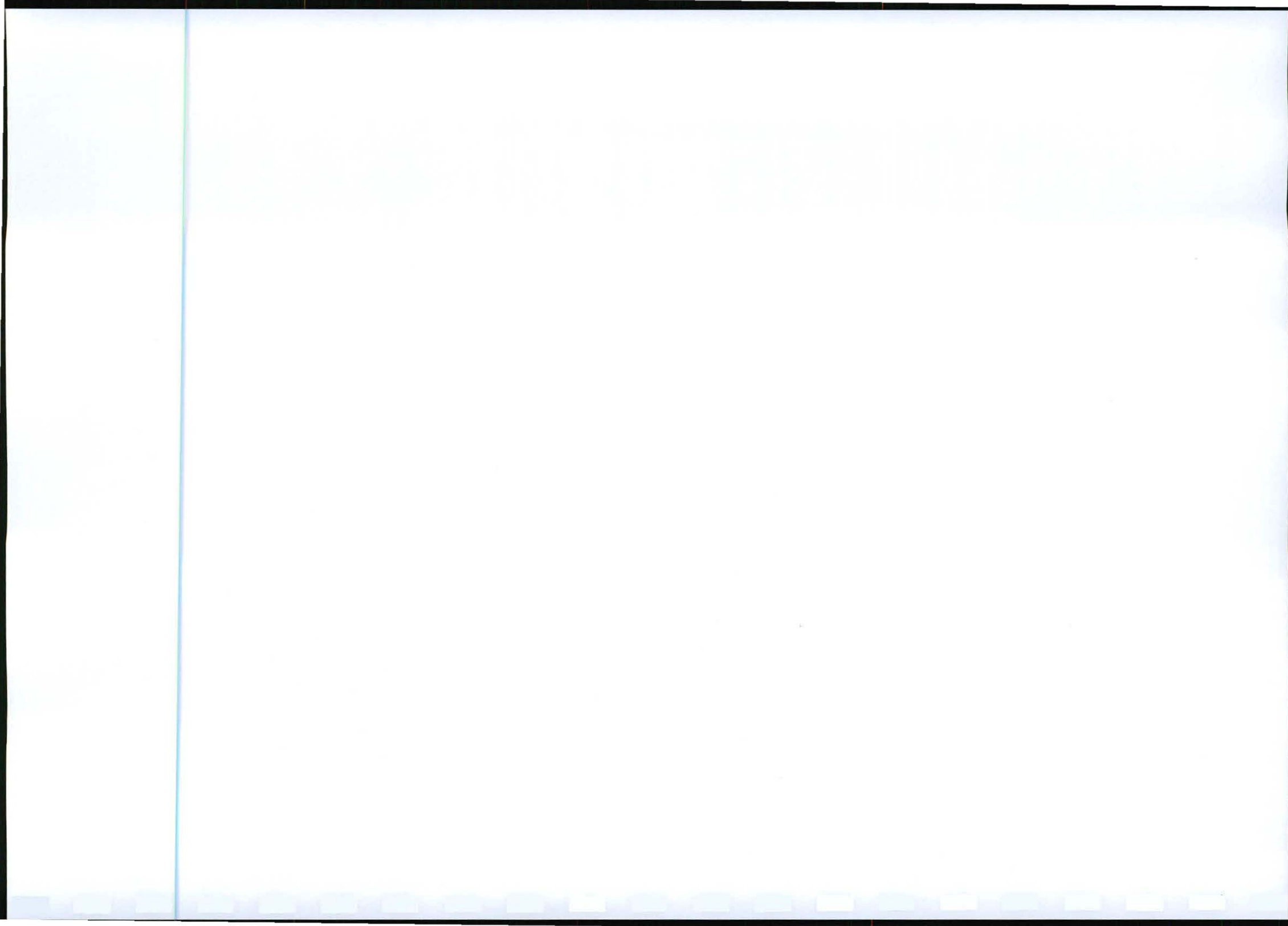
The study area is predominantly Western Sandy Bushveld, with a portion in the vicinity of the Mokolo Dam (Hans Strijdom Dam) being Central Sandy Bushveld. The veldtypes of Waterberg Mountain Bushveld and Limpopo Sweet Veld are mentioned in the study because they are in the immediate vicinity and often times elements of these veldtypes can be observed in transitional zones or within the main veldtypes discussed.

### **Vegetation of the study area**

Strategic sampling was undertaken within the specific corridors for the powerline. Special cognisance was taken of areas that exhibit sensitive biophysical attributes. These included areas of surface water (rivers, wetlands, floodplains) and areas of high slopes (ridges, rocky outcrops, koppies).

The vegetation of the inspection site is predominantly that of Central Sandy Bushveld, with the most westerly section falling within the vegetation unit of Western Sandy Bushveld. Small areas in the vicinity of the Dorset substation are typical of Waterberg Mountain Bushveld. The alternative powerline corridors from Bulge River substation (up to approximately where they cross over the Mokolo River) are typical Western Sandy Bushveld. This area is predominantly bushveld (5-6m high) with trees such as *Acacia erubescens* (Blue thorn), *Acacia nigrescens* (Knob thorn), *Acacia mellifera* subsp. *detinens* (Black thorn), *Acacia nilotica* (Scented-pod), *Acacia tortilis* (Umbrella thorn), *Combretum apiculatum* (Red bushwillow), *Combretum zeyheri* (Large-fruited bushwillow), *Peltophorum africanum* (African weeping wattle) and *Terminalia sericea* (Silver clusterleaf) observed to be common.

From east of the Mokolo River to Dorset substation the powerline corridors run mainly within the Central Sandy Bushveld. The change in veldtype is especially



evident by the very noticeable increase in the widespread presence of *Burkea africana* (Burkea) and *Ochna pulchra* (Peeling plane, Peeling bark ochna).

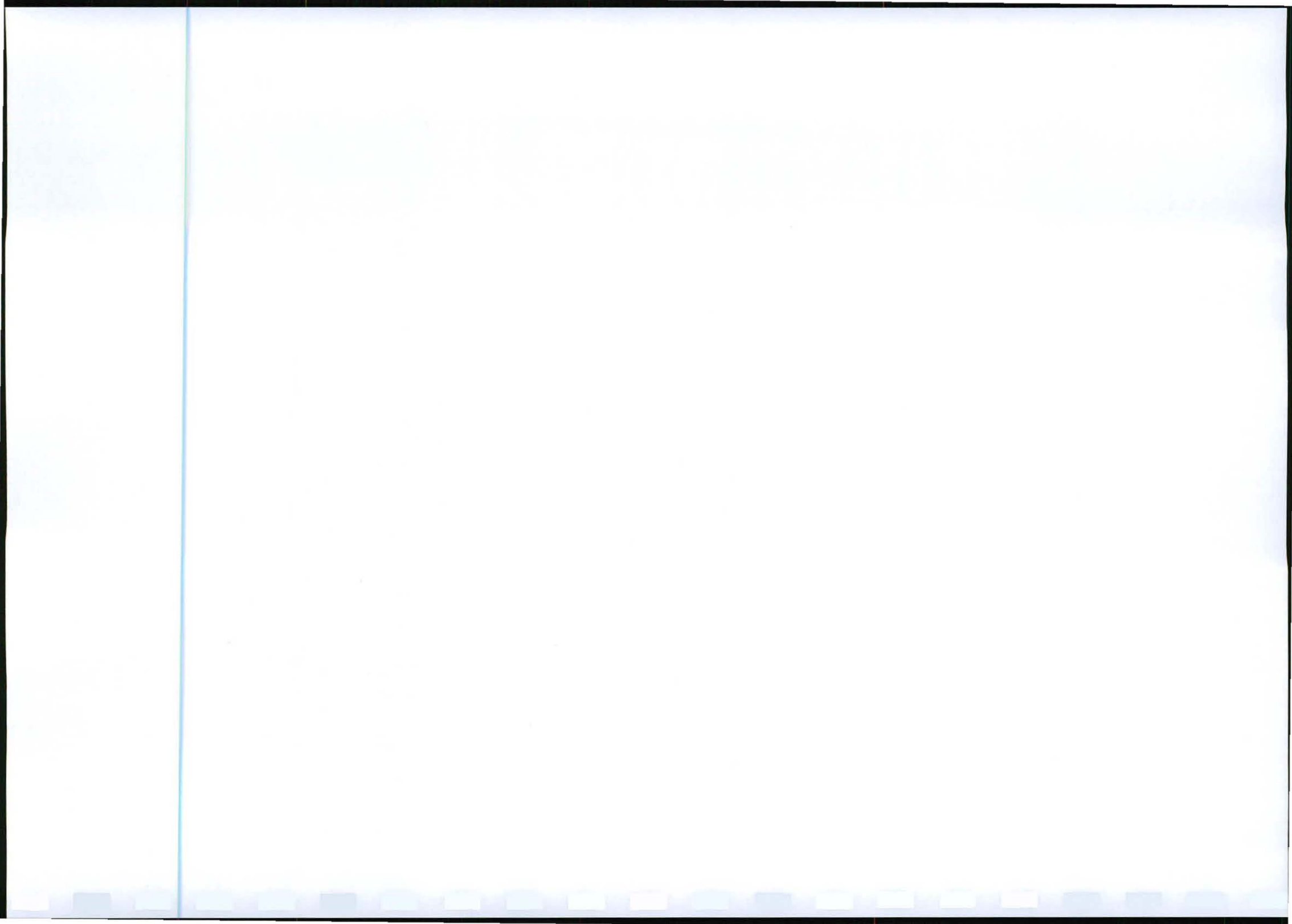
The following Red data and protected tree species were found in the study area: *Sclerocarya birrea* subsp. *caffra* (Marula), *Combretum imberbe* (Leadwood) and *Acacia erioloba* (Camel thorn).

#### **Tree and shrub species observed in the study area**

*Acacia ataxacantha* (Flame-pod acacia); *Acacia burkei* (Black monkey thorn); *Acacia caffra* (Common hook thorn); *Acacia erubescens* (Blue thorn); *Acacia galpinii* (Monkey thorn); *Acacia karroo* (Sweet thorn); *Acacia mellifera* subsp. *detinens* (Black thorn); *Acacia nigrescens* (Knob thorn); *Acacia nilotica* (Scented-pod); *Acacia tortilis* (Umbrella thorn); *Acacia robusta* (Robust thorn); *Bauhinia pertersiana* (Kahlahari bauhinia); *Boscia foetida* (Bushveld shepherd's tree); *Burkea africana* (Burkea); *Combretum apiculatum* (Red bushwillow); *Combretum imberbe* (Leadwood); *Combretum molle* (Velvet bushwillow); *Combretum zeyheri* (Large-fruited bushwillow); *Commiphora mollis* (Velvet-leaved corkwood); *Croton gratissimus* (Lavender croton); *Dichrostachys cinerea* (Sicklebush); *Diplorhynchus condylocarpon* (Horn-pod tree); *Englerophytum magalismontanum* (Stamvrug, Stamvrug milkplum); *Euclea crispa* (Blue guarri); *Gardenia volkensii* (Transvaal gardenia); *Grewia bicolor* (White-leaved raisinbush); *Grewia flava* (Wild raisin); *Grewia monticola* (Grey raisin, silver raisinbush); *Lannea discolor* (Live long lannea); *Peltophorum africanum* (African weeping wattle); *Gymnosporia polyacantha* (Synonym: *Maytenus polyacantha*) (Hedge spikethorn); *Ochna pulchra* (Peeling plane, Peeling bark ochna); *Rhus lancea* (Karee); *Rhus leptodictya* (Mountain karee); *Rhus pyroides* (Common wild currant); *Sclerocarya birrea* subsp. *caffra* (Marula); *Spirostachys africana* (Tamboti); *Terminalia sericea* (Silver clusterleaf); *Ziziphus mucronata* (Buffalo thorn);

Three red data and/or protected species were observed. Namely, *Sclerocarya birrea* subsp. *caffra* (Marula), *Combretum imberbe* (Leadwood), *Spirostachys africana* (Tamboti) and *Acacia erioloba* (Camel thorn).





### Grass and reed species (Graminoids) observed in the study area

*Aristida bipartita* (Rolling grass); *Aristida transvaalensis* (Rock three-awn grass, Klipgras); *Chloris virgata* (Feathertop grass); *Eragrotis gummiflua* (Gum grass); *Eragrotis lehmanniana* (Lehmann's love grass); *Heteropogon contortus* (Spear grass); *Hyparrhenia hirta* (Common thatching grass); *Rhynchelytrum repens* (Natal red top); *Setaria sphacelata* var. *sericea* (Golden bristle grass); *Themeda triandra* (Red grass); *Trachypogon spicatus* (Giant spear grass).

### Herbs, Forbs and other plant species observed in the study area

*Aloe greatheadii* var. *davyana* (Transvaal aloe); *Aloe marlothii* (Mountain aloe); *Asclepias meliodora*; *Asparagus setaceus* (Asparagus fern); *Felicia fascicularis*; *Gladiolus crassifolius* (sword lily); *Helichysum acutatum* (Sticky everlasting); *Helichrysum coriaceum* (Everlasting); *Helichrysum nudifolium* (Hottentot's tea); *Hibiscus calyphyllus* (Large yellow wild hibiscus); *Hibiscus trionum* (Bladder hibiscus); *Hibiscus vitifolius* (Vine-leaved hibiscus); *Indigofera filipes*; *Leonotis intermedia* (Synonym: *Leonotis dysophylla*); *Psammotropha myriantha*.

No red data species were observed.

### Aquatic plants observed in the study area

*Cyperus sexangularis* (cyperus, matjiesgoed); *Eleocharis acutangula* (Sedge); *Ludwigia adsendens* (Willow-herb); *Phragmites australis* (Common reed); *Phragmites mauritianum* (Thatching reed); *Typha capensis* (Bulrush).

No red data species were observed.

### Dominant alien plants (weeds) observed in the study area

The dominant alien plant species encountered in the study area are recorded, along with their category rating, in Table 4<sup>11,12,13</sup>.

Table 4: Dominant alien plants (weeds) observed in the study area

BOTANIAL NAME	COMMON NAME	CARA CATEGORY
<i>Arundo donax</i>	Giant reed	1



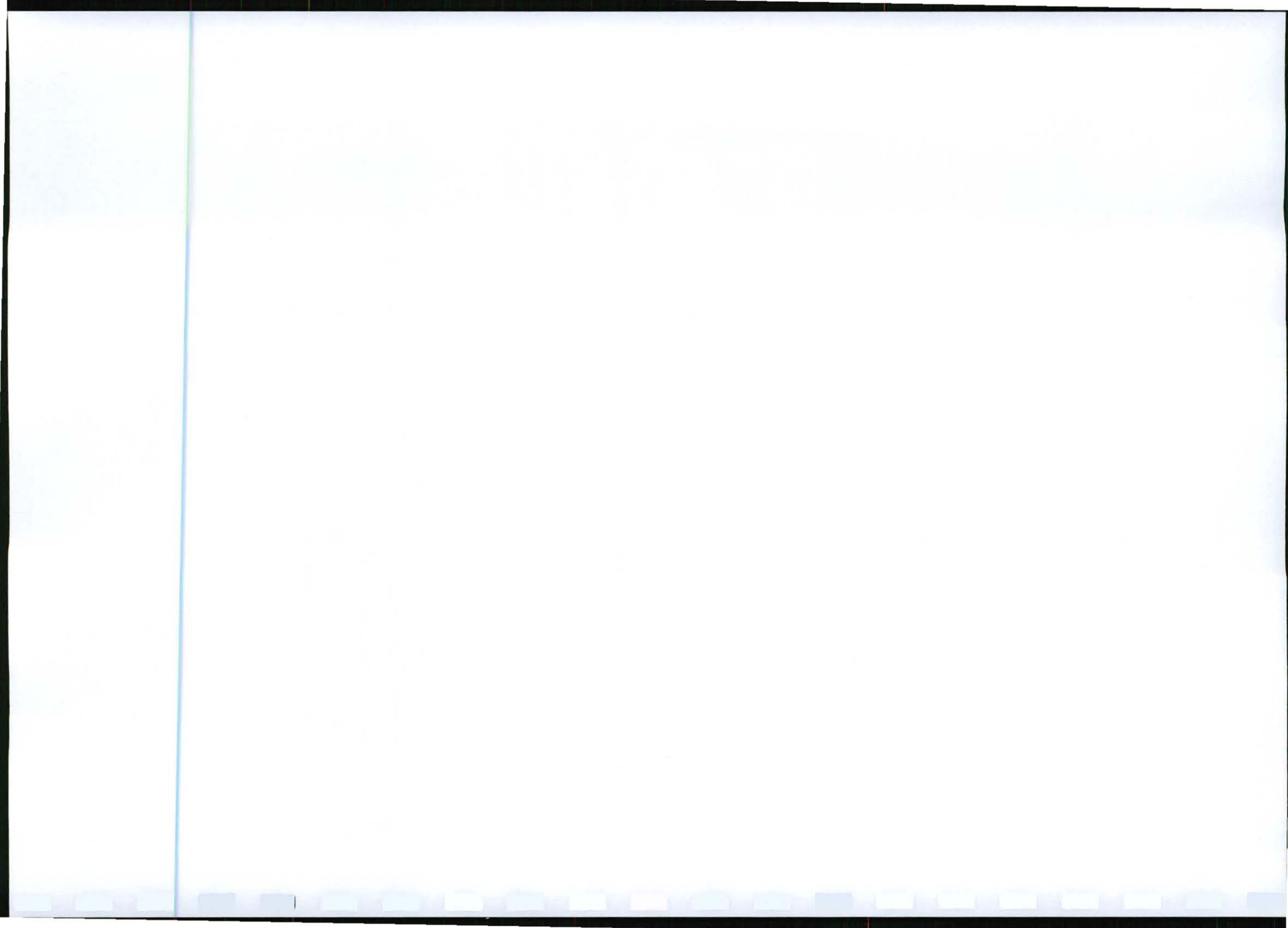
<i>Bidens pilosa</i>	Blackjacks	-
<i>Campuloclinium macrocephalum</i>	Pompom weed	1
<i>Ipomoea purpurea</i>	Morning glory	3
<i>Jacaranda mimosifolia</i>	Jacaranda	3
<i>Melia azedarach</i>	Syringa	3
<i>Populus x canescens</i>	Grey poplar	2
<i>Salix babylonica</i>	Weeping willow	2
<i>Sesbania punicea</i>	Red sesbania	1
<i>Solanum elaeagnifolium</i>	Silverleaf bitter apple	1
<i>Solanum mauritiana</i>	Bugweed	1
<i>Solanum panduriforme</i>	Poison apple	-
<i>Tagetes minuta</i>	Khakibos, kahki weed	-
<i>Verbena bonariensis</i>	Wild verbena	-
<i>Xanthium strumarium</i>	Large cocklebur	1

Note: CARA = Conservation of Agricultural Resources Act (43 of 1983)

### **Fauna of the region**

Human population density and proximity to the habitat have significant impacts on the presence of most fauna species, especially larger mammals and reptiles. The Bulge River and Dorset substations and powerline corridors between the two lay within a very beautiful and relatively undisturbed area, with low levels of human impact. Probably of far greater significance is the growing enthusiasm to preserve and rehabilitate the region. This has resulted in the development of numerous private game lodges, ranches, nature reserves and the Waterberg Biosphere Reserve. This area stretches from Mokopane (Potgietersrus), Mookgophong (Naboomspruit) and Modimolle (Nylsvlei) in the east, to Thabazimbi and Lephalale (Ellisras) in the west. Within the biosphere reserve are nature reserves such as Marakele National Park in the Waterberg and the Mokolo Dam and Nature Reserve. Many game farms have also introduced or re-established large mammals onto their farms, resulting in the region being home to the Big Five.





The largest extent of the faunal assemblages of any region is typically encountered in the more dominant and common habitat type. In the case of the study area this habitat falls within the Savanna Biome, which is fairly well represented in the greater region of the biome. Due to the situation of the servitudes the presence of indigenous fauna is considered to be high.

During site visits numerous mammals, birds, small reptiles and insects were observed in and surrounding the study site. These included the following mammals: Vervet monkey (*Chlorocebus aethiops*); plains zebra (*Equus burchellii*); impala (*Aepyceros melampus*); elephant (*Loxodonta Africana*); black-backed jackal (*Canis mesomelas*); warthog (*Phacochoerus africanus*); blesbok (*Damaliscus dorcas phillipsi*); banded mongoose (*Mungos mungo*); impala (*Aepyceros melampus*); giraffe (*Giraffa camelopardalis*); baboon (*Papio ursinus*); tree squirrel (*Paraxerus cepapi*) and evidence of porcupine (*Hystrix africaeaustralis*).

Birds identified on field trips were the following: Cinnamon breasted bunting (*Emberiza tahapisi*); Klass's cuckoo (*Chrysococcyx klaas*); African fish eagle (*Haliaeetus vocifer*); Diderick cuckoo (*Chrysococcyx caprius*); Black-chested snake-eagle; Jacobin cuckoo (*Oxylophus jacobinus*); Red-chested cuckoo (*Cuculus solitarius*); Black-shouldered kite (*Elanus caeruleus*); helmeted guineafowl (*Numida meleagris*); ostrich (*Struthio camelus*); yellow-fronted canary (*Serinus mozambicus*); European bee-eater (*Merops apiaster*); barn swallow (*Hirundo rustica*); forked-tailed drongo (*Dicrurus adsimilis*); pied kingfisher (*Ceryle rudis*); greater-striped swallow (*Hirundo cucullata*); African paradise flycatcher (*Terpsiphone viridis*); yellow-fronted tinkerbird (*Pogoniulus chrysoconus*); Cape glossy starling (*Lamprotornis nitens*); Cape turtle dove (*Streptopelia capicola*); laughing dove (*Streptopelia senegalensis*); feral pigeon (*Columba livia*); and house sparrow (*Passer domesticus*). The presence of many of these bird species indicate that the general condition of the veld is good and that there is adequate open, undisturbed veld in which they can feed, nest and breed.

A number of butterfly species were observed which also tends to show that there is sufficient, undisturbed vegetation for them to breed and flourish, eventhough some





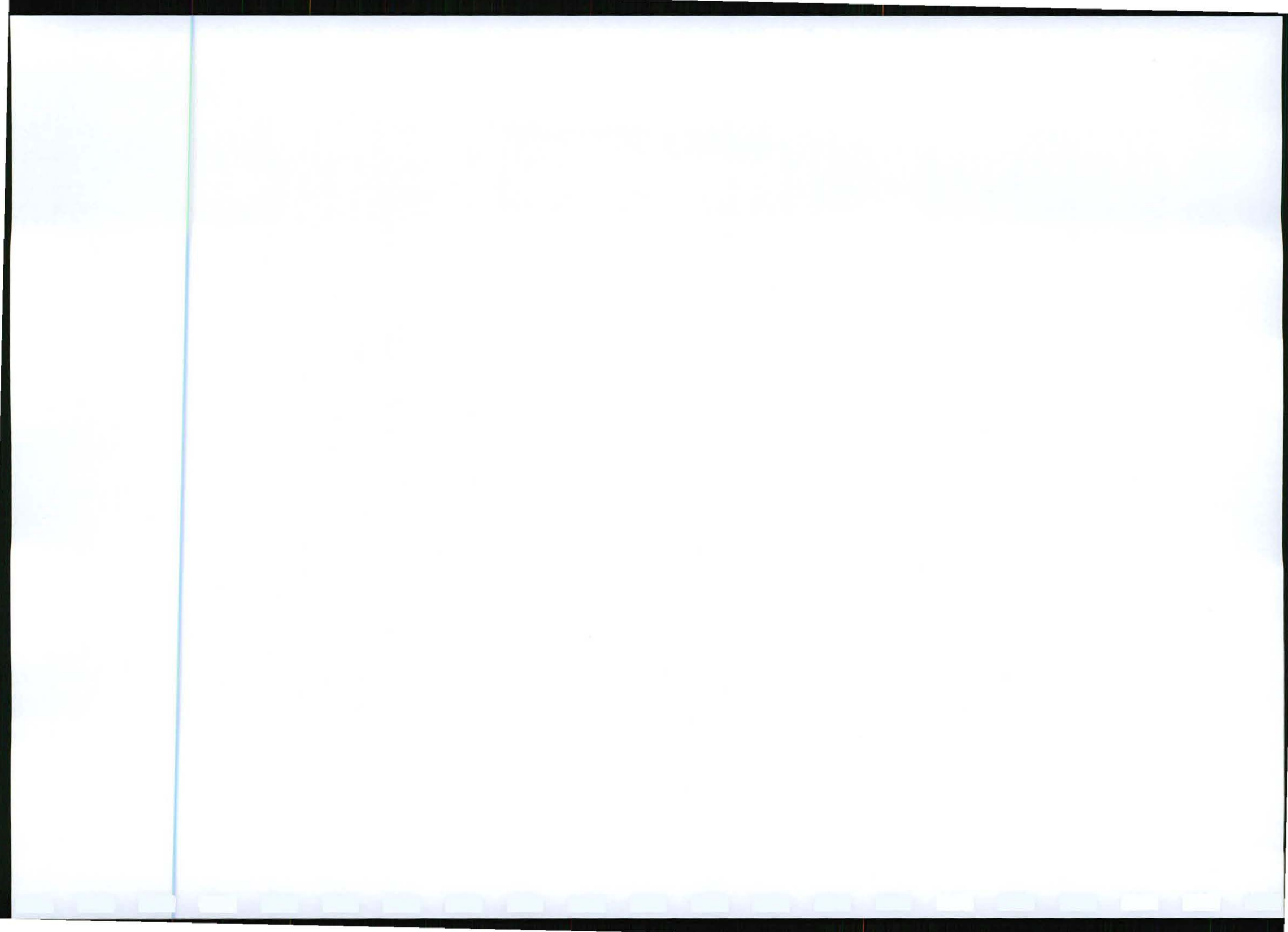
are migratory species. Species noted include *Acraea* species (*Acraea* spp.); African monarch (*Danaus chrysippus*); Brown-veined white (*Belenois aurota aurota*); Bushveld orange tip (*Colotis pallene*); Broad-bordered grass yellow (*Eurema brigitta*); African clouded yellow (*Colias electo electo*); Citrus swallowtail (*Papilio demodocus*); and Yellow pansy (*Junonia hierta*); Veined orange (*Colotis vesta argillaceus*). According to certain reports the endangered Roodepoort copper (*Aloeides dentatis*) could possibly occur in the region<sup>14</sup>. However, according to correspondence with experts from Conservation of Butterflies in South Africa (CBISA) there are no known records of endangered butterfly or moth species in the servitudes or immediate area<sup>15</sup>.

The area surveyed contains a number of small farm dams, rivers and the comparatively large Mokolo Dam in the nearby region, but no permanent or seasonal wetlands. Numerous seasonal drainage lines are present, which typically run after heavy rains and dry out again quickly due to the sandy soils and their low holding capacity of surface water. No amphibians were observed during site visits. However, due to the good quality of the river and dam water, with ideal habitat for various amphibians they undoubtedly will be present. It is also possible that the threatened Giant bullfrog (*Pyxicephalus adspersus*) occurs in the general area, although not observed during field trips<sup>16</sup>.

A number of Yellow-throated plated lizards (*Gerrhosaurus flavigularis*) and gecko species (Gekkonidae) were observed in the vicinity of rocky areas, but no snakes. Numerous "important" insects such as dung beetles and dragonflies were observed as well. The presence of these species is often an indication of good veld and environmental conditions.

Despite the rich diversity and presence of fauna in the study area it is expected that all disturbed and displaced fauna will not be adversely affected or destroyed and that they will return to the area of construction within the short-term once rehabilitation has taken place and mitigating procedures have been strictly adhered to. This is directly due to the nature of the project, which effectively does not leave a significant





footprint on the actual ground of the study area. Fauna most adversely affected by the presence of the powerlines will be large avian raptors.

Two animals that could potentially create concern for the powerline and substation, namely elephant and giraffe, do not occur in the study area.

### Potential Red Data species in the study area

#### Flora

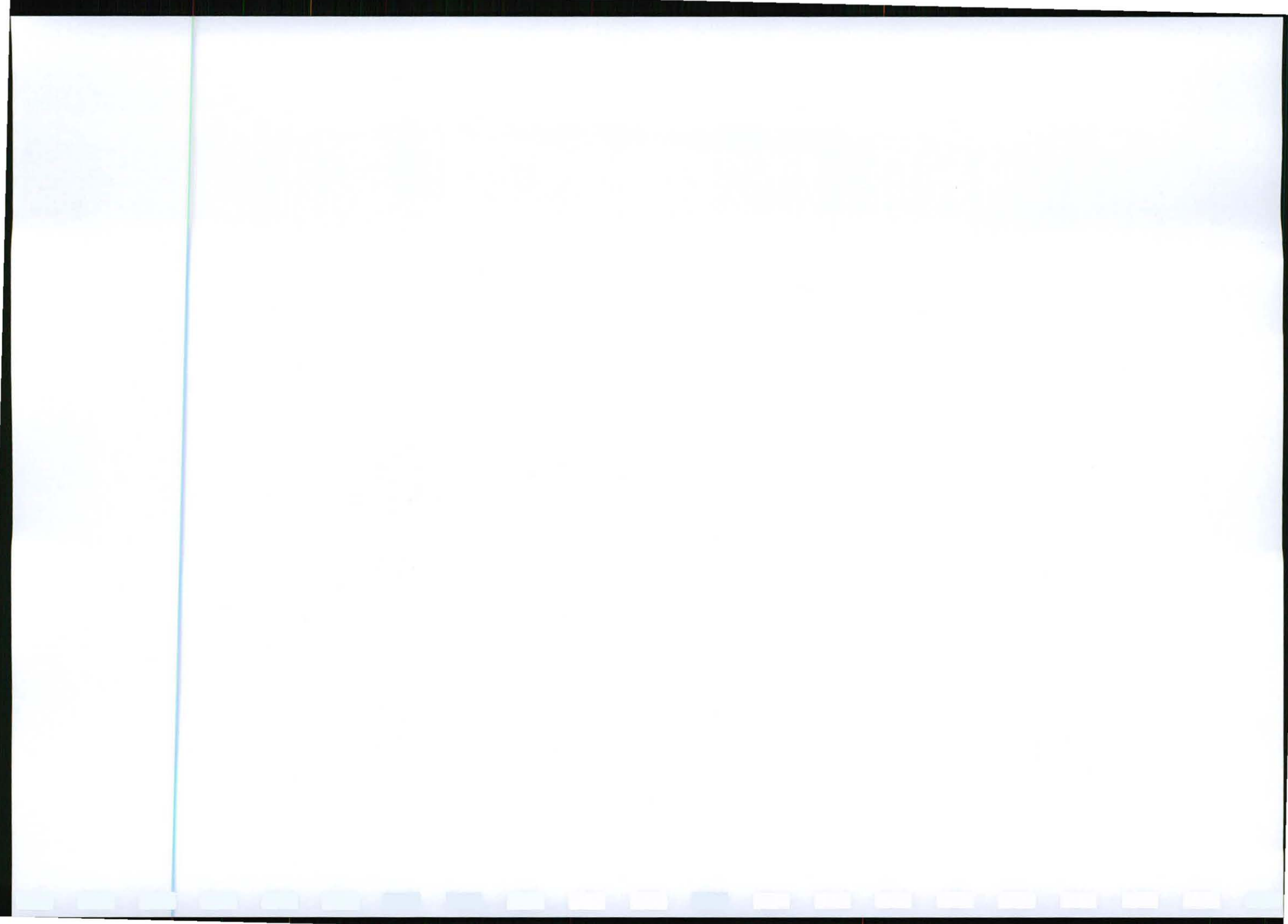
During site investigations in the study area three Red Data and/or protected flora species were observed. These were *Sclerocarya birrea* subsp. *caffra* (Marula), *Combretum imberbe* (Leadwood) and *Acacia erioloba* (Camel thorn). Other trees and shrubs that potentially occur in the study area, but that were not observed include, *Boscia albitrunca* (Shepperd's tree), *Dombeya rotundifolia* var. *rotundifolia* (Wild pear), *Elaeodendron transvaalense* (Bushveld saffron), *Erythrophysa transvaalensis* (Bushveld red balloon) and *Securidaca longipedunculata* (Violet tree).

#### Fauna

During site visits no Red Data fauna species were encountered in the study area. However, due to the habitats and veldtypes in the area there remains the high potential for certain Red Data species, as listed in Table 5, to be present<sup>17,18</sup>.

**Table 5: Red Data fauna species most likely to occur in the study area**

BIOLOGICAL NAME	COMMON NAME	RED DATA STATUS	HABITAT TYPE	HABITAT RESTRICTIONS
<b>FROGS</b>				
<i>Pyxicephalus adspersus</i>	Giant bullfrog	Threatened	Grassland; savanna	Temporary floodplains, pans
<b>MAMMALS</b>				
<i>Atelerix frontalis</i>	SA hedgehog	Near threatened	Most, broad	Broad
<i>Manis temmincki</i>	Pangolin (Scaly anteater)	Vulnerable	Grassland, savanna	Woody savanna, ants, termites
<i>Mellivora</i>	Honey badger	Near	Most, broad	Broad



<i>capensis</i>	(Ratel)	threatened		
<i>Pipistrellus rusticus</i>	Rusty bat	Near threatened	Most, broad	Woody savanna, large trees
<b>SNAKES</b>				
<i>Python natalensis</i>	Southern African python	Vulnerable	Ridges, wetlands	Rocky areas; open water

## Conservation

### Central Sandy Bushveld

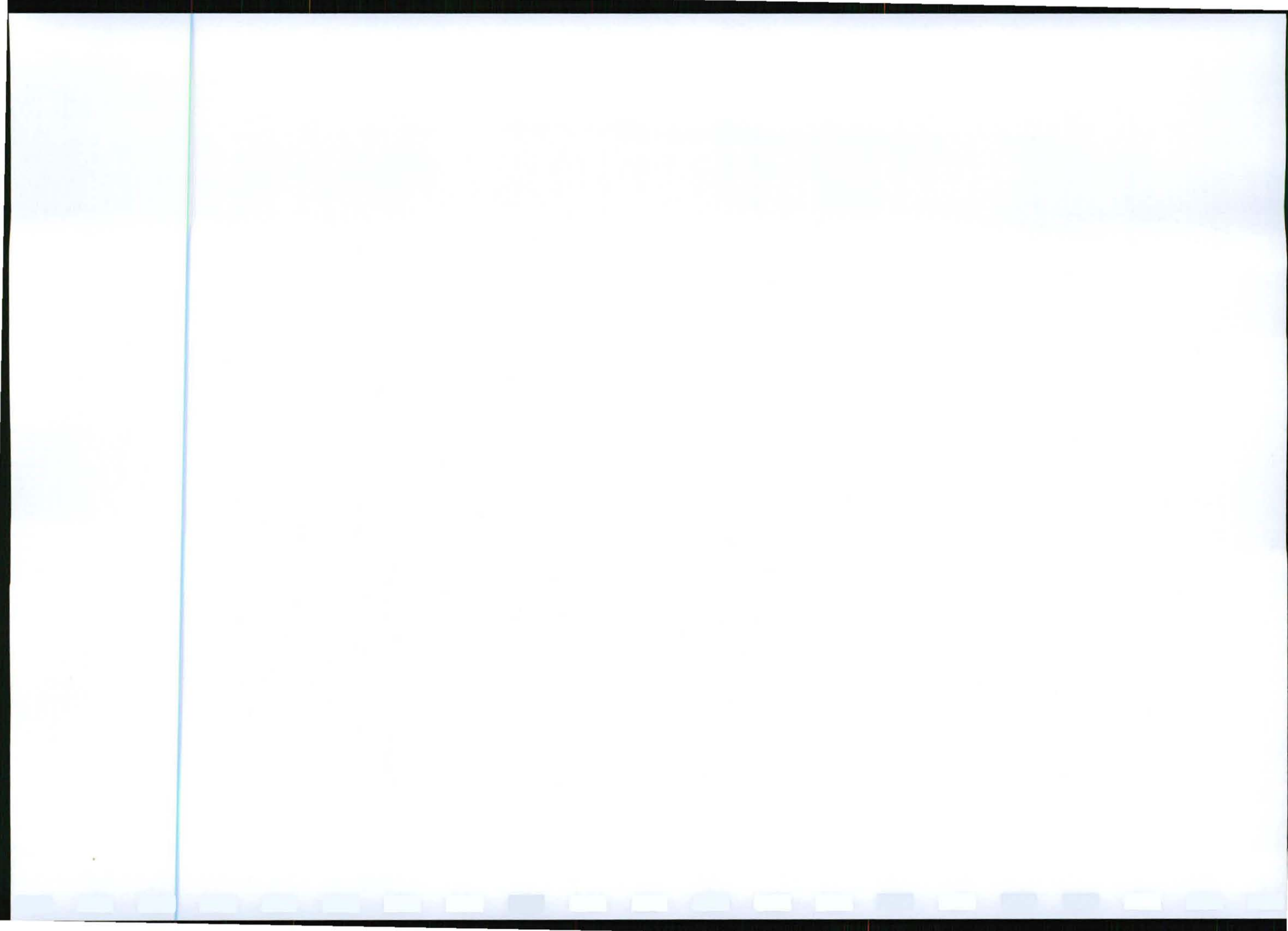
This vegetation type is considered vulnerable. Less than 3% is statutorily conserved and this is spread thinly across a number of reserves such as Foorndraai Dam and Skuinsdraai Nature Reserve. The Mokolo Dam Nature Reserve, which borders directly on the study area falls within this veldtype. An additional 2% is conserved in SANDF property (Wallmansthal) and a grouping of private reserves and game farms, which includes the Nylsvlei freshwater wetlands. Approximately 24% is transformed, which includes agriculture (19%) and urbanisation (4%)<sup>1</sup>. Erosion is very low to high depending on the area in question. However, within the study area it is low, although the same concern regarding development and erosion exists in the view of the authors.

According to the South African National Biodiversity Institute (SANBI) the ecosystem (Central Sandy Bushveld) in which the study area falls is not threatened<sup>19</sup>. SANBI has put together maps (VEGMAP) which also highlight the threatened, or conservation, status of the various vegetation types. The status of the vegetation type (Central Sandy Bushveld) in which the study area falls are shown in Table 6.

### Western Sandy Bushveld

According to Mucina & Rutherford (2006) this veldtype is least threatened. There is a general target to protect 19% of the veldtype, while at present approximately 6% is statutorily conserved. Just over half of which falls within the Marakele National Park. Around 4% of veldtype is totally transformed, mainly by agriculture, some of which is presently being rehabilitated in game farms and conservation areas. Although soils  
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are mostly sandy erosion is generally low to very low due to the veld cover and lack of steep gradients. However, it is the opinion of the authors that erosion is a potential threat in certain areas with regard to development.

According to the South African National Biodiversity Institute (SANBI) the ecosystem (Western Sandy Bushveld) in which the study area falls is not threatened.

### **Waterberg Mountain Bushveld**

Almost 6% of this veldtype is statutorily protected, with a further 3% conserved in other reserves, such as private game farms. The ultimate target for conservation is 19%. The veldtype has a "least threatened" status. Approximately 18% of the vegetation unit has been transformed, predominantly by cultivation, with very little resulting from urbanisation and built-up areas. Erosion is low to high with the area mostly been used for game ranching. The conservation status of the vegetation types in which the study area falls are shown in Table 6<sup>1</sup>.

**Table 6: Conservation status of vegetation types**

Vegetation type	Transformed	Conserved	Target to conserve	Ecosystem status	Protection level
Central Sandy Bushveld	24%	3%	19%	Vulnerable	Low
Waterberg Mountain Bushveld	18%	9%	19%	Least threatened	Moderate
Western Sandy Bushveld	4%	6%	19%	Least threatened	Moderate

Note: The percentage of the original area currently under protection was calculated based on Type 1 protected areas only. The biodiversity target refers to the percentage of the original areas required to capture 75% of the species occurring in each vegetation type. Ecosystem status is based on the percentage of the original area remaining untransformed in relation to the biodiversity target and a threshold for ecosystem functioning. Protection level is based on the % of the biodiversity target conserved in Type 1 protected areas.

Erosion in the study area is very low to low. Alien plant infestation in the study area is very low and tends to be localised to disturbed areas such as human settlements; agricultural fields; old, unused lands and river systems.



## 6. SENSITIVE FLORISTIC HABITAT TYPES

### **Rocky outcrops**

Rocky outcrops (koppies) are regarded as sensitive. The association of rocky outcrops and mountains with Red Data and threatened plant species has been proven extensively. There were no typical rocky outcrops found in the study area. These rocky outcrops are mainly as a result of atypical habitat conditions created by rockiness, high slopes, lack of grazing and fire damage. There are a few areas of rockiness along the powerline corridors, but these should not be confused with rocky outcrops (koppies) or rocky ridges. Notwithstanding, these rocky areas, although not highly sensitive, should still be viewed as sensitive and approached with care. These rocky regions are considered suitable habitat for the presence of Red Data flora species such as *Dombeya rotundifolia* var. *rotundifolia* (Wild pear) and protected tree species such as *Sclerocarya birrea* (Marula). However, no Red Data species were observed.

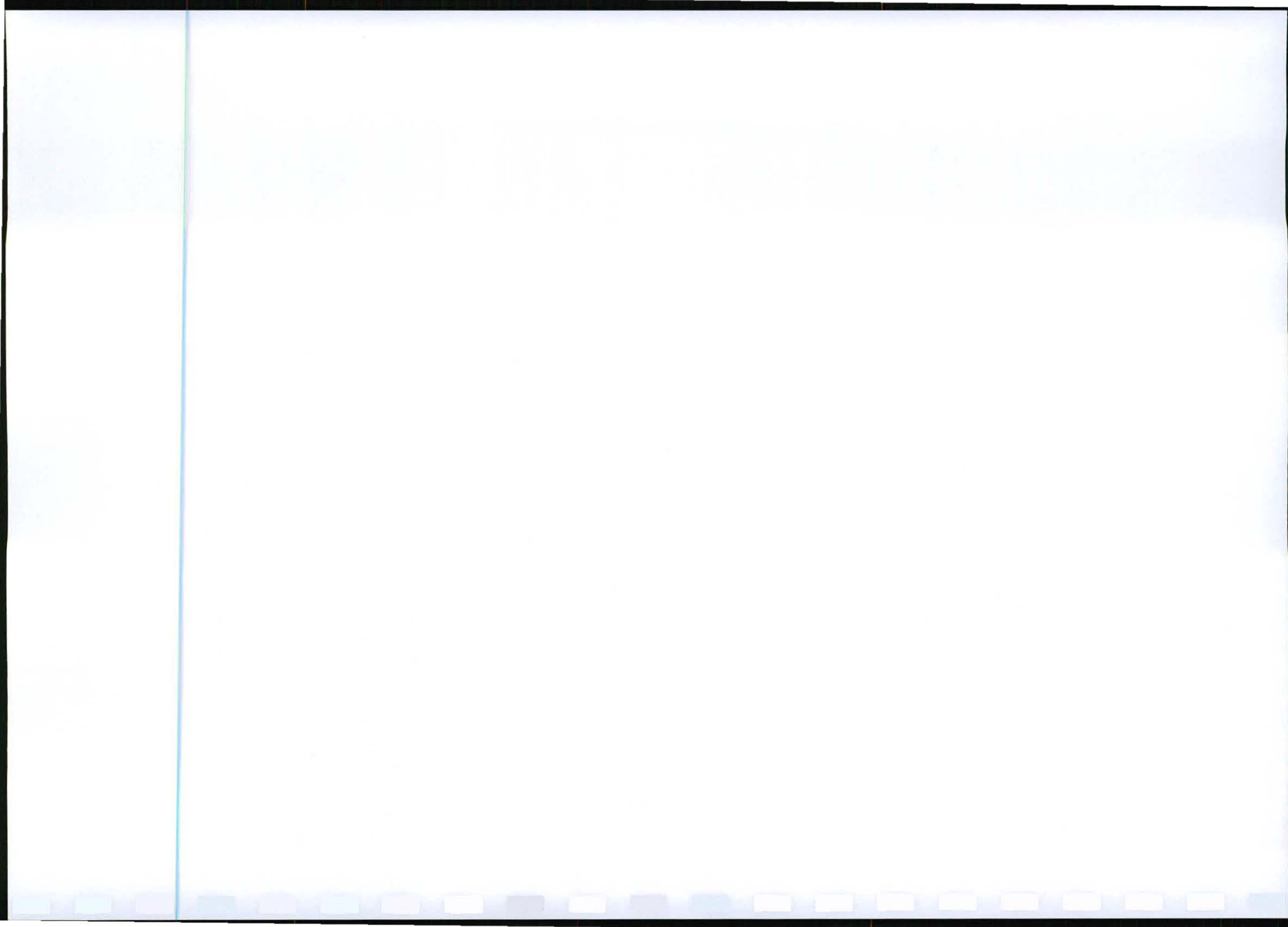
### **Gradients and elevations of the study site**

The study area consists mainly of flat and low undulating plains, with a lack of steep or sudden gradients. The highest elevation is at the Dorset Substation site (1554m) and the lowest elevation around the Mokolo River (949m). The Bulge River Substation site is at an elevation above sea level of 1080m. From the lowest elevation (Mokolo River) the powerline corridors climb gradually over a distance of approximately 13km (as the crow flies) to the Bulge River Substation site. This gives a low gradient of only 1% over that distance. The corridor running up to the Dorset Substation site, over a distance of about 35km (as the crow flies), is steeper. However, the gradient is still low at only 1,7%.

### **Rivers and Wetlands**

Rivers and wetlands, along with their associated vegetation should all be viewed as sensitive. Even where these bodies of water might be degraded or infested with alien vegetation. Two main rivers or streams fall within and/or cross the powerline corridors. Namely, the Mokolo River and Poer se Loop. The proper implementation





and management of mitigating measures are crucial. A number of drainage lines move across the powerline corridors and also need to be avoided.

No wetlands were found to be present in the study area.

#### **Camel thorn grove**

There are a few camel thorn (*Acacia erioloba*) trees growing just east of the Mokolo River and both sides of the sand road (D1882). Camel thorns are protected trees and this small grove should be viewed as a "No-Go" zone and totally avoided.

GPS coordinates taken from the road: S24<sup>0</sup>06.822'; E27<sup>0</sup>48.301'.

## **7. SENSITIVE FAUNAL HABITAT TYPES**

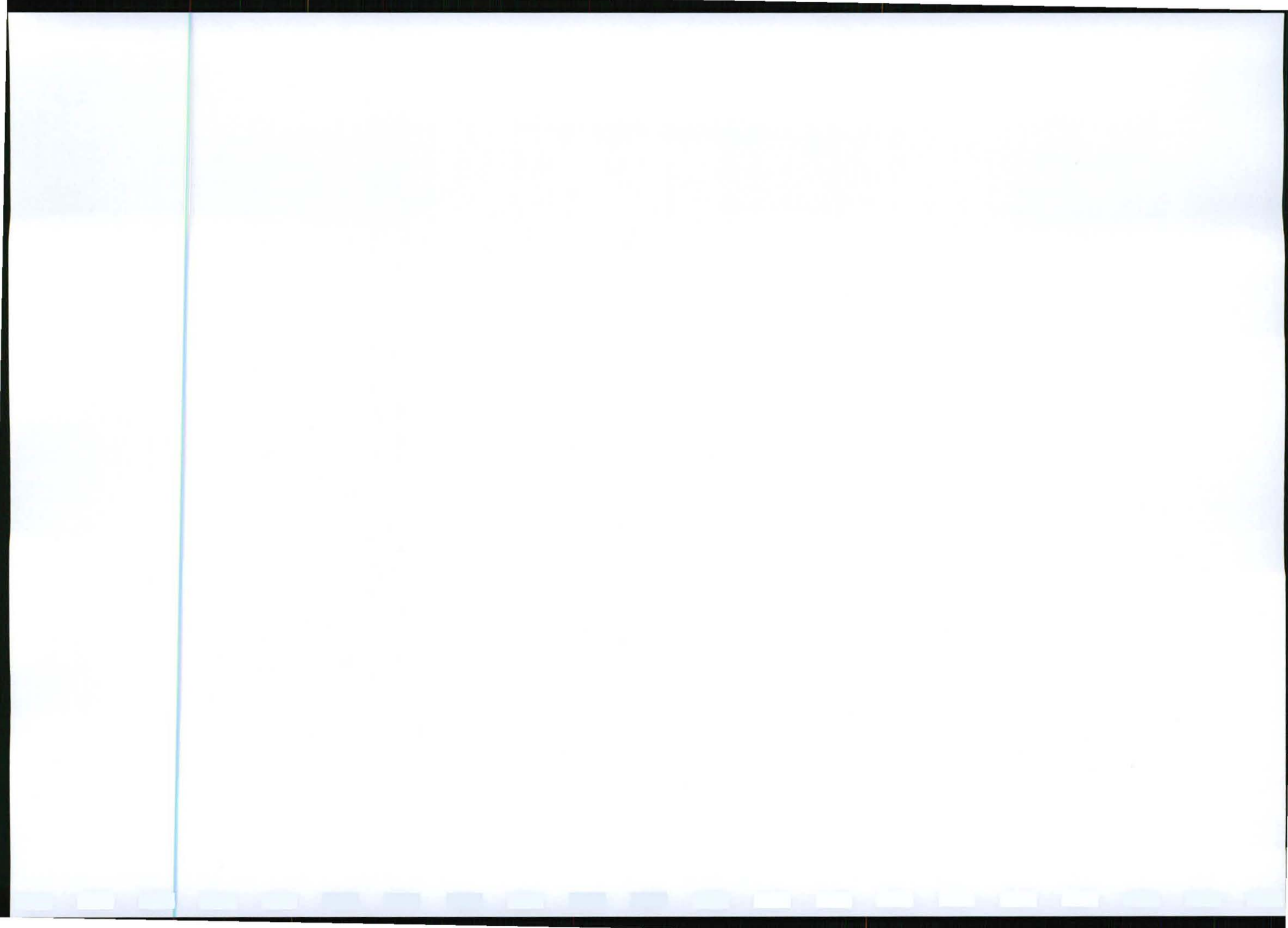
#### **Rocky outcrops**

Atypical habitat types, such as koppies (rocky outcrops and ridges) generally represent sensitive faunal habitat, although not always containing a high diversity of species. These micro-habitats are highly suitable for the presence of Red Data species. No rocky outcrops occur in the study. The rocky regions should however be viewed as sensitive although not as "No-Go" zones. Proper implementation of mitigating measures is essential.

#### **Open plains**

The dominant vegetation types of the inspection site are those of Central Sandy Bushveld and Western Sandy Bushveld. Most of the site is undulating plains. These plains are not seen as sensitive habitat types and most potentially occurring Red Data species are associated with either wetlands or rocky ridges. However, Red Data species such as the Pangolin (Scaly anteater) (*Manis temmincki*), Southern African hedgehog (*Atelerix frontalis*), Honey badger (Ratel) (*Mellivora capensis*) are not specifically linked to restricted habitats and do occur in savanna habitat. Due to the pristine nature of much of the bushveld in the study area it is likely that some of these species do occur in the area.

## **8. FLORISTIC SENSITIVITY ANALYSIS**



A large percentage of the vegetation in the study area can be viewed as pristine. However, the vegetation is fairly uniform with no small ecosystems or islands of uniqueness being present. For the greater part the vegetation of the study area is therefore seen as moderately sensitive. This excludes the localised area of Camel thorn trees (*Acacia erioloba*) in the vicinity of the Mokolo River, which is viewed as highly sensitive. The rocky areas within the powerline corridors are viewed as sensitive, but not as “No-Go” zones. The Mokolo River and Poer se Loop are seen as being sensitive.

### Floristic sensitivity calculation

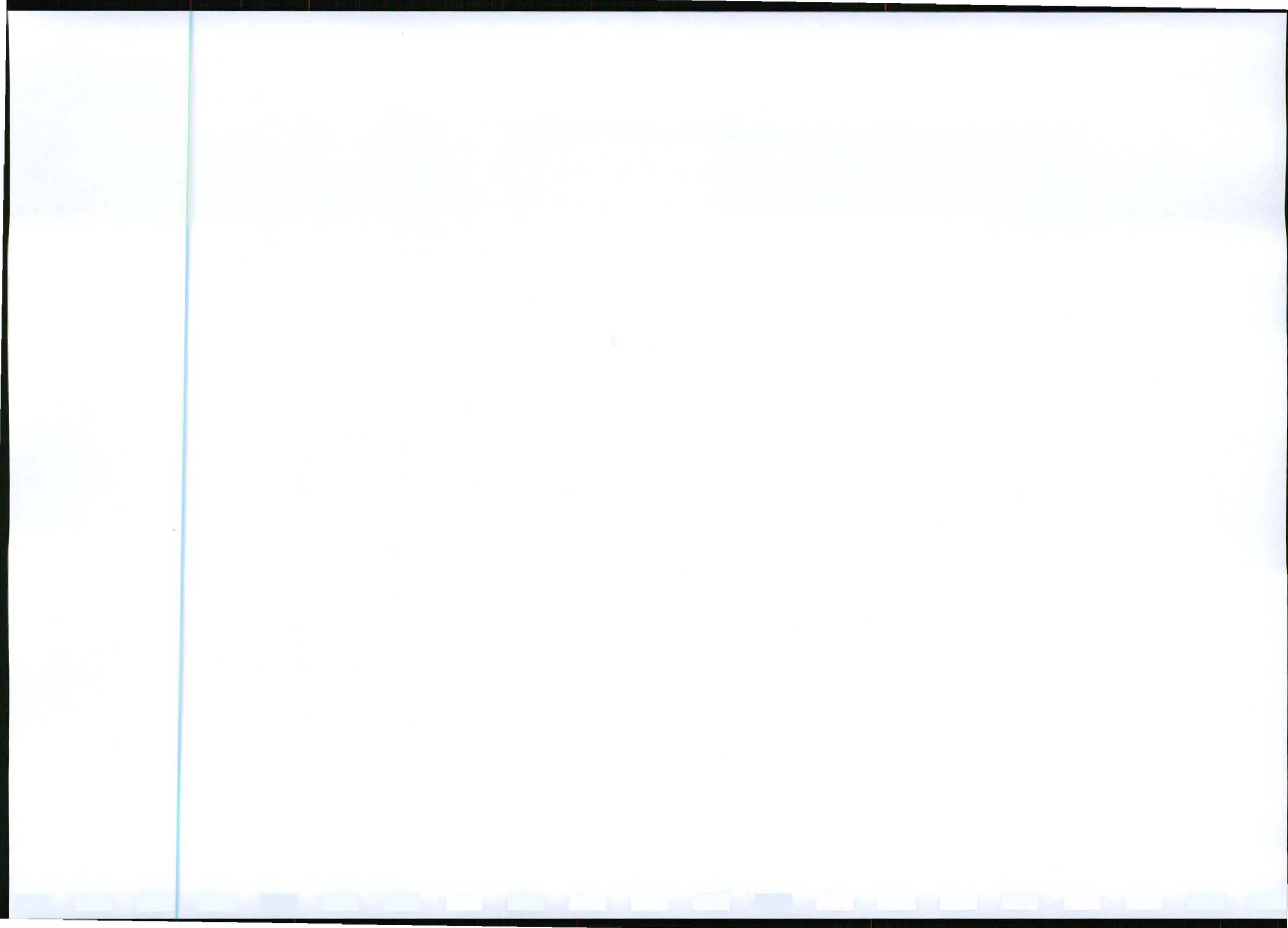
CRITERIA	PLANT COMMUNITY DESCRIPTION			
	Regional vegetation	Rivers	Rocky Areas	Camel thorns
Red Data Species	5	4	8	10
Habitat Sensitivity	5	10	8	10
Floristic Status	5	6	6	10
Floristic Diversity	6	7	7	7
Ecological Fragmentation	4	4	4	4
Sensitivity Index	50%	62%	66%	82%
Sensitivity Level	MEDIUM	MEDIUM / HIGH	MEDIUM / HIGH	HIGH
Development Go Ahead	GO-SLOW	GO-BUT	GO-BUT	NO-GO

Criteria are rated on an increasing sensitivity level using a scale of 1-10.

## 9. FAUNAL SENSITIVITY ANALYSIS

A faunal sensitivity calculation of the rocky areas in the study area renders these parts sensitive. This is due mainly to these sites been ideal habitat for red data fauna





species, as well as the relatively pristine nature of the vegetation. The regional vegetation of the study area is considered moderately sensitive due to the percentage of pristine areas. Within the regional vegetation are a number of actively cultivated lands and fallow lands that are viewed as having a low sensitivity value. Keep in mind that a number of these fallow lands have been incorporated into reserves and ranches and are slowly rehabilitating.

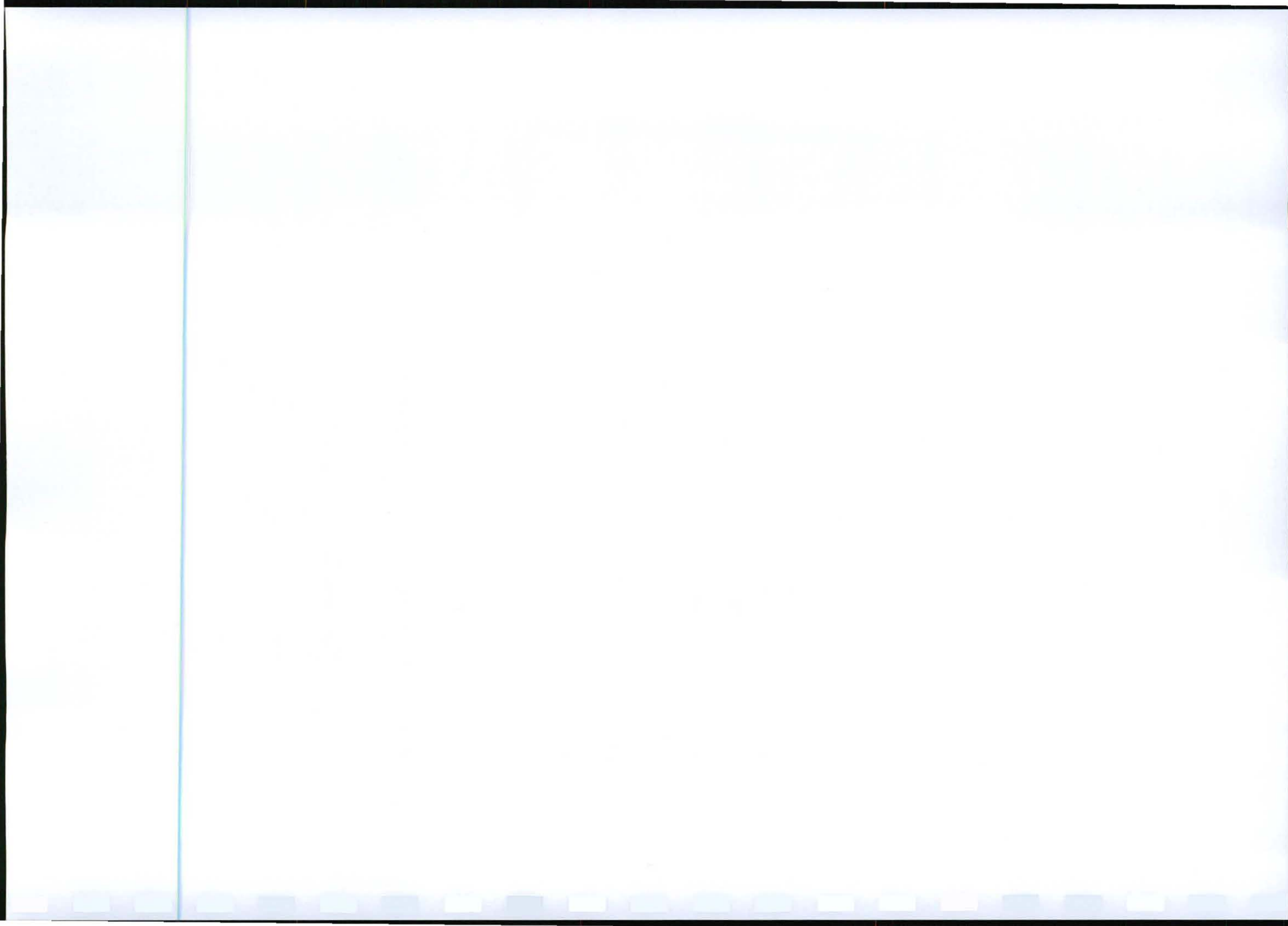
### Faunal sensitivity calculation

CRITERIA	ANIMAL COMMUNITY DESCRIPTION			
	Regional vegetation	Rivers	Rocky Areas	Camel thorns
Red Data Species	5	6	8	4
Habitat Sensitivity	5	10	9	5
Faunal Status	5	6	6	6
Faunal Diversity	6	7	7	6
Ecological Fragmentation	4	4	4	4
Sensitivity Index	50%	66%	68%	50%
Sensitivity Level	MEDIUM	MEDIUM / HIGH	MEDIUM / HIGH	MEDIUM
Development Go Ahead	GO-SLOW	GO-BUT	GO-BUT	GO-SLOW

Criteria are rated on an increasing sensitivity level using a scale of 1-10.

## 10. ECOLOGICAL SENSITIVITY ANALYSIS

The ecological sensitivity of the study area is determined by combining the sensitivity analyses of both the floral and faunal components. The highest calculated unit is



taken to represent the sensitivity of that ecological unit, whether it is floristic or faunal in nature.

**Ecological sensitivity of the study area**

COMMUNITY	FLORISTIC SENSITIVITY	FAUNAL SENSITIVITY	ECOLOGICAL SENSITIVITY	DEVELOPMENT GO AHEAD
Regional vegetation	Medium	Medium	Medium	GO-SLOW
Rivers	Medium / High	Medium / High	Medium / High	GO-BUT
Rocky areas	Medium / High	Medium / High	Medium / High	GO-BUT
Camel thorns	High	Medium	High	NO-GO

**11. IMPACT EVALUATION**

**Nature of impacts**

No proposed impacts on the ecology of the environment were identified as beneficial. However, due to the physical nature of the powerlines, their impact will be minimal over the medium- to long-term. The impact of the substations will be greater over the long-term especially with regards to fauna returning to the immediate area. Trees and shrubs growing directly under the powerlines will be cleared and kept permanently so. This has a massive impact on the floral diversity directly within this corridor. However, due to the good condition of the veld and the low negative impacts in the immediate vicinity, the impact, when viewed on the larger scale, is minimal with regards to species destruction.

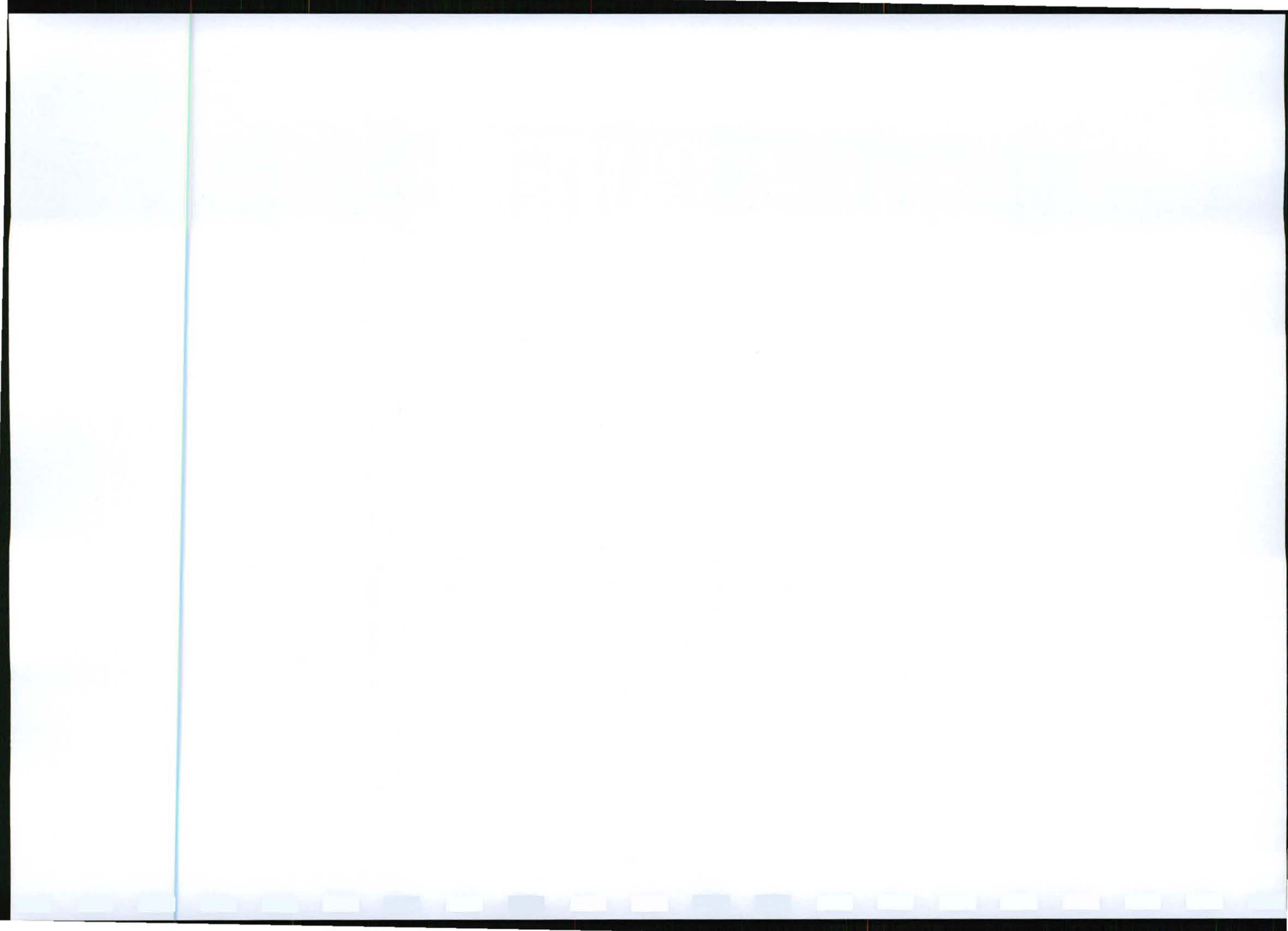
Please note that this report looks at impacts and sensitivities solely from an ecological point of view. It does not consider other impacts such as on agriculture, human settlements or even that of a visual nature.

**Significance of impacts**

Regional vegetation

Surface changes within the regional vegetation of the undulating plains will result in the loss of some biophysical attributes, albeit slight. These effects are for the most





part permanent, especially within the corridor of the powerlines and substation sites. However, the impacts are likely to have a low negative affect on sensitive species or Red Data species. Representative habitat is still widely present in the surrounding regions and in good condition and diversity. The implementation of mitigating measures would suffice in limiting localised impacts, as well as allowing for effective control and reduction of impacts.

#### Rivers

Rivers and wetlands are always seen as sensitive and should be avoided at all cost. In this instance there is no other choice but to cross over two such water courses. Namely, the Mokolo River and Poer se Loop. Mitigating measures are necessary, the implementation of which will ensure that almost no negative impact in terms of the ecological environment are felt.

#### Rocky areas

Surface changes within the rocky areas will result in greater loss of biophysical attributes than in those of the regional vegetation of the undulating plains. Fortunately the rocky areas encountered in the powerline corridors area spread over a large area and area not as sensitive, or unique, with regard to species diversification as would be the case of isolated rocky outcrops or ridges. Effects are mostly permanent and the significance of these impacts is therefore deemed high. Implementation of mitigating measures is considered necessary.

#### Camel thorns

Immediately east of the Mokolo River is a small grove of camel thorn trees (*Acacia erioloba*), which should be considered highly sensitive, due to the conservation status of the tree species and not the uniqueness of the micro ecosystem. This area needs to be handled as a "No-Go" area and avoided. For this reason, no mitigating measures are seen as been able to reduce the impact on the site, save the one of total avoidance.

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### **Rating Matrixes for Assessing Impacts**

#### **Regional vegetation**

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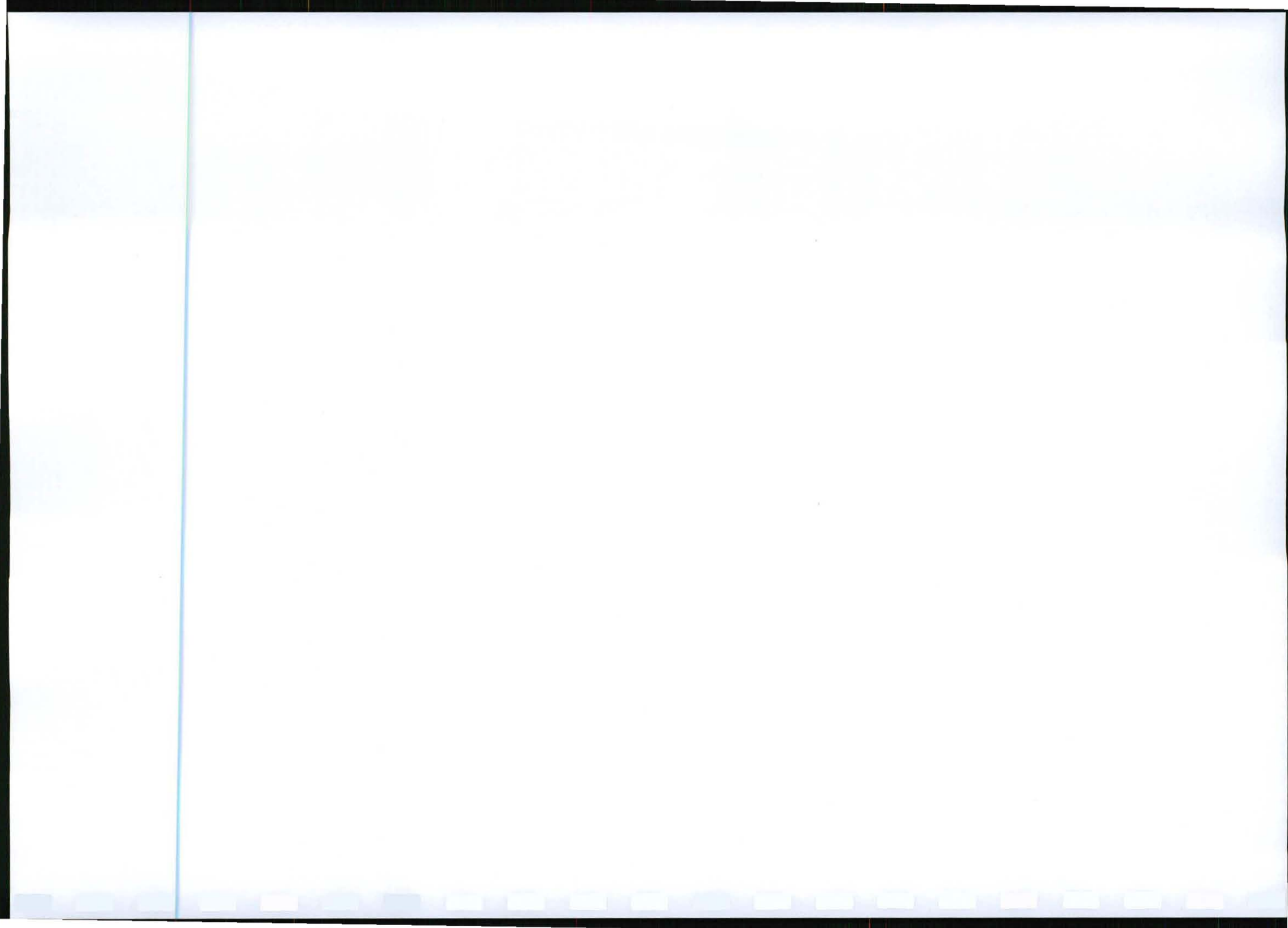


<b>Impact – Destruction of sensitive habitat &amp; areas of high biodiversity</b>	
<b>Criteria</b>	<b>Rating</b>
Extent	2
Duration	4
Intensity	3
Probability of occurrence	1
<b>Total</b>	<b>10</b>
This is rated as a MEDIUM negative impact before the implementation of mitigating and management measures	
<b>Impact AFTER Mitigating and Management Measures</b>	
<b>Criteria</b>	<b>Rating</b>
Extent	1
Duration	3
Intensity	1
Probability of occurrence	1
<b>Total</b>	<b>7</b>
This is rated as a LOW negative impact after the successful implementation of all mitigating and management measures	

### **Rivers**

<b>Impact – Destruction of sensitive habitat &amp; areas of high biodiversity</b>	
<b>Criteria</b>	<b>Rating</b>
Extent	2
Duration	4
Intensity	2
Probability of occurrence	2
<b>Total</b>	<b>10</b>
This is rated as a MEDIUM (bordering on HIGH) negative impact before the implementation of mitigating and management measures	
<b>Impact AFTER Mitigating and Management Measures</b>	





Criteria	Rating
Extent	1
Duration	3
Intensity	1
Probability of occurrence	1
<b>Total</b>	<b>6</b>
This is rated as a LOW negative impact after the successful implementation of all mitigating and management measures	

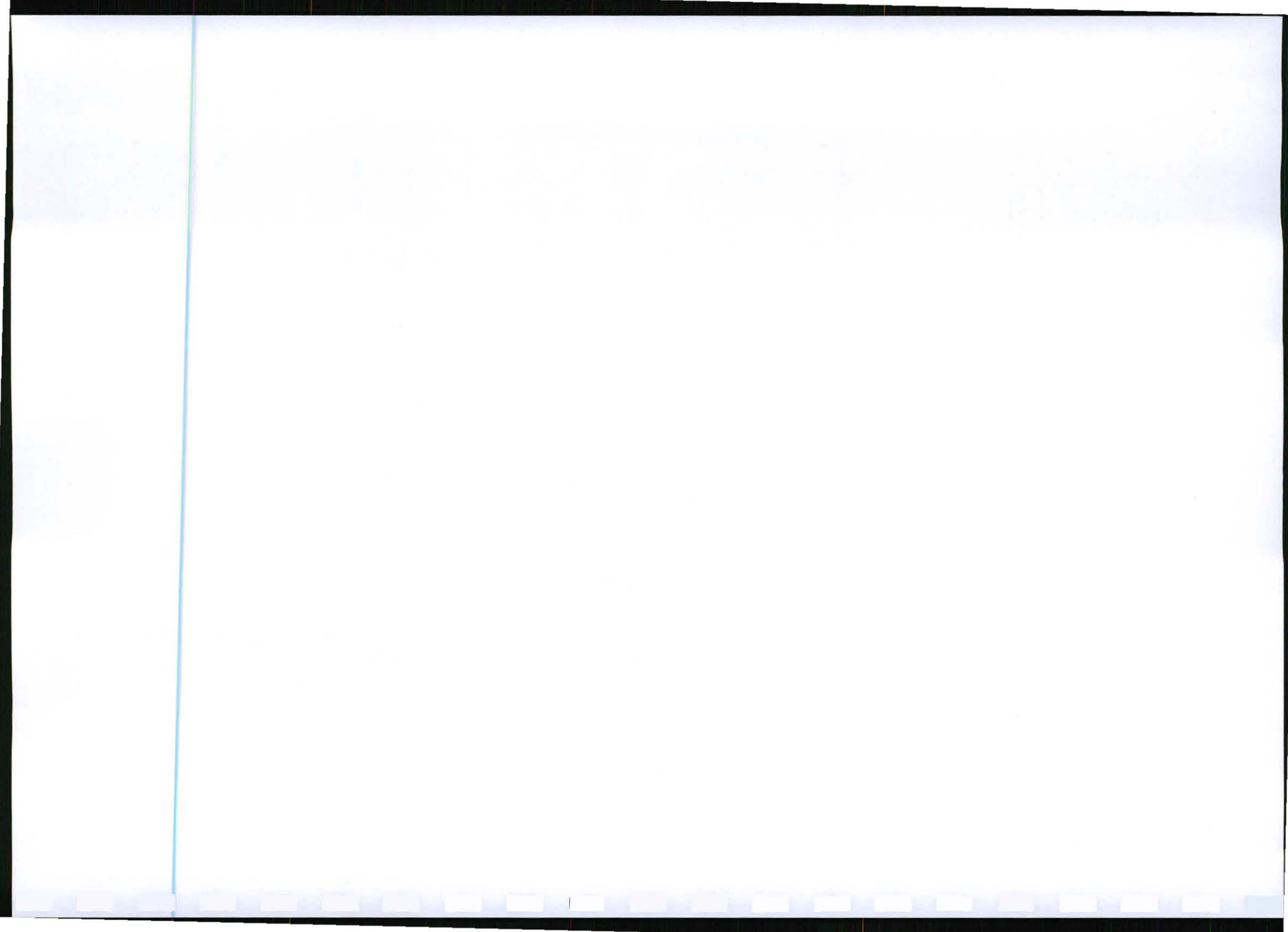
### Rocky areas

Impact – Destruction of sensitive habitat & areas of high biodiversity	
Criteria	Rating
Extent	2
Duration	3
Intensity	2
Probability of occurrence	3
<b>Total</b>	<b>10</b>
This is rated as a MEDIUM (bordering on HIGH) negative impact before the implementation of mitigating and management measures	

### Impact AFTER Mitigating and Management Measures

Criteria	Rating
Extent	1
Duration	3
Intensity	1
Probability of occurrence	2
<b>Total</b>	<b>7</b>
This is rated as a LOW negative impact after the successful implementation of all mitigating and management measures	

### Camel thorns

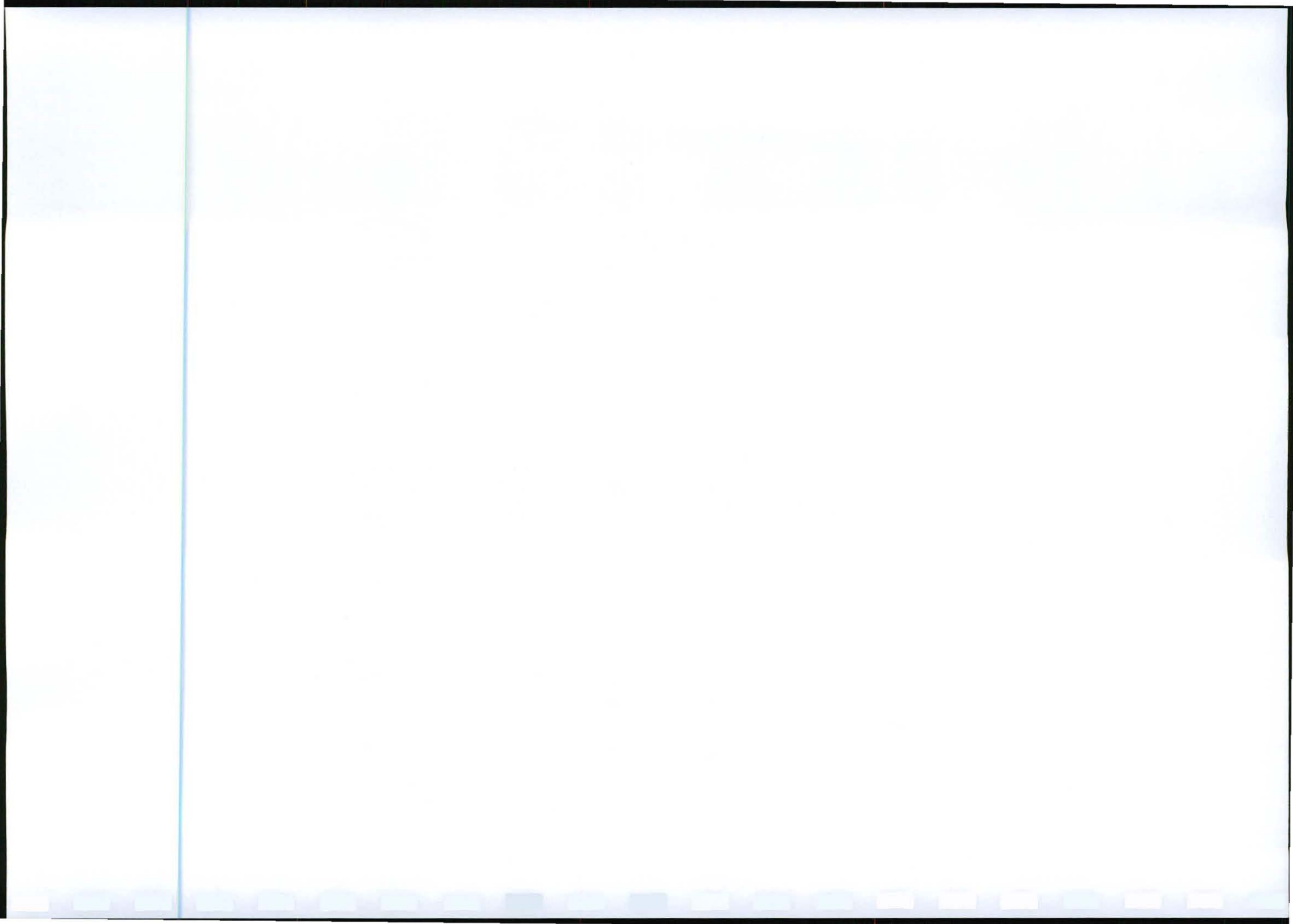


No rating matrix is given. There are no possible mitigating measures and the area must be approached as a "No-Go" area.

**Summary of general impacts as determined from site investigations**

Issue	Significance rating before and after mitigation	
	Before	After
<b>Farming related issues</b>		
Access to properties	Medium	Low
Access roads (damage to)	Low	Low
Loss of agricultural potential	Low	Low
Impacts on seasonal activities	Low	Low
<b>Natural environment</b>		
Erosion	Low	Low
Impact on flora	Medium	Low
Impact on fauna	Medium	Low
Importation of alien vegetation	Medium	Low
Impact of herbicides	Medium	Low
Impact on conservation areas	Medium	Low



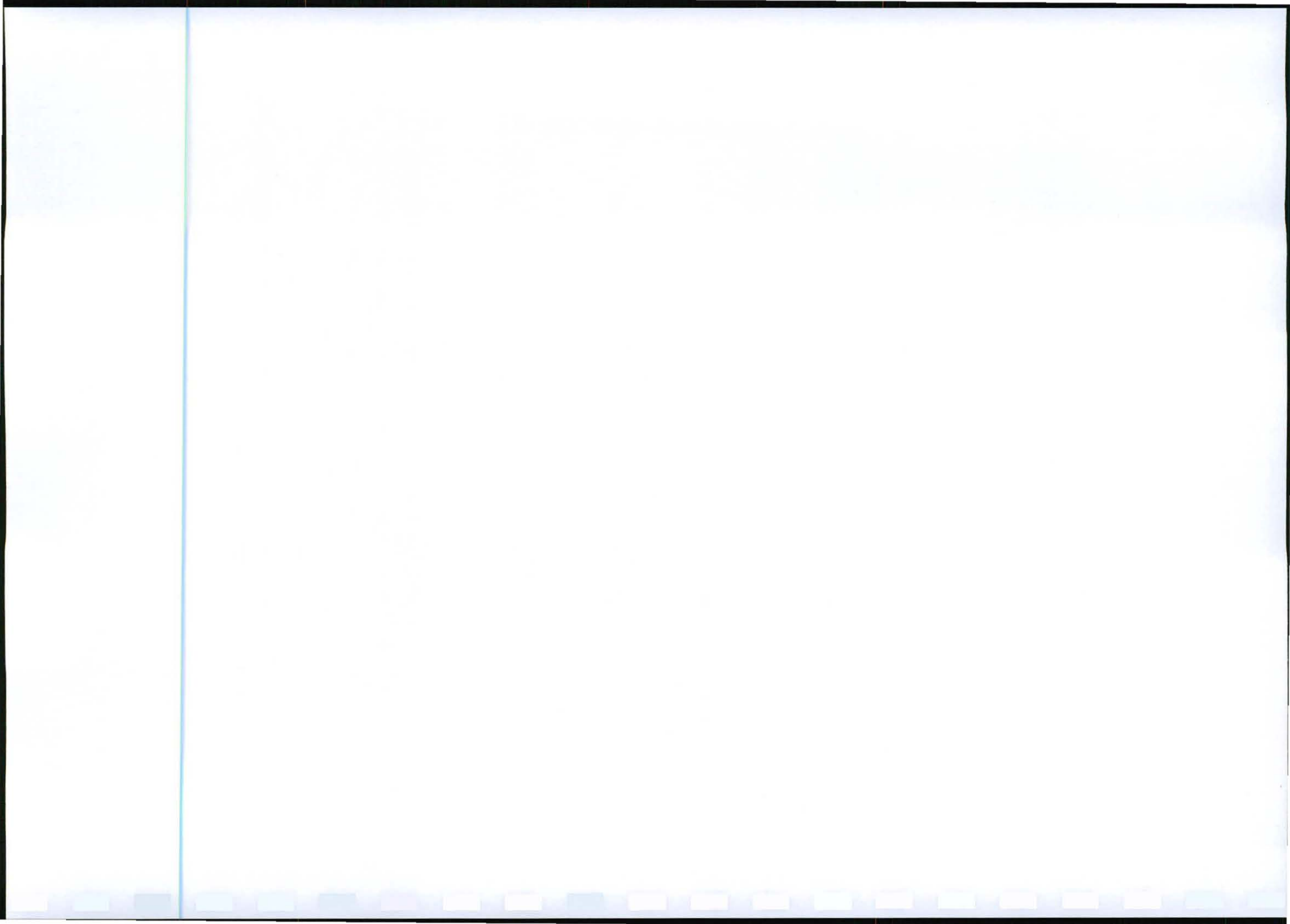


## **12. MITIGATION OF IMPACTS**

### **Powerline corridors**

#### **Plains of the regional habitat**

- Due to the long (almost 65km) distance covered by the powerline corridors between Bulge River Substation and Dorset Substation it may be necessary to set up temporary storage and accommodation facilities along the route. If so, areas of flat, open lands should be selected. This need to be old, previously cultivated lands that are open and not wooded. No area should be selected where it would be necessary to cut down any trees or clear any shrub land whatsoever. Any selected temporary site still needs to be within the 100m powerline corridor. All mitigating and management measures as laid out for temporarily facilities under "Bulge River Substation" need to be adhered to.
- No site within a rocky area or within 300m of a river or stream may be used for temporary accommodation or storage.
- Positioning of the foundation slabs for the pylons must be a minimum of 10m away from the edge of all drainage lines.
- No trees outside of the powerline corridor of 8m to be removed.
- Disturbed surface areas in the construction phase to be rehabilitated. No open trenches to be left. No mounds of soils created during construction to be left.
- The sandy nature of the soils in the area makes it susceptible to soil erosion by water once disturbed, especially in steeper areas. The ground around all foundation slabs for the pylons need to be inspected before and after the summer rainy season for erosion. Any erosion found needs to be fixed and preventative measures put in place to prevent a reoccurrence of the situation.
- An ongoing programme to be implemented to mechanically control alien plant species that invade the disturbed soils around the newly erected pylons. This should be done in such as way as to allow the natural grasses and pioneer plants to colonise the disturbed areas.
- Mechanical control of alien species to be implemented within two months of completion of construction of the powerline. Thereafter ever six months.

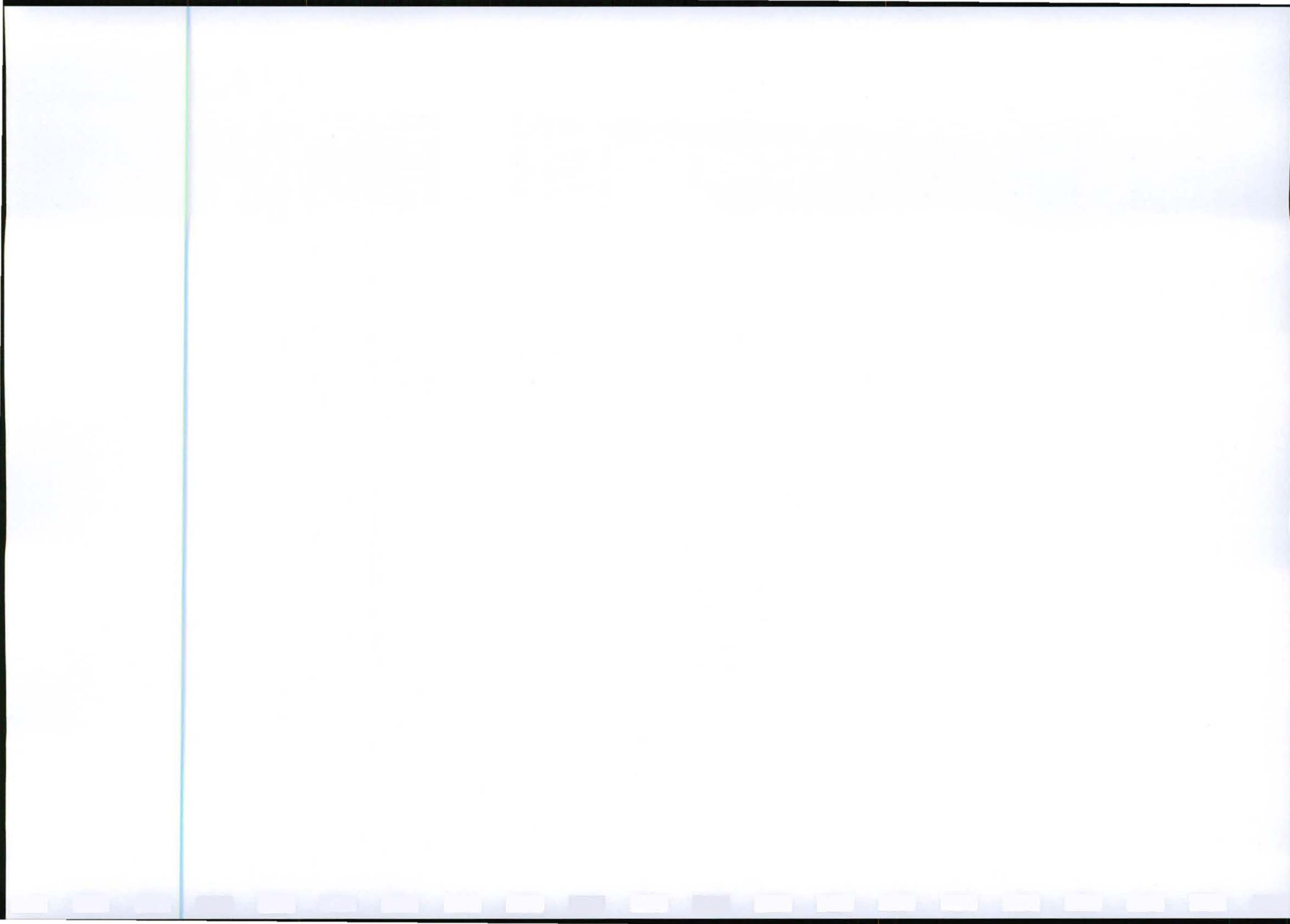


- Surface area under powerlines to be mowed and not ploughed.
- No chemical control (herbicides) to be used in the control of alien plants or indigenous plants, except on tree and bush stumps in 8m corridors directly under powerlines.
- Removal of all construction material and equipment after construction.
- Removal of all waste construction material to an approved waste disposal site.

### **Rocky area**

- A few rocky areas have been identified along the proposed servitude routes. These areas are considered moderately sensitive and should be approached with caution.
- The area is not seen as a "No-Go" area, but care should still be taken to avoid any unnecessary disturbance of veld or soil. Removal of trees, shrubs and other vegetation should be kept strictly to within the 8m corridor under the powerlines.
- Only a single, basic vehicle track to be constructed as an access road under pylons moving through the rocky area.
- Access roads need to be kept to an absolute minimum.
- No trees to be cut down or roads to be created to access the powerline corridor from the public road by vehicle. Or to create shortcuts into this region. Any vehicles needing to access the powerlines running through the rocky area will need to do so from out of the less sensitive plains along the corridor itself.
- No temporary storage facilities, toilets, dwellings, etc. of any kind to take place within this rocky area. Not even within the demarcated powerline corridor.
- The longest possible distance between pylons should be used in an effort to limit the footprint size on the rocky area.
- The powerline must run as straight as possible through and over rocky areas. This in an effort to limit sharp turns that literally create a larger physical footprint on the ground.

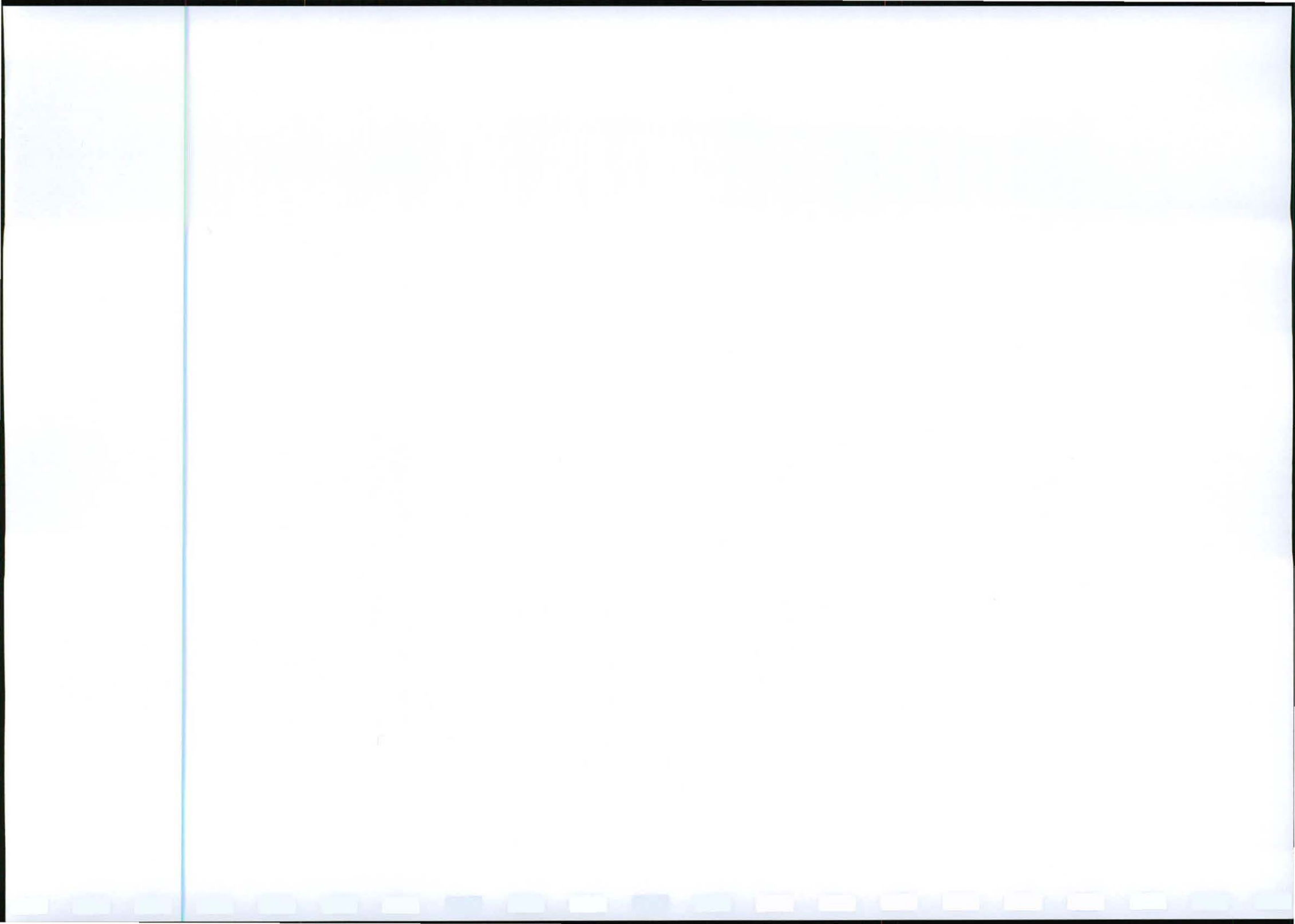




- Great care and thought must be taken into the actual positioning and construction of the foundation slabs. The soils are sandy and this area has the steepest gradient of the study site. There is therefore a real danger of soil erosion and resulting veld degradation in this area.
- The sandy nature of the soils in the area makes it susceptible to soil erosion by water once disturbed, especially in steeper areas. The ground around all foundation slabs for the pylons need to be inspected before and after the summer rainy season for erosion. Any erosion found needs to be fixed and preventative measures put in place to prevent a reoccurrence of the situation.
- Disturbance of the soils must be kept to an absolute minimum to limit the potential introduction of alien plants. This area is pristine with little to no alien infestation. Alien plants generally get a foothold in an area where the soils have been disturbed.
- Mechanical control of alien species must be implemented within two months of completion of construction of the powerline. Thereafter ever six months.
- No chemical control of alien plant species to be used.

#### **Rivers and seasonal streams**

- Two major water courses (Mokolo River and Poer se Loop) along with a few seasonal streams and drainage lines cross the corridors for the powerlines. These need to be completely avoided and no pylons may be placed directly within any one of these water courses.
- No temporary or other construction facilities to be erected or stored within 200m of the banks of the Mokolo River or the Poer se Loop stream.
- Positioning of any pylons need to be a minimum of 30m from the edge of the river banks or outside of the 1 in 100 year floodline.
- Positioning of the foundation slabs for the pylons must be a minimum of 10m away from the edge of all drainage lines.
- Under no circumstances may a pylon be placed directly in the bed of a river or drainage line.
- No temporary ablution facilities to be placed within 200m of the banks of any of the rivers or seasonal streams.



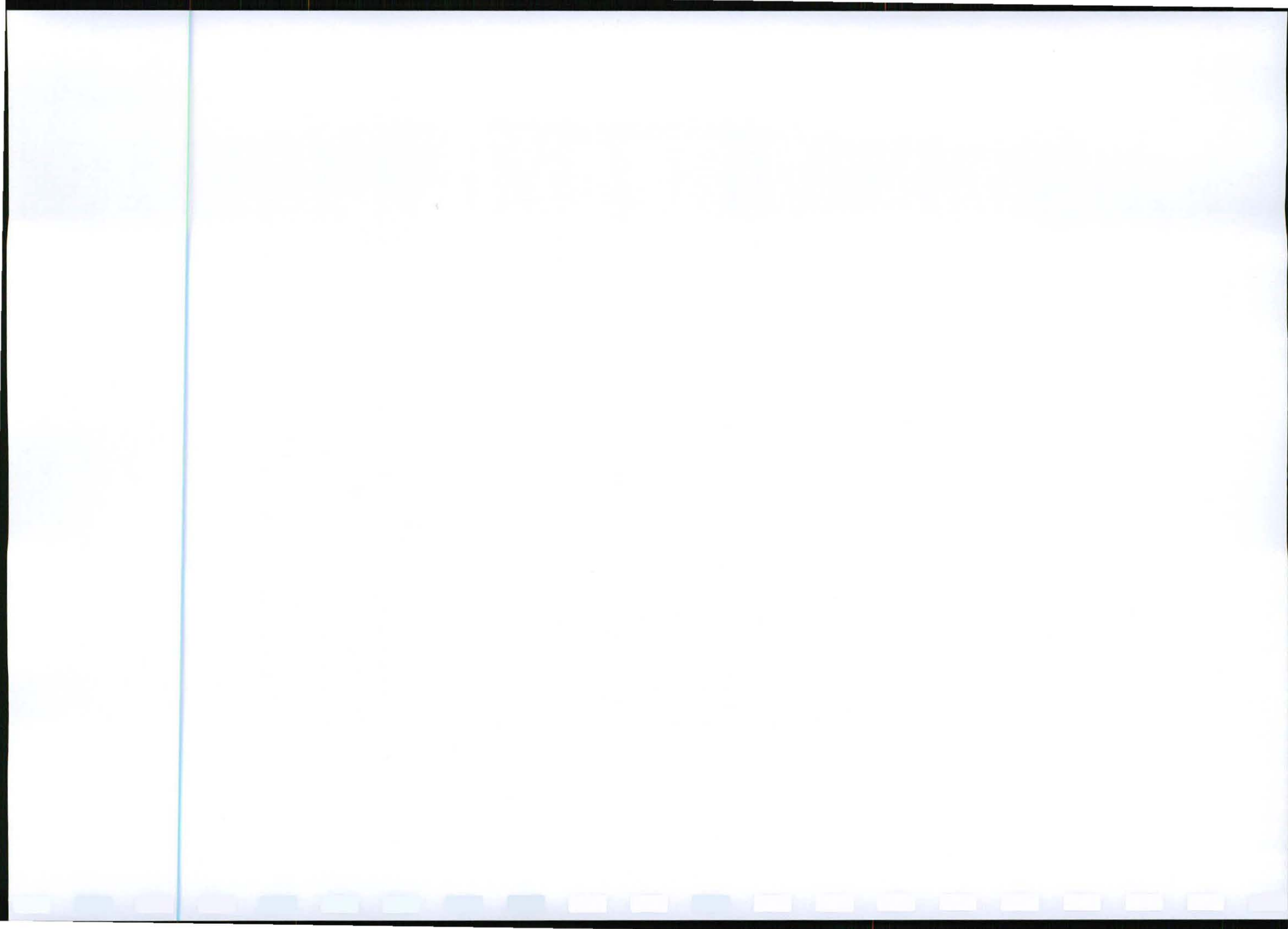
- No temporary ablution facilities to be placed within 200m of any drainage line, even if they are dry.
- Only proper portable, chemical ablution facilities to be used and these to be positioned only within the 31m powerline servitudes.
- Portable ablution facilities only to be serviced by registered companies and on a regular basis. Under no circumstances may any effluent or sewage be dumped in the open veld.
- Proper water facilities need to be installed and maintained for construction workers. No water from out of the rivers may be used for drinking, washing or cooking purposes.

## **13. GENERAL RECOMMENDATIONS**

### **Construction phase**

- Camp site, storage facilities and other necessary temporary structures to be erected within the immediate area demarcated for the Bulge River substation and the Dorset substation. With the possibility of another one (maximum two) temporary sites within the powerline corridors due to the distance between the substations.
- No open fires to be allowed outside of the Bulge River and Dorset substations sites.
- Collection of wood for fires and cooking from out of the surrounding veld is prohibited.
- In the campsite a designated area for camp fires and cooking needs to be made. Should open fires be used then an area of at least 2m by 2m needs to be cleared of any flammable materials such as grass. This
- No open fires to be allowed in the powerline corridors or adjacent areas.
- No material or machinery to be stored or placed in the open veld outside the designated area of the powerline corridors.
- Proper and adequate containers (rubbish bins) to be put in campsites for the temporary disposal of food waste and general litter generated by construction workers. These containers need to close securely to avoid items (eg. Paper and plastic) being blown into the veld, or being pushed over and rummaged





through by wild animals such as monkeys. Proper waster management is essential.

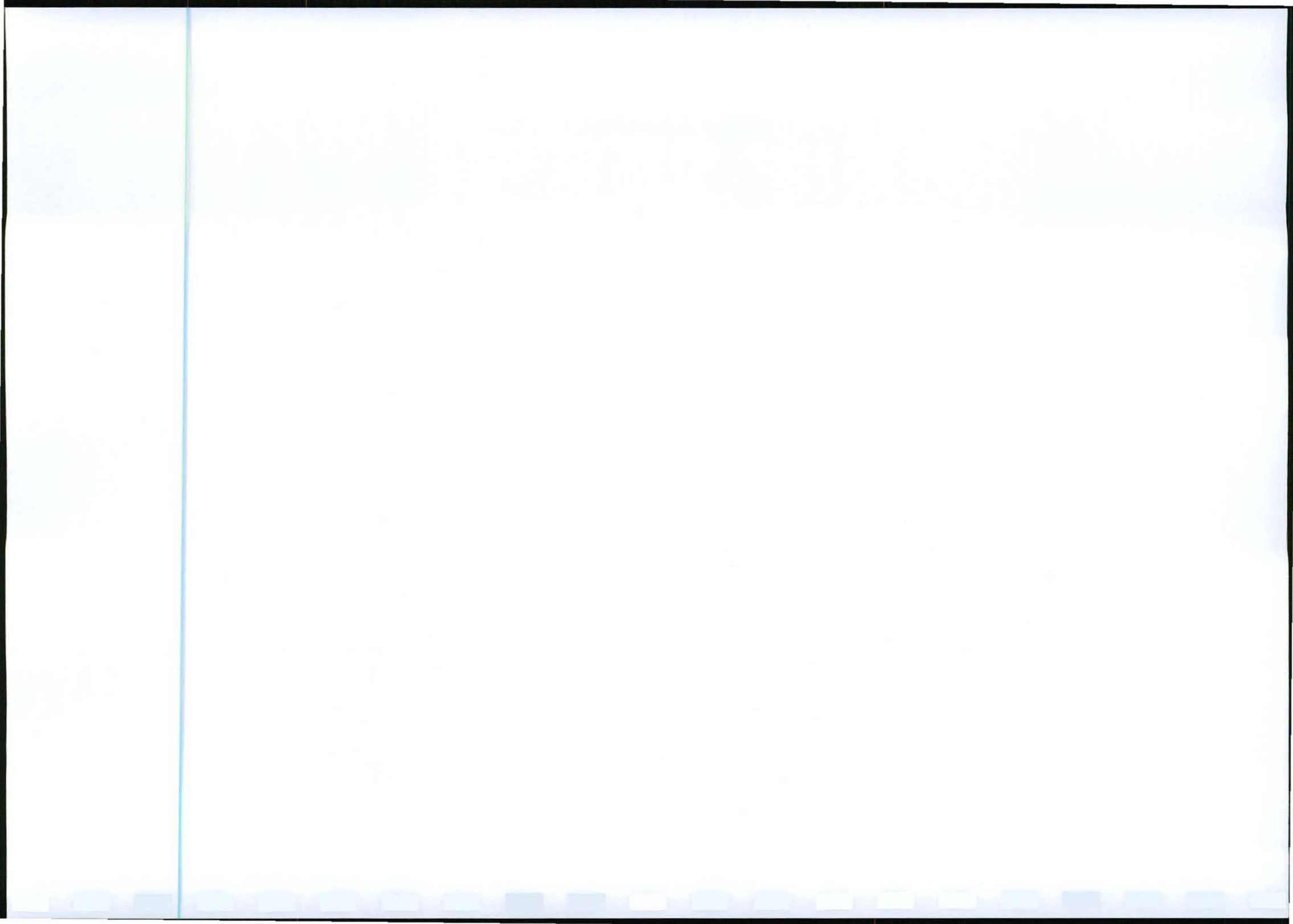
- Containers for food and general waste to be removed weekly to avoid bins overflowing their capacity.
- Under no circumstances may any sewage, waste food or general litter be dumped in the veld.
- No camp sites or other temporary structures to be erected outside the designated areas of the powerline corridors.
- No concrete to be allowed to be mixed in the veld.
- All construction activities and movement of people and machinery to remain within the designated powerline corridor.
- Temporary access roads for vehicles carrying equipment, materials, etc. into the powerline corridors need to be kept to an absolute minimum. No of these accesss roads may cross through sensitive areas.
- Work corridor to be limited to 20 metres along the route of the servitudes.

#### **Completion phase**

- Removal of all leftover construction material and equipment after construction needs to be done. This within 3 months of completion of the project.
- Removal of all waste construction material to an approved waste disposal site only.
- Proper and complete removal of all temporary accommodation sites including all litter needs to take place.
- All disturbed sites and surfaces to be rehabilitated.
- No unused sand, soil or construction materials of any kind whatsoever to be left behing in the powerline corridors.

#### **Maintenance phase**

- Mechanical control of alien plants around disturbed areas to be implemented within two months of completion of construction. Thereafter every six months. These areas are predominantly around the erected pylons. Mechanical



control to be of such a nature as to allow local grasses and other pioneers to colonise the previously disturbed areas, thereby keeping out alien invasives.

- No chemical control (herbicides) of alien plants to be used. These chemicals will have a detrimental effect on the surrounding vegetation and habitats.
- Vegetation under pylons and next to pylons to be mowed and not ploughed.
- Area around foundation slabs to be check before and after the summer rainy season for signs of soil erosion due to water run-off. Such sites need to be modified and rehabilitated to prevent ongoing erosion.
- Two of the impacts of greatest concern on the environment are the introduction of alien plants and soil erosion. As already mentioned these impacts need to be monitored and managed on an ongoing basis.

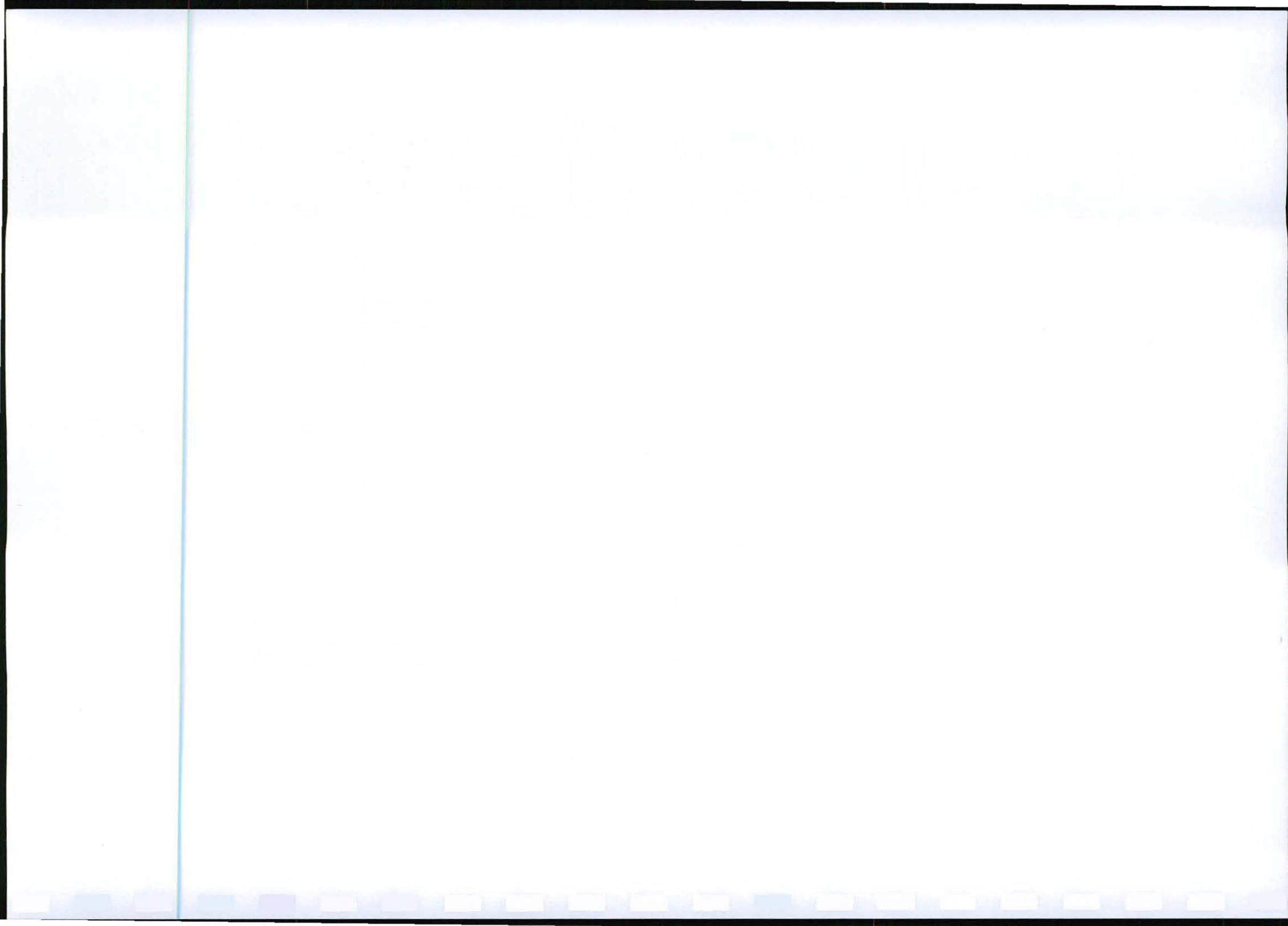
#### 14. LINE VARIANT RECOMMENDATIONS

Line variant recommendations are made on the strength of all the impacts and mitigating actions. As well as the sensitivities of the various biophysical features and vegetation types encountered in the study area.

#### Comparison of the number of ecologically sensitive units alternative routes potentially impact on

Ecologically sensitive criteria	Alternative Route 1					Alternative Route 2				
	A-B	B-C	C-D	D-E	E-F	A-B	B-G	G-D	D-H	H-F
Areas of high sensitivity	0	1	0	0	0	0	1	0	0	0
No-Go areas	0	1	0	0	0	0	1	0	0	0
Rivers and streams	2	1	0	0	1	2	1	0	0	1
Rocky outcrops	0	1	0	0	1	0	1	0	0	1
Wetlands	0	0	0	0	0	0	0	0	0	0
Sub-Total	2	4	0	0	2	2	4	0	0	2
Total	8					8				

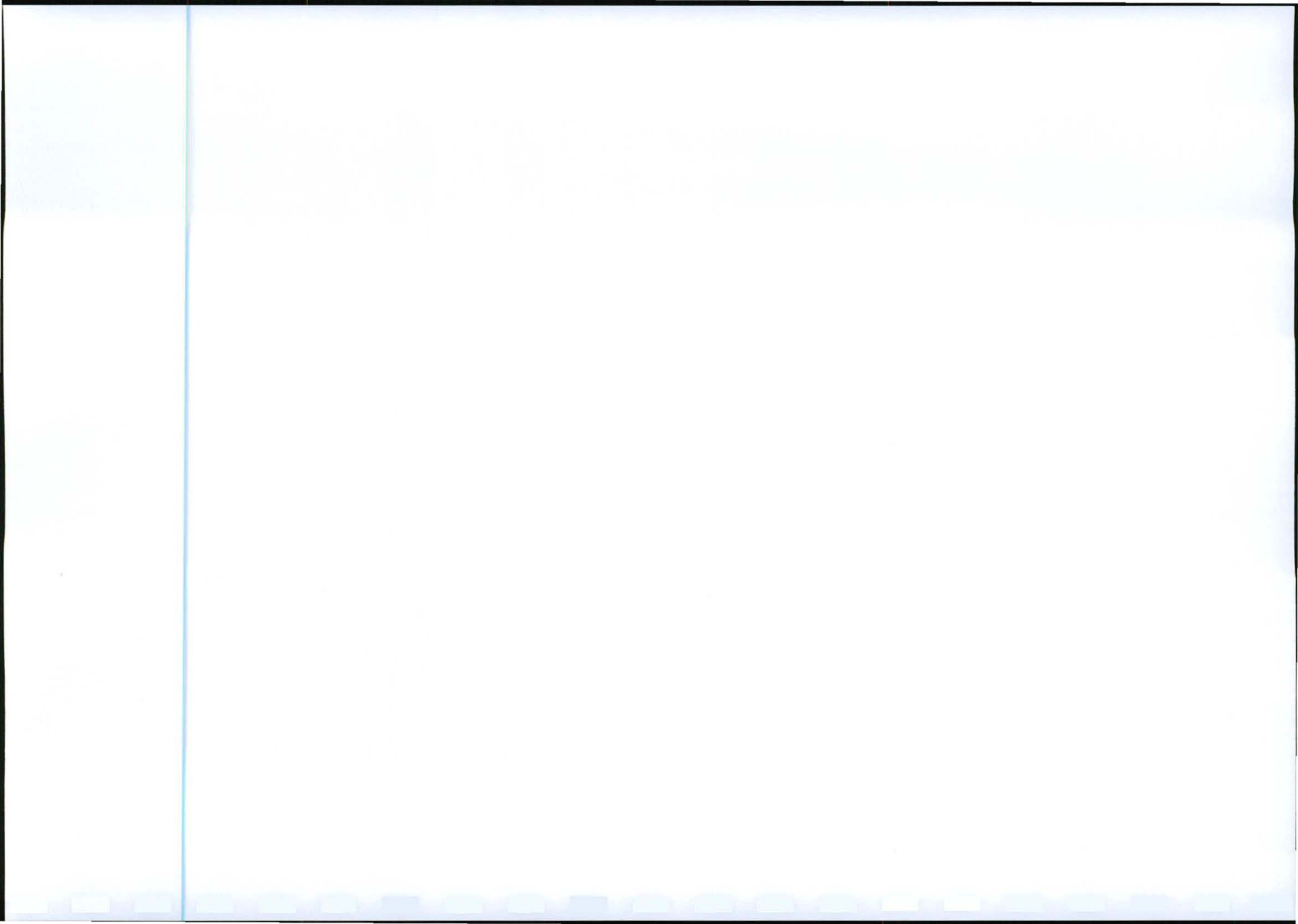




Ecologically sensitive criteria	Alternative Route 3					Alternative Route 4				
	A-B <sub>1</sub>	B <sub>1</sub> -C <sub>1</sub>	C <sub>1</sub> -D	D-H	H-F	A-B <sub>1</sub>	B <sub>1</sub> -C <sub>2</sub>	C <sub>2</sub> -C <sub>1</sub>	C <sub>1</sub> -D	D-F
Areas of high sensitivity	0	1	0	0	0	0	1	0	0	0
No-Go areas	0	1	0	0	0	0	1	0	0	0
Rivers and streams	1	1	0	0	1	1	1	0	0	1
Rocky outcrops	0	1	0	0	1	0	1	0	0	1
Wetlands	0	0	0	0	0	0	0	0	0	0
Sub-Total	1	4	0	0	2	1	4	0	0	2
Total	7					7				

When the alternative powerline routes are compared with each other regarding the possible number of ecological sensitive regions they could impact on, the results are the same for Routes 1 & 2 (both with a total of 8). Alternative Routes 3 & 4 have lower impact assessments on sensitive areas, with both having the same total count of 7. The fundamental difference making Alternative Route 4 the preferred alternative is found on the route deviation C<sub>2</sub>-C<sub>1</sub> (see ecological sensitivity maps). It is along this section of the proposed powerline routes that the other alternative routes move through much rockier areas, while the corridor of Route 4 is less rocky, more open and moves through more flat areas. The rockiness of the area increases to the north side of the public sand road (D1882). Keep in mind that rocky areas (not to be confused with rocky outcrops or rocky ridges) have a medium/high sensitivity rating prior to mitigating measures been implemented and that they need to be avoided wherever possible.

The alternative routes also differ slightly across the route section A-B (see ecological sensitivity maps). Here Routes 1&2 are the same, crossing over two rivers (Bulge and Malmanies) and potentially obstructing entrances to game and other farms.



While Routes 3&4 follow another route which only crosses one major river (Bulge) and doesn't potentially impact on entrances to game and other farms. For these reasons Routes 3&4 have lower ecological impact ratings over this section of the route.

The section of Alternative Route 1 (E-E<sub>1</sub>) near the Dorset Substation, is seen as having a greater impact on the environment than the other three routes that follow the more disturbed route along the road (E-H-F), on their way to the Dorset Substation (F).

Between map points C<sub>1</sub> and D (see ecological sensitivity maps) Alternative Routes 3 & 4 take different routes, albeit through the same general terrain. Across this specific section there is no significant difference in the potential ecological impact of Routes 3 & 4. In other words, across this specific section the ecological recommendation is that either route is acceptable and other factors need to be taken into consideration in determining the final route (eg. Cost of construction; agreements with landowners, etc.).

All the alternative routes cross over drainage lines en route. These have been investigated during field trips, but have not been mentioned in determining the recommended route due to the fact that they balance out between the alternative routes and therefore carry no decisive weight in the decision process. Obviously, relevant mitigating measures need to be implemented when such drainage lines are encountered during the construction phase and ongoing inspection of the powerlines.

Other factors have also been taken into account during investigations. Such as the number of sharp turns a route takes compared to a straight line between the two end points and the actual surface area in the 8m powerline corridor that potentially needs to be totally cleared of any trees or shrubs. Sharp turns are significant because the actual footprint on the ground at a turn in a powerline is much larger than along a straight line. Generally speaking the shorter and straighter a corridor is able to be constructed the better.





For all of the above reasons, **Alternative Route 4 (A-B<sub>1</sub>-C<sub>2</sub>-C<sub>1</sub>-D-H-F)** is the ecologically recommended alternative. However, between map points (C<sub>1</sub> – D) both sections of Alternative Routes 4 & 3 are ecologically acceptable and either made be used.



# 15. MAPS

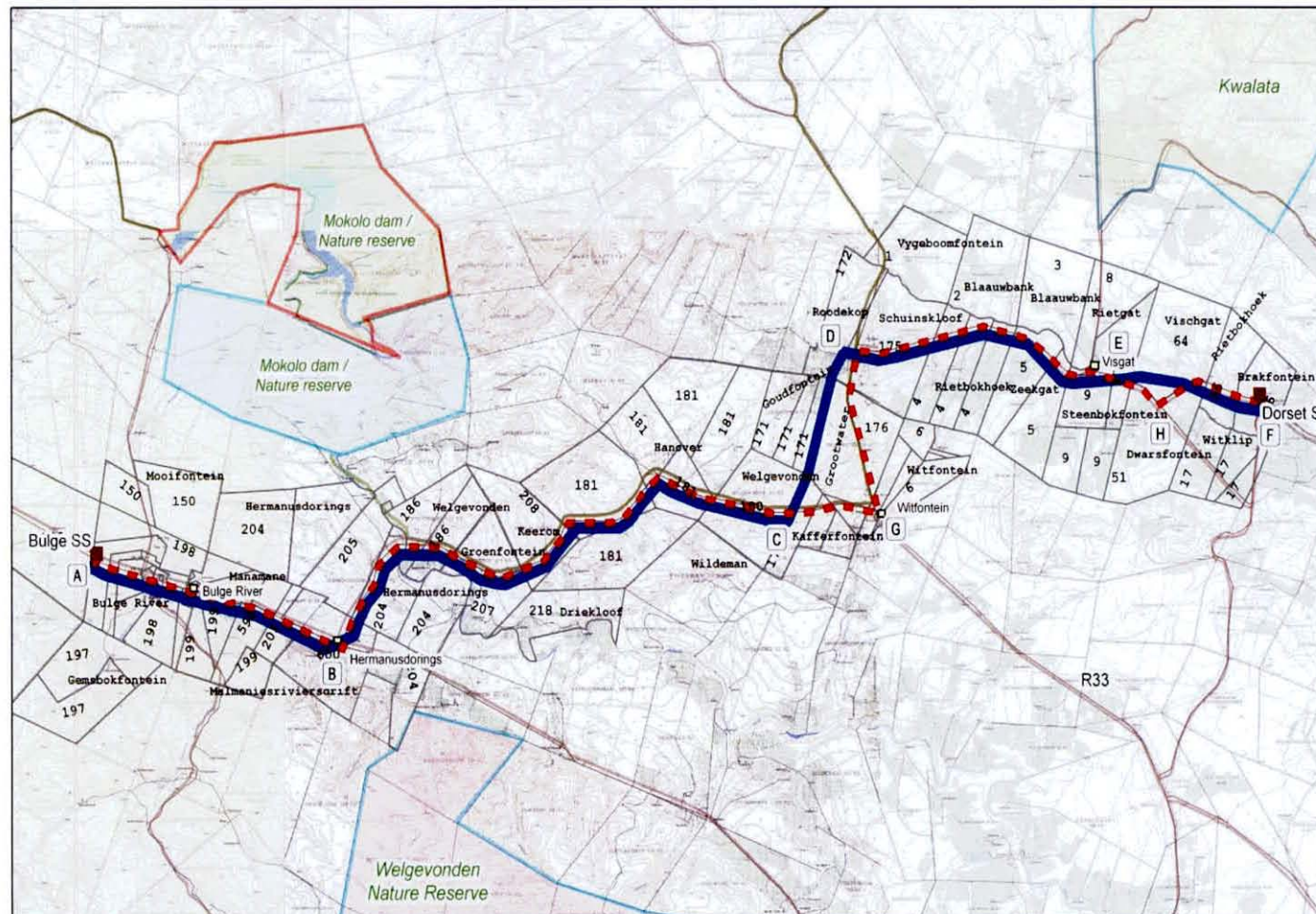
## 1. Location of the study area



### Bulge-Dorset 132kV line Detail map - Route alternatives



Flori Horticultural Services



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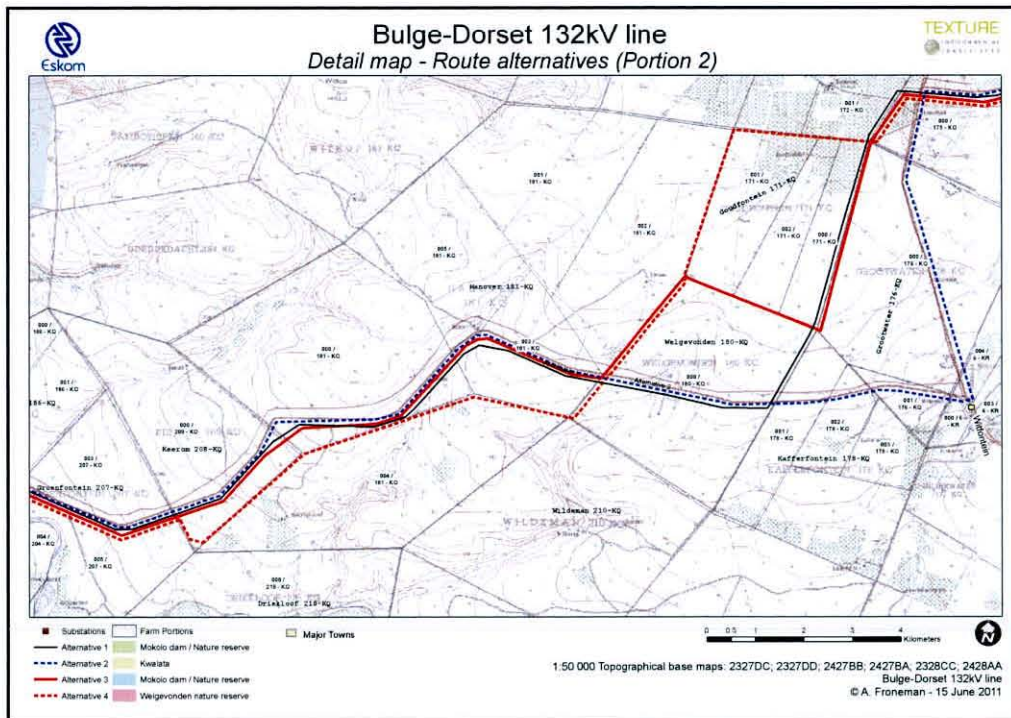
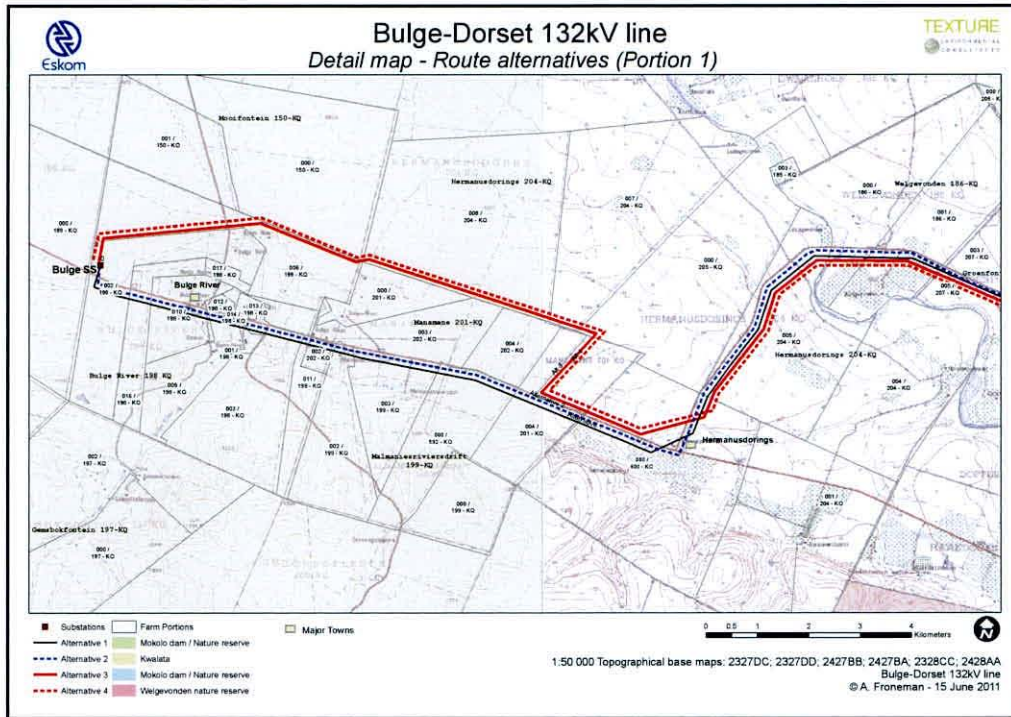
- Substations
- Biosphere buffer zone
- Mokolo dam / Nature reserve
- Alt 1
- Biosphere moepel core
- Kwalata
- Alt 2
- Biosphere transition zone
- Mokolo dam / Nature reserve
- Farms
- Major Towns
- Welgevonden nature reserve

1:50 000 Topographical base maps: 2327DC; 2327DD; 2427BB; 2427BA; 2328CC; 2428AA  
Bulge-Dorset 132kV line  
© A. Froneman - 22 December 2010





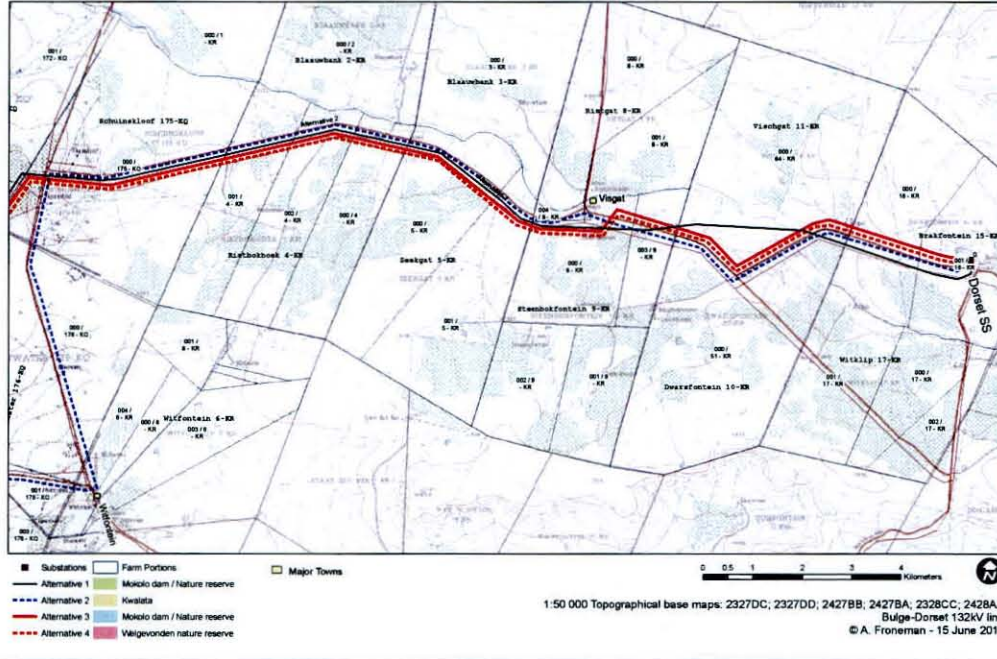
## Location of study area showing map detail (Portions 1,2 & 3)







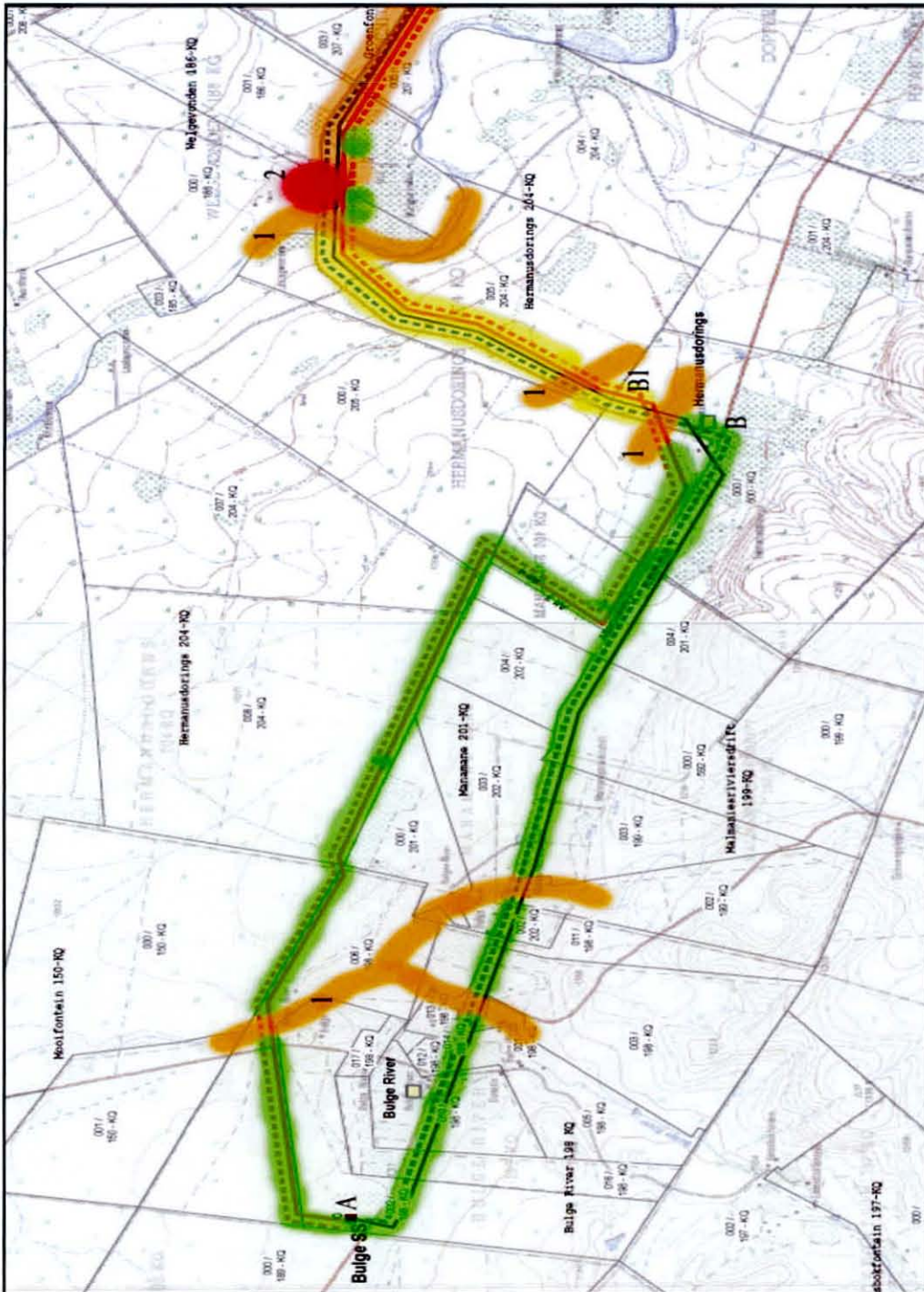
### Bulge-Dorset 132kV line Detail map - Route alternatives (Portion 3)

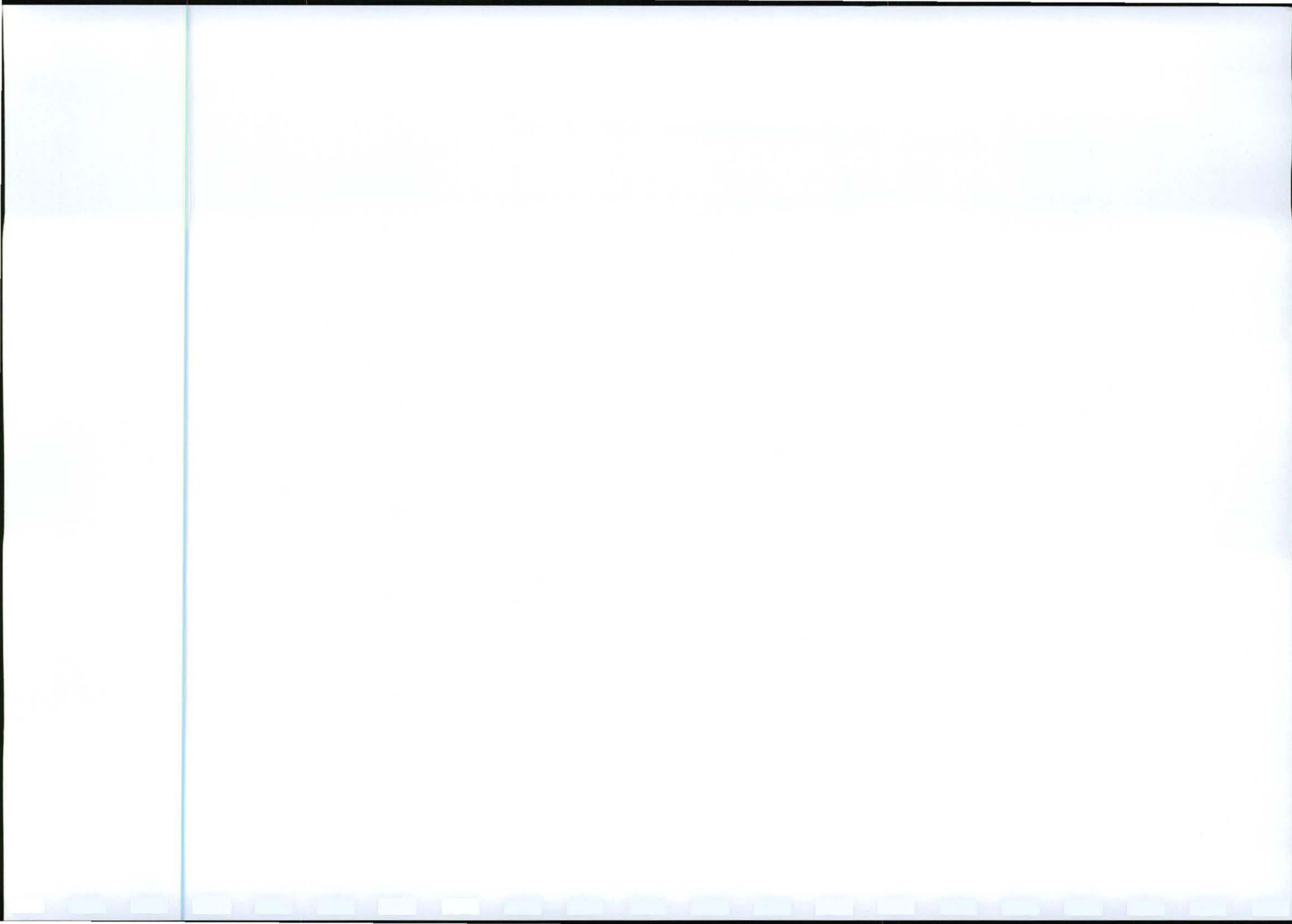




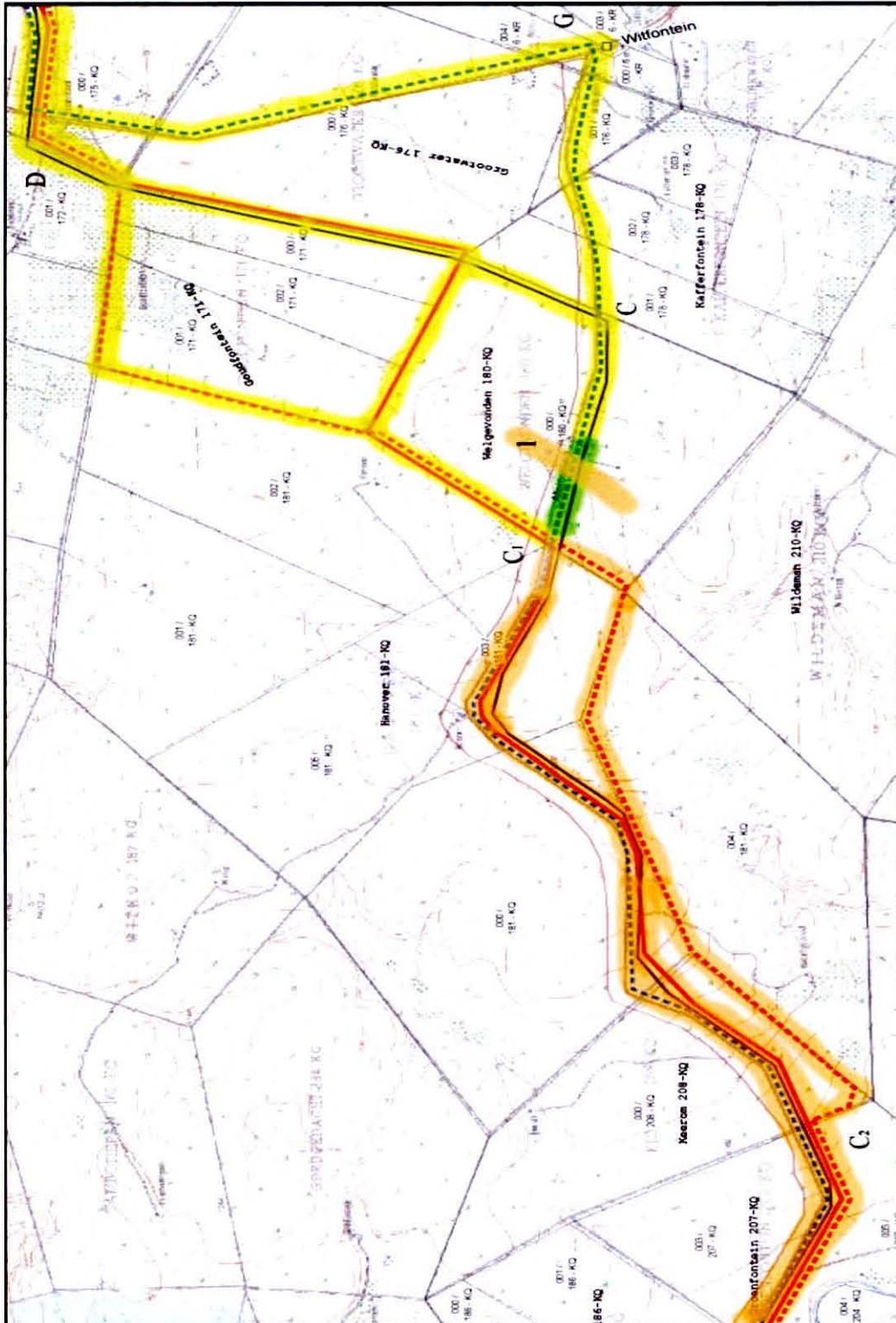


**2. Ecological Sensitivity of Alternative Routes**  
**Map Detail – Route alternatives (Portion 1 of 3)**





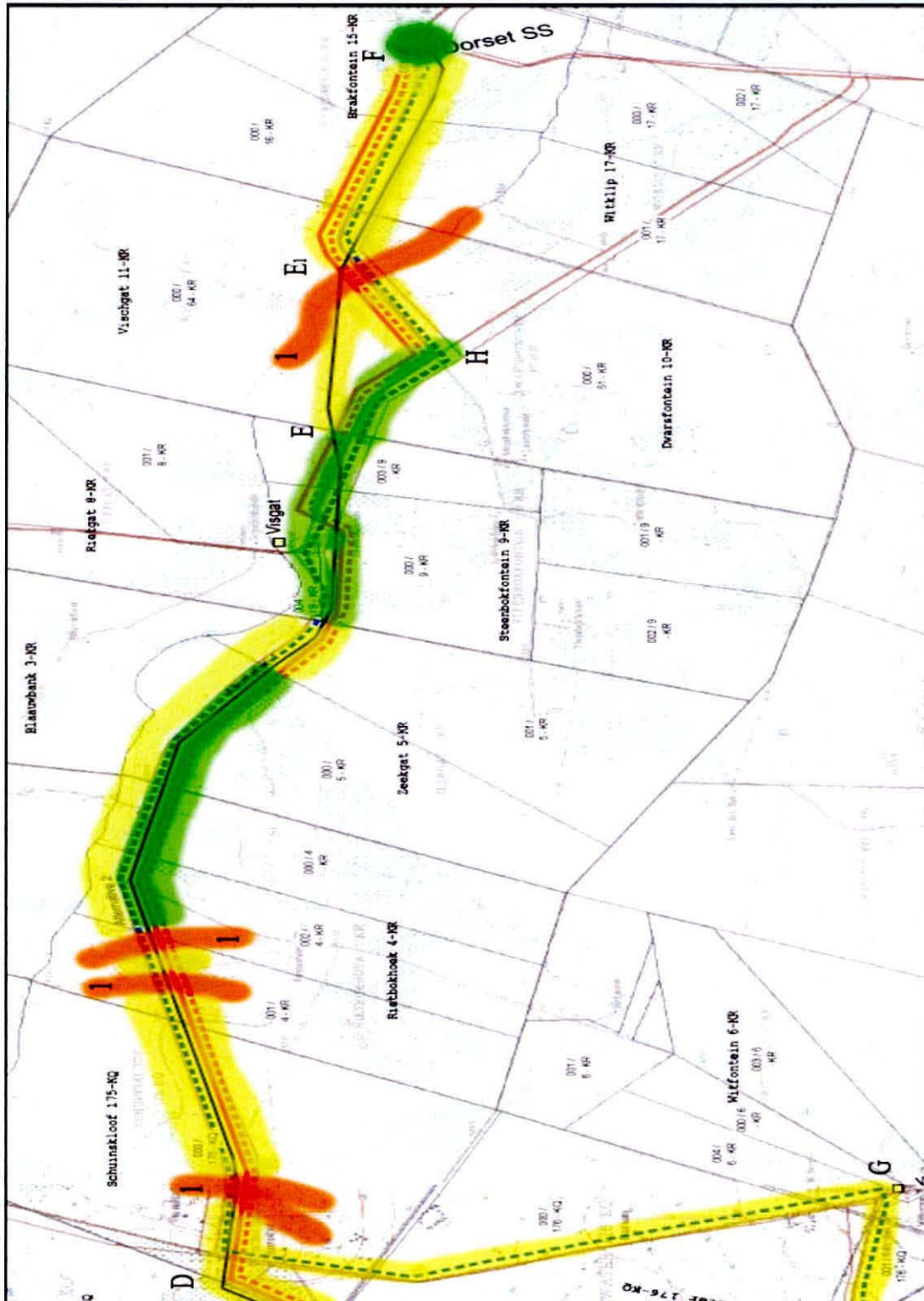
Map Detail – Route alternatives (Portion 2 of 3)

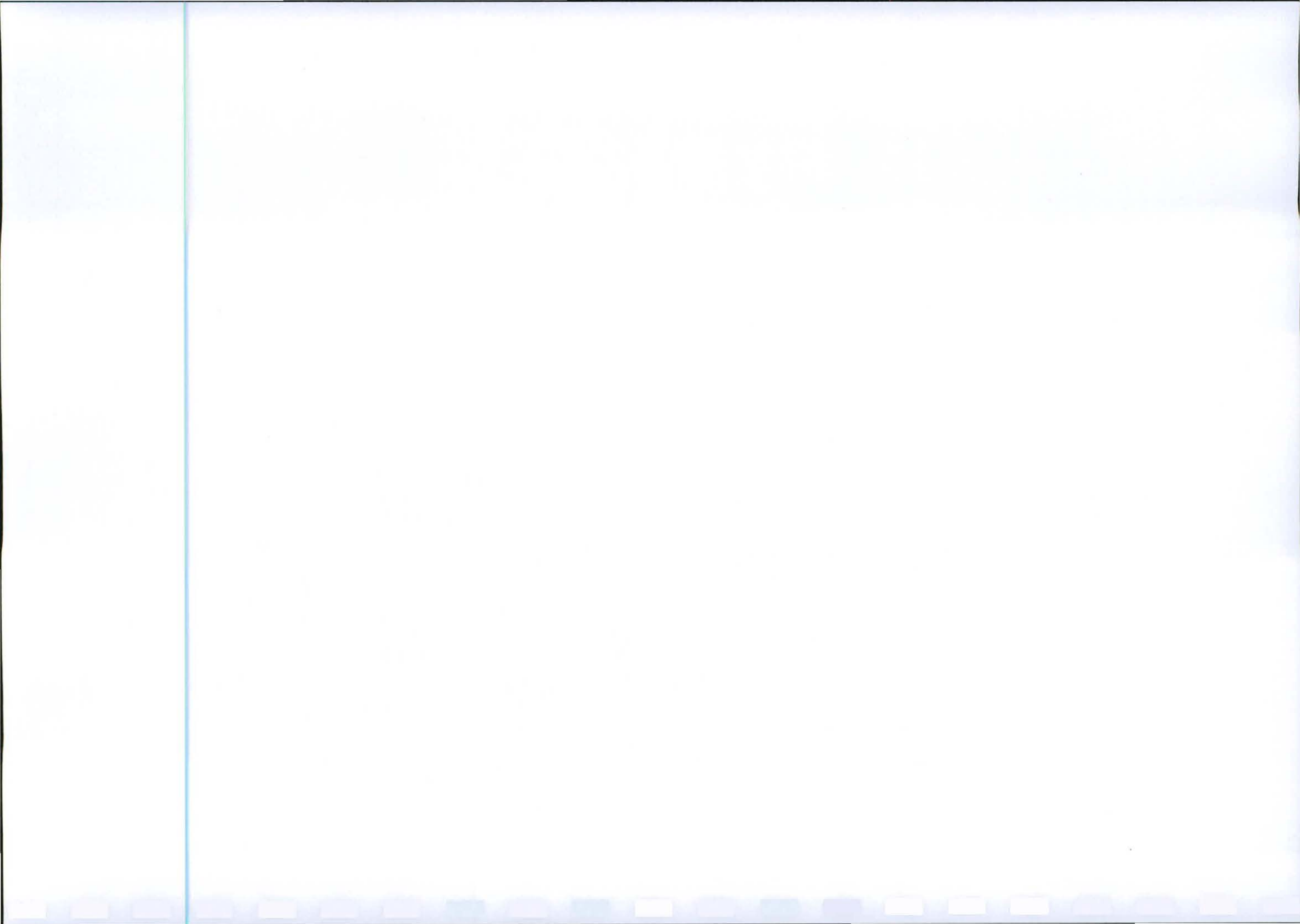










Map Detail – Route alternatives (Portion 3 of 3)

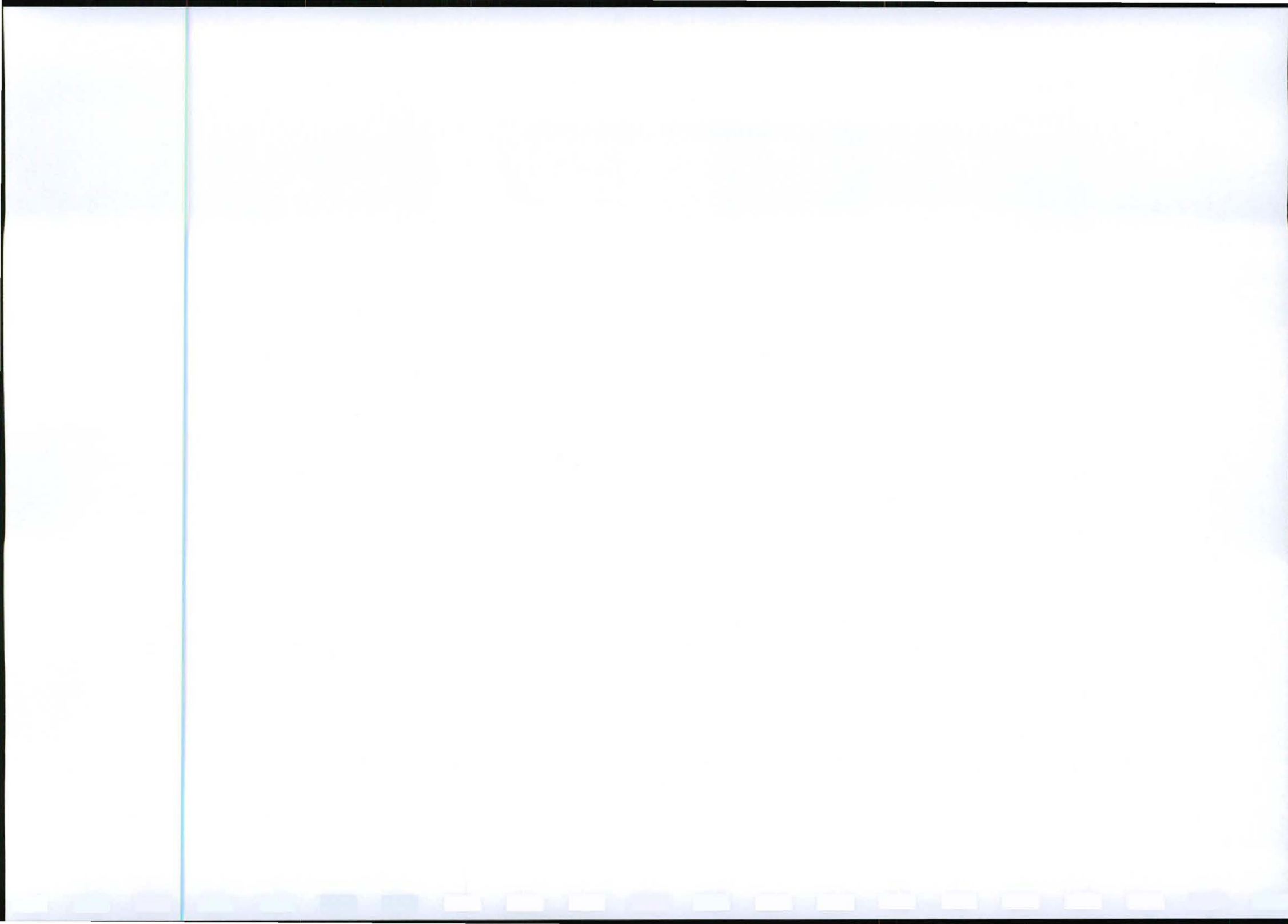




**Legend to Map Detail – Route Alternatives (Portions 1,2 & 3)**

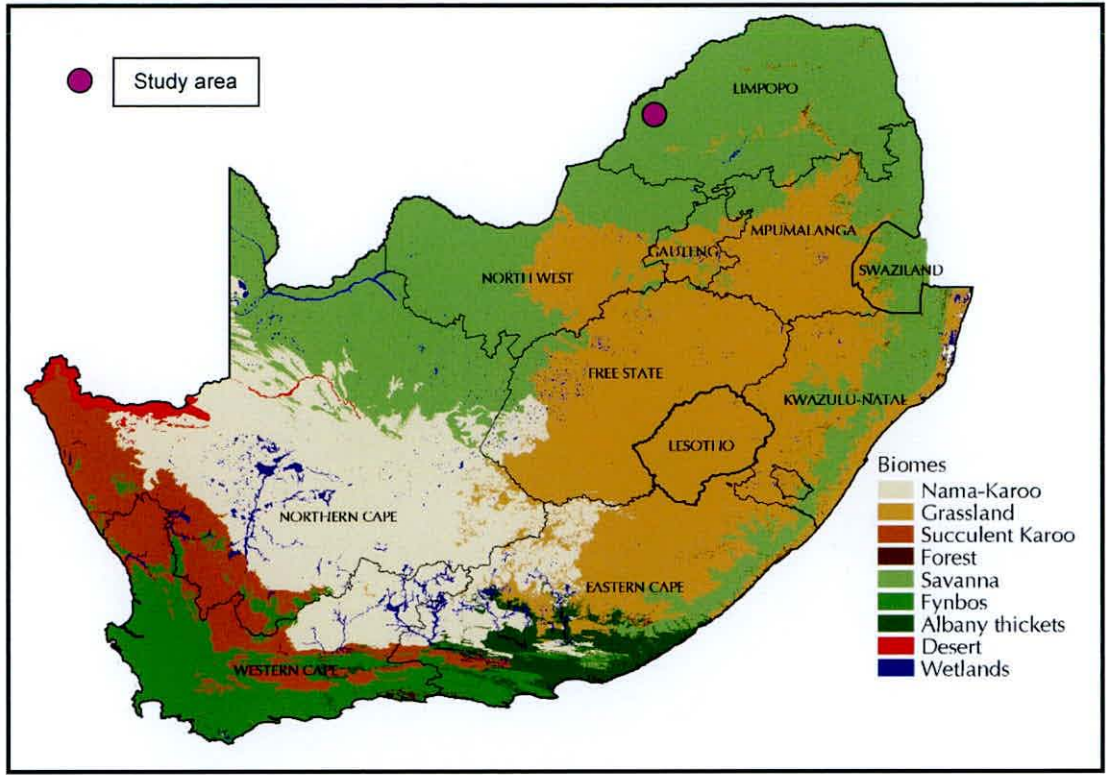
-  Areas of High ecological sensitivity. No-Go areas.
  -  Areas of Medium / High ecological sensitivity. Go-But areas.
  -  Areas of Medium ecological sensitivity. Go-Slow areas.
  -  Areas of Low to Medium / Low ecological sensitivity. Go areas.
- 1 Rivers, streams and major drainage lines.
  - 2 "No-Go" zone of Camel thorn trees (*Acacia erioloba*)

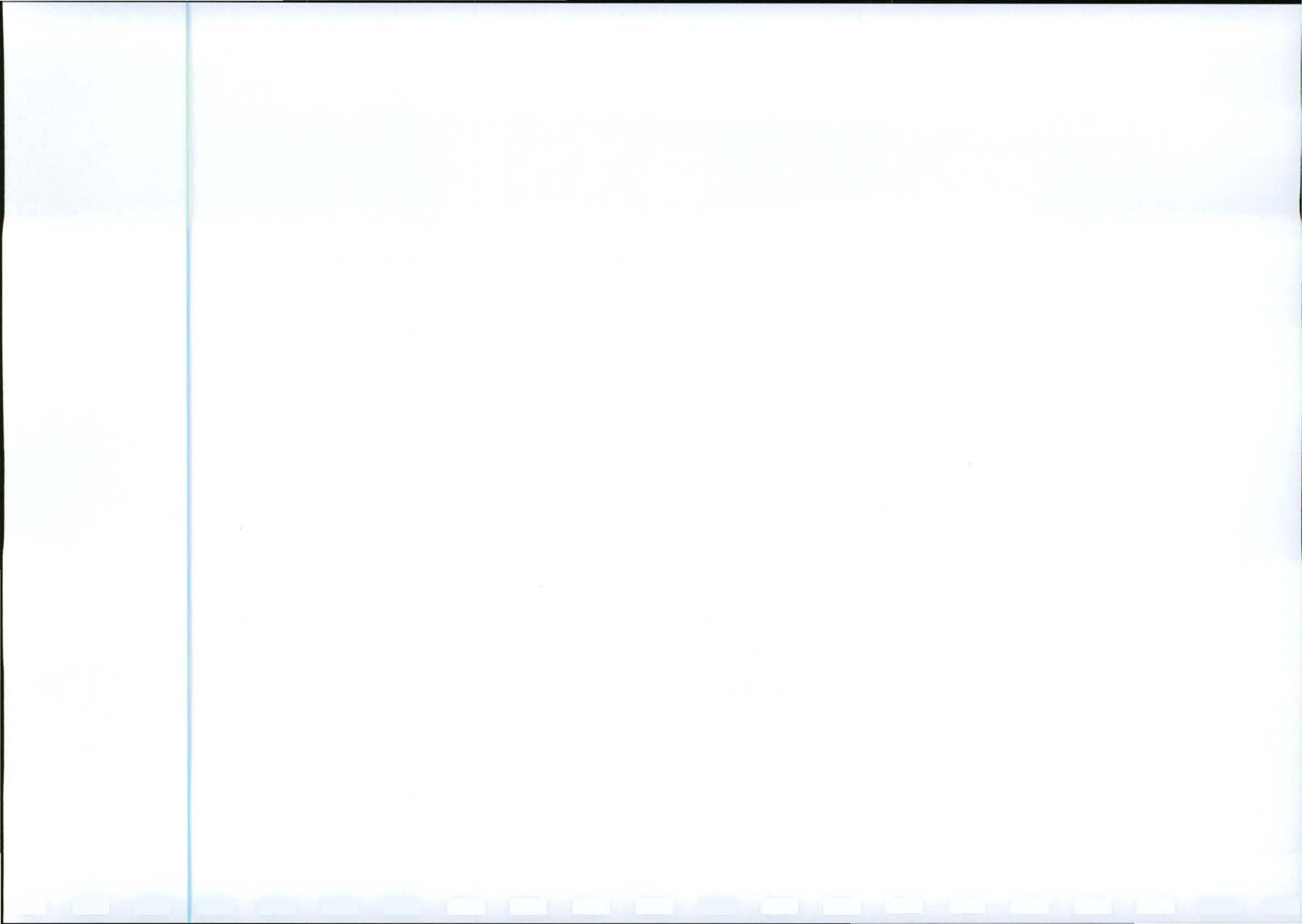




### 3. Biomes of South Africa

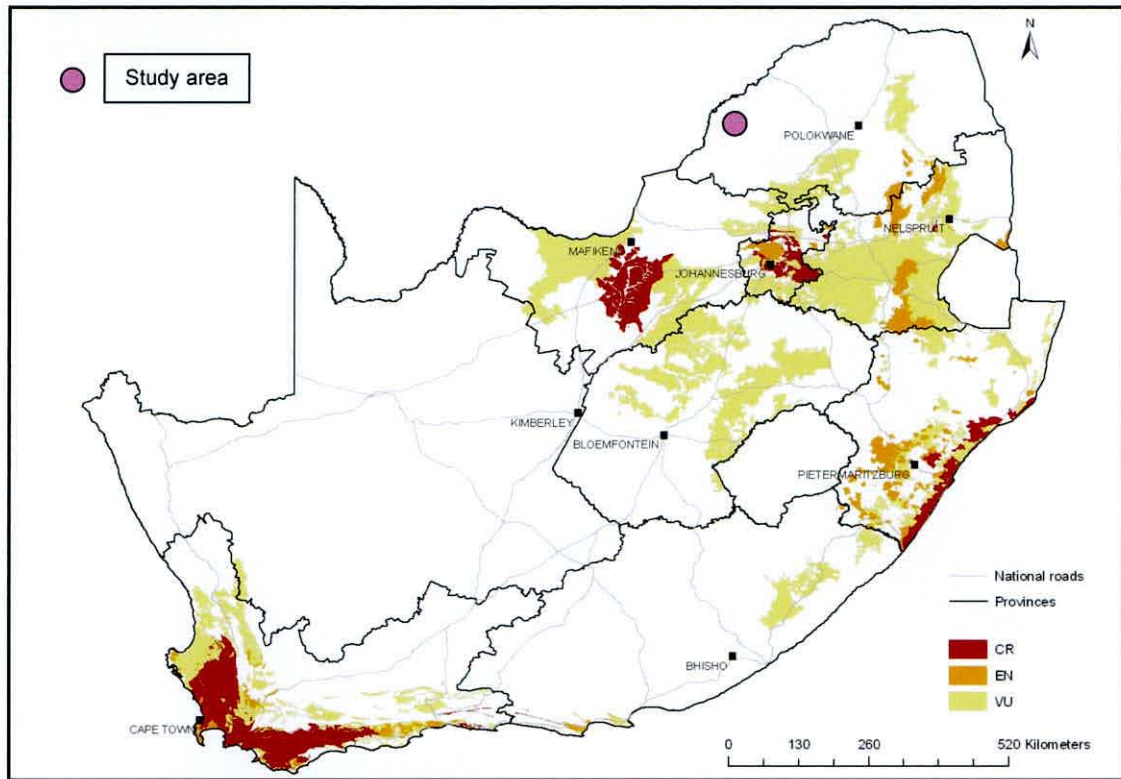
The study area falls within the Savanna Biome. Also known as the Bushveld Biome<sup>19,20</sup>.





#### 4. Status of biomes

According to SANBI<sup>19</sup>, the study area is not in an ecosystem of vulnerable status.



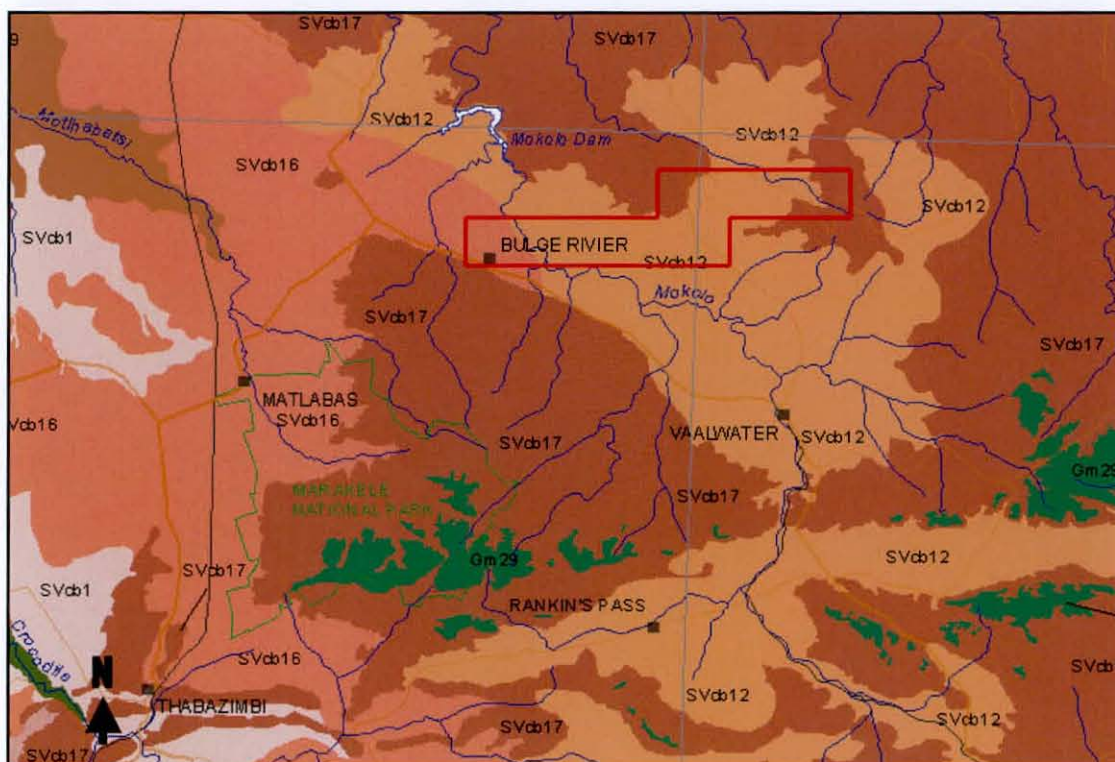
CR = Critically endangered; EN = Endangered; VUI = Vulnerable





## 5. Vegetation types of the region and study area

Based on the classification used by the South African National Botanical Institute (SANBI) (Mucina & Rutherford, 2006), the study area falls within the Savanna Biome. This study area spreads over two veldtypes. Namely, Western Sandy Bushveld and Central Sandy Bushveld. With possible elements from two close by veldtypes of Limpopo Sweet Bushveld and Waterberg Mountain Bushveld present in the study area<sup>21</sup>.



Study area

### Key to veldtypes of the region and study area

SVcb12 – Central Sandy Bushveld

SVcb16 – Western Sandy Bushveld

SVcb17 – Waterberg Mountain Bushveld

SVcb1 – Dwaalboom Thornveld

GM29 – Waterberg – Magaliesberg Summit Sourveld

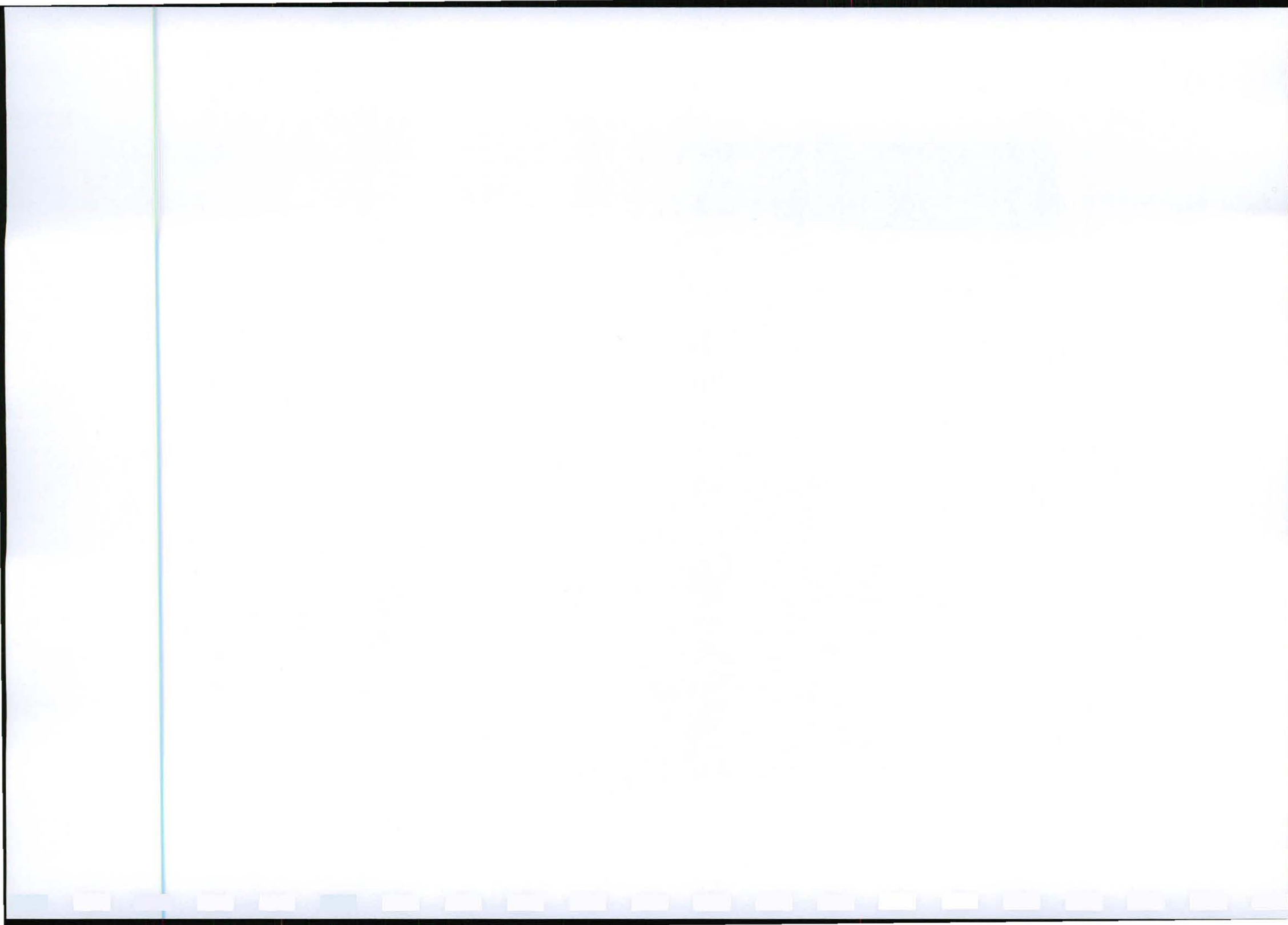


## 16. PHOTOGRAPHS

**Figure 1.** Typical Central Sandy Bushveld of study area with *Burkea* (back-right); Silver clusterleaf (front-right); and peeling bark ochna (front middle) (Dec.2010)

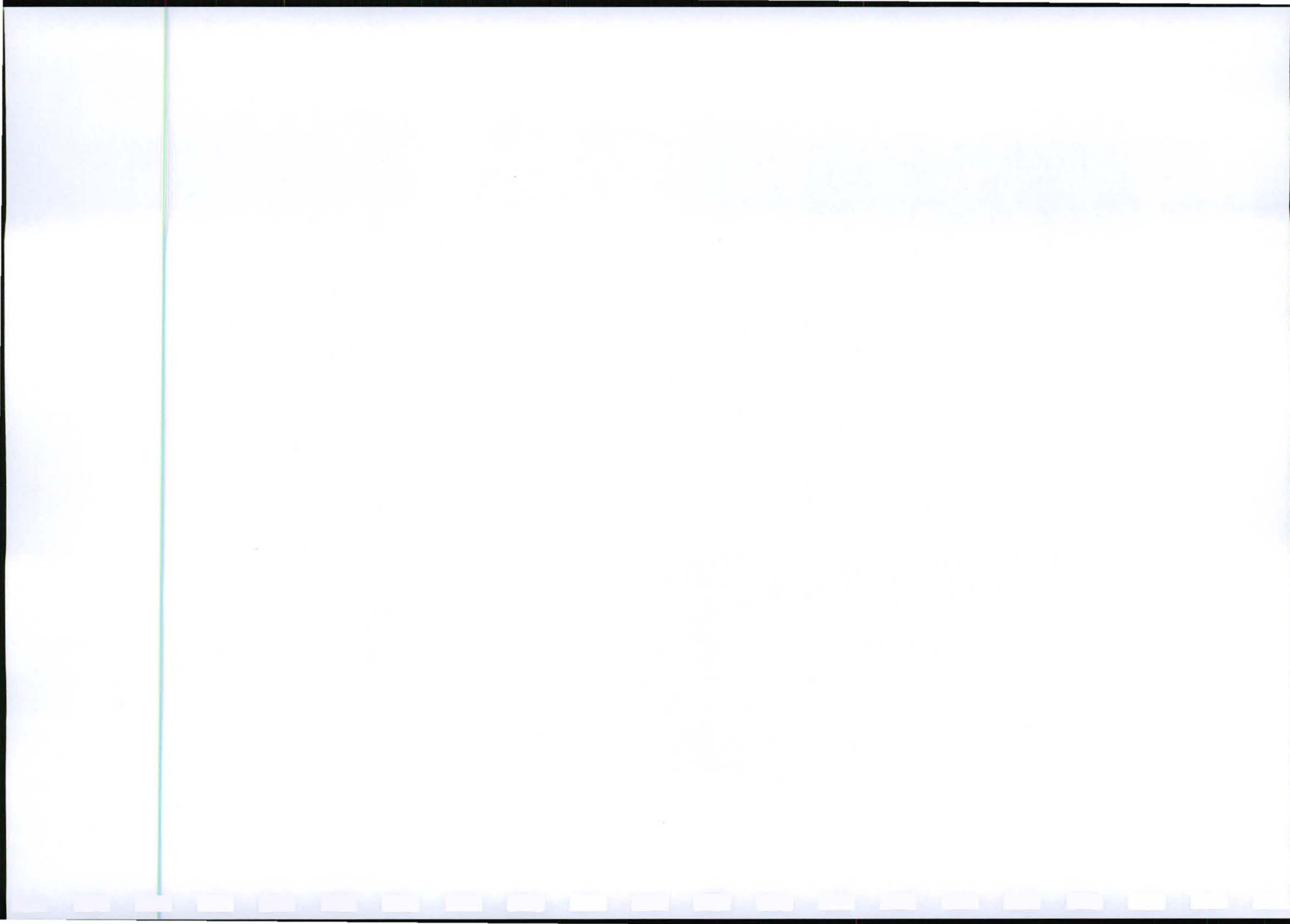






**Figure 2.** Site of Bulge River Substation showing typical Western Sandy Bushveld with a mix of Acacia thorn trees and silver clusterleaf (Dec.2010)





**Figure 3.** Typical view of study area from sand road (D1882) (Dec.2010. North)

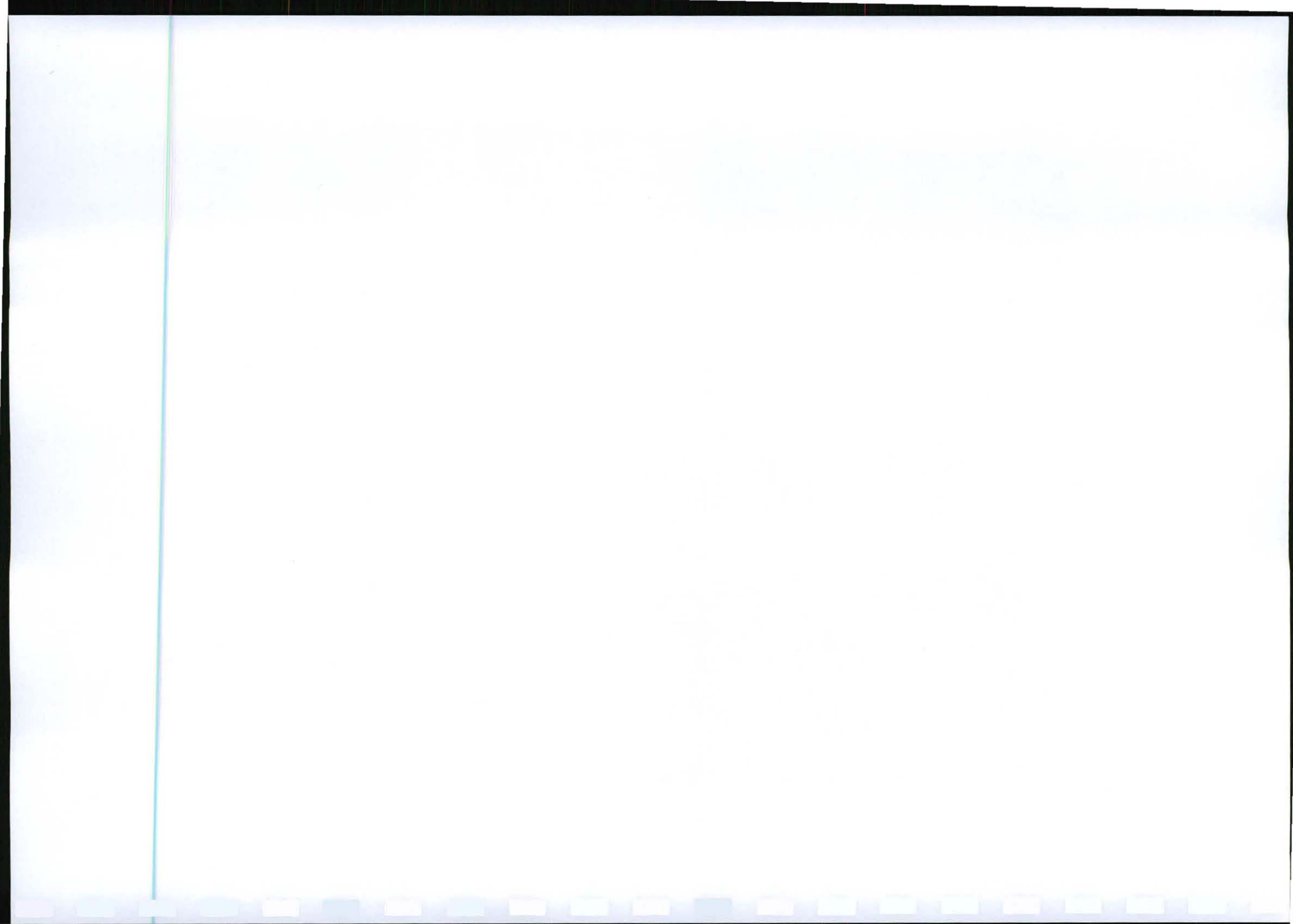






**Figure 4.** Areas of more open bushveld such as in the photo below are common in the study area (Dec.2010)





**Figure 5.** Mokolo River which runs through the study area. With a mix of natural bushveld and pivot-irrigated lands common in the region (Dec.2010)





